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Vegetable

Production Handbook of Florida



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Florida Pesticide Emergency Phone List

Call 911 for pesticide emergencies. For non-emergency pesticide questions or concerns, contact the following:

- National Pesticide Information Center (NPIC), 800-858-7378, 11 a.m.–3 p.m. Eastern Time, Monday through Friday.
- Poison Control Center Emergency Telephone Service, 800-222-1222
- The manufacturer of the pesticide in question. Their phone number is listed on the pesticide label.

The information above was provided by the UF/IFAS Pesticide Information Office, 352-392-4721.

Chapter 1. Commercial Vegetable Production in Florida¹

Xavier Martini, Nicholas S. Dufault, Ramdas Kanissery, and Xiaoying Li²

Vegetable production remains a tremendous industry for Florida in terms of acreage and value. The 2024 value of production for major berries, spring potatoes, vegetable crops, and watermelons totaled \$3.0 billion in Florida. Growing seasons are well defined by the peninsular geography, allowing Florida to serve as the main vegetable supplier to the United States during late fall, winter, and early spring months. Although more than 40 vegetable crops are commercially planted in the state, Florida ranks in the top three for production value of tomato, bell pepper, snap bean, squash, sweet corn, watermelon, cabbage, cucumber, and strawberry (Table 1).

The objective of this publication is to provide updated information on crop cultivars, pesticide labels, and certain practices for vegetable production in Florida. Suggested practices are guidelines for growers to plan farm activities and are always subject to review using the latest scientific data available.

Web Links to Additional Information on Vegetable Production Topics

UF/IFAS Extension provides information through Ask IFAS/EDIS at <https://ask.ifas.ufl.edu/>. Below is a partial list of Ask IFAS publications and other resources pertaining to vegetable production for further information beyond the *Vegetable Production Handbook of Florida*.

Vegetable Crop Production

Complete *Vegetable Production Handbook*:
<https://ask.ifas.ufl.edu/publication/CV292>

FDACS/UF-IFAS Florida Farm to School Partnership:
https://ask.ifas.ufl.edu/topics/farm_to_school

“Introduction to Organic Crop Production”:
<https://ask.ifas.ufl.edu/publication/CV118>

“Row Covers for Commercial Vegetable Culture in Florida”:
<https://ask.ifas.ufl.edu/publication/CV201>

“Value Added Agriculture: Is It Right for Me?”:
<https://ask.ifas.ufl.edu/publication/FE638>

Fertility and Irrigation

“Commercial Vegetable Fertilization Principles”:
<https://ask.ifas.ufl.edu/publication/CV009>

“Controlled-Release and Slow-Release Fertilizers as Nutrient Management Tools”:
<https://ask.ifas.ufl.edu/publication/HS1255>

“Cover Crop Benefits for South Florida Commercial Vegetable Producers”:
<https://ask.ifas.ufl.edu/publication/SS461>

“Drip Irrigation: The BMP Era—An Integrated Approach to Water and Fertilizer Management for Vegetables Grown with Plasticulture”:
<https://ask.ifas.ufl.edu/publication/HS172>

“Soil and Fertilizer Management for Vegetable Production in Florida”: <https://ask.ifas.ufl.edu/publication/CV101>

Postharvest Quality and Handling Resources

Ask IFAS on Postharvest and Handling:
<https://ask.ifas.ufl.edu/topics/postharvest>

Postharvest Technology: <https://postharvest.ucdavis.edu/>

UF/IFAS Postharvest Programs and Information:
<https://irrec.ifas.ufl.edu/postharvest/>

Marketing and Regulatory Resources

Florida Department of Agriculture and Consumer Services (FDACS): <https://www.fdacs.gov/Divisions-Offices/Marketing-and-Development>

FoodData Central Database: <https://fdc.nal.usda.gov/>

National Agricultural Statistics Service:
https://www.nass.usda.gov/Statistics_by_State/Florida/index.php

National Organic Program:

<https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program>

U.S. Grade Standards for Fruits and Vegetables:

<https://www.ams.usda.gov/standards>

Food Safety Resources

Ask IFAS on Food Safety:

https://ask.ifas.ufl.edu/topics/food_safety

CDC: Division of Foodborne, Waterborne, and Environmental Diseases:

<https://www.cdc.gov/ncezid/divisions-offices/about-dfwed.html>

“The Food Safety Modernization Act and the FDA Facility Registration Program”:

<https://ask.ifas.ufl.edu/publication/FS231>

“Food Safety on the Farm: Good Agricultural Practices and Good Handling Practices—an Overview”:

<https://ask.ifas.ufl.edu/publication/FS135>

U.S. Food and Drug Administration: Food Safety Modernization Act (FSMA):

<https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/food-safety-modernization-act-fsma>

Fumigation

“Maximizing the Efficacy of Soil Fumigant Applications for Raised-Bed Plasticulture Systems of Florida”:

<https://doi.org/10.32473/edis-hs1169-2010>

Pesticide Safety

Ask IFAS on Pesticide Safety and Handling:

<https://ask.ifas.ufl.edu/topics/pesticide-safety>

“Minimizing Honey Bee Exposure to Pesticides”:

<https://ask.ifas.ufl.edu/publication/IN1027>

Pest Management

Ask IFAS on Florida Nematode

Management: https://ask.ifas.ufl.edu/topics/nematode_management

Ask IFAS on Pest Management:

https://ask.ifas.ufl.edu/topics/pest_management

Ask IFAS on Weed Management:

<https://ask.ifas.ufl.edu/topics/weed-management>

Table 1. Vegetable production acreage and value in Florida.

Crop	Planted Acres ¹	Value (million US\$) ¹	US Rank ²
Tomato	30,000	532.2	2
Strawberry	17,000	714.4	2
Bell pepper	11,500	136.8	2
Sweet corn	45,000	187.6	1
Potato	17,000	106.2	12
Snap bean	33,000	95.3	1
Watermelon	24,000	186.8	1
Squash	8,000	57.8	2
Cabbage	5,600	51.2	2
Cucumber	17,200	61.1	1
Sources: ¹ USDA-NASS. 2025. <i>2025 State Agricultural Overview—Florida</i>. Quick Stats Database. ² USDA-ERS. 2026. "Cash Receipts by Commodity, State Ranking, 2024, Nominal (Current Dollars)." Farm Income and Wealth Statistics. Last updated February 5, 2026.			

Chapter 2. Fertilizer Management for Vegetable Production in Florida¹

Guodong Liu, Eric H. Simonne, Kelly T. Morgan, George Hochmuth, Shinsuke Agehara, Rao Mylavarapu, Craig Frey, and Xiaoying Li²

Best Management Practices

With the passage of the Federal Clean Water Act (FCWA) in 1972, all states were required to assess the negative impacts of agricultural fertilizer additions on surface and groundwater quality. Upon identification of the impaired waterbodies, Florida has established specific numeric criteria for the waterbodies and set limits on the supplied nutrients as per the Basin Management Action Plan, whenever an excess of nutrients is attributed to agricultural sources. For vegetable production regions, water quality indicators are concentrations of nitrates, phosphates, and total dissolved solids. Best Management Practices (BMPs) are specific cultural practices aimed at reducing the load of specific nutrients entering the ground and surface water while sustaining profitable yields. BMPs are intended to be economically sound, cost-effective, and environmentally friendly based on scientific evidence. It is important to recognize that BMPs do not aim at becoming an obstacle to vegetable production. Instead, they should be considered as a means of promoting horticultural and environmental sustainability. The BMPs that will apply to vegetable production in Florida are described in *Water Quality and Water Quantity Best Management Practices for Florida Vegetable and Agronomic Crop (VAC) Operations* produced by the Florida Department of Agriculture and Consumer Services (FDACS). This manual was developed through a cooperative effort between state agencies, water management districts, and commodity groups, and under the scientific leadership of the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS). The manual was adopted by reference in 2006 and by rule in Florida Statutes (5M-8 Florida Administrative Code) and was revised in 2024 (download at <https://www.fdacs.gov/content/download/77230/file/vegAgCropBMP-loRes.pdf>). Vegetable growers may contact their local UF/IFAS Extension agent for one-on-one consultation on (1) the benefits of joining the BMP program, (2) how to join it, (3) how to select the BMPs that apply to their operation, and (4) how to meet the requirements.

The vegetable BMP program has adopted the current UF/IFAS nutrient recommendations ("UF/IFAS

Standardized Nutrient Recommendations for Vegetable Crop Production in Florida," <https://ask.ifas.ufl.edu/publication/CV002>), including irrigation management (see the new BMP manual on "Irrigation Management" or FDACS's webpage on BMPs, <https://www.fdacs.gov/Agriculture-Industry/Best-Management-Practices-BMPs>). At the field level, adequate fertilizer rates should be selected together with proper irrigation-scheduling techniques, and crop nutritional status monitoring tools (leaf analysis, petiole sap testing) may also be employed as appropriate. In the BMP manual, adequate fertilizer rates may be achieved by combinations of UF/IFAS-recommended basal rates and supplemental nitrogen (N) allowances to be added in case of leaching rainfall, when planting during cooler seasons, when tissue analysis shows any nutrient deficiency, or when the harvesting season is prolonged.

Soils

Vegetables are grown in various soil types throughout the state. These soil types include sandy and sandy loam soils, muck soils, and calcareous marl soils. Vegetables are produced predominantly on sandy soils throughout the Florida peninsula and on sandy and sandy loams in the Panhandle. Sandy soils have some advantages, such as ease of tillage, production of the earliest vegetable crops, and timely production operations, but also disadvantages, including the potential risk for leaching mobile nutrients such as nitrogen, potassium, and even phosphorus after heavy rains or excessive irrigation. For more information on soils, refer to "Agricultural Soils of Florida" (<https://ask.ifas.ufl.edu/publication/SS655>). Therefore, sandy soils must be managed carefully regarding nutrient programs and irrigation scheduling. For more information, see "Soil and Fertilizer Management for Vegetable Production in Florida" (<https://ask.ifas.ufl.edu/publication/CV101>).

Soil Preparation

A well-prepared planting bed is important for uniform stand establishment of vegetable crops. Previous crop residues and weeds should be plowed down well in advance of crop establishment. A six-to-eight-week period between plowing down green cover crops and crop establishment is recommended to allow the decomposition of the residues. Freshly incorporated plant material promotes severe incidence of damping-off organisms, such as *Pythium* spp. and *Rhizoctonia* spp. Turning under plant residue well in advance of cropping, reduces proliferation of damping-off disease organisms. Land should be kept disked, if necessary, to avoid new weed emergence prior to cropping.

In the Panhandle area, chisel plowing may assist in breaking down subsurface hardpan in fields. For more information about soil preparation for commercial vegetable production, see “Soil Preparation and Liming for Vegetable Gardens” (<https://ask.ifas.ufl.edu/publication/VH024>).

Liming

Current UF/IFAS recommendations call for maintaining soil pH between 6.0 and 6.5 (Table 1); further discussion is in “Soil pH Range for Optimum Commercial Vegetable Production” (<https://ask.ifas.ufl.edu/publication/HS1207>). If soil pH is too low, liming is needed to adjust the pH to the target range. A frequent problem in Florida has been over liming, which results in high soil pH that ties up micronutrients and phosphorus, thus limiting nutrient uptake by plants. Over liming can also reduce the accuracy of a soil test to estimate the need for supplemental fertilizer application based on the Crop Nutrient Requirement (CNR) approach. For more information about liming, see “Liming of Agronomic Crops” (<https://ask.ifas.ufl.edu/publication/AA128>). Liming does not only adjust soil pH but also supplies plants with calcium and magnesium when dolomite (i.e., calcium magnesium carbonate) is used.

Irrigation water from wells within limestone aquifers serves as an additional liming material. The combination of liming and the use of alkaline irrigation water has resulted in soil pH above 7.0 in many sandy soils in Florida. To determine the liming effect via irrigation, a water sample must be analyzed for total bicarbonates and carbonates annually, and the results should be converted to pounds of calcium carbonate per acre. Liming (Table 2), fertilization (Table 3), and irrigation management are closely related to each other. To maximize the overall production potential, soil and water tests are essential in any nutrient management program. Elevated soil pH can be adjusted to the recommended range after identifying the reason(s) for the increases. More information on soil pH reduction can be found in “Lowering Soil pH to Optimize Nutrient

Management and Crop Production” (<https://ask.ifas.ufl.edu/publication/SS651>).

Bedding

Fields prone to flooding, those using seepage irrigation, or those with shallow soil profiles should utilize raised beds for cropping. Beds range from 3–8 inches in height, and the tallest ones are preferred where the risk of flooding is high. Taller beds facilitate faster drainage, which can help reduce weed growth in furrows. Raised beds, especially when covered with black plastic mulch, promote early-season soil warming, leading to increased early crop production during cool seasons. Mulching requires a smooth, well-pressed bed for efficient heat transfer from black mulch to the soil. Adequate soil moisture is essential for forming a suitable bed using a bed press. Depending on the planting date and the sensitivity of the crop to heat stress, growers may consider using white or reflective plastic mulch instead of black mulch.

Fertilization

Commercial vegetable production requires intensive nutrient management for optimal production. Effective implementation of **4R** nutrient stewardship principles—**Right Source, Right Rate, Right Place, and Right Time**—when applying nutrients to a crop is shown to enhance nutrient efficiencies and minimize nutrient loss to the environment. More information about the 4Rs is available in “What is 4R nutrient stewardship?” (<https://ask.ifas.ufl.edu/publication/HS1264>) and “The Four Rs of Fertilizer Management” (<https://ask.ifas.ufl.edu/publication/SS624>). For tomato production, more information is available in “Implementing the Four Rs (4Rs) in Nutrient Stewardship for Tomato Production” (<https://ask.ifas.ufl.edu/publication/HS1269>).

Right Rate

Soil Testing

Soil testing is the #1 BMP for nutrient management. There are 17 elements essential to plant growth (Table 4). The crop nutrient requirement (CNR) for a particular nutrient is defined as the total amount in pounds per acre (lb/A) of that element needed by the crop to produce optimum profitable yield. The CNR can be satisfied using many sources, including soil, water, air, organic matter, or fertilizer.

The CNR for a crop has been determined from field calibrations and validation. The CNR is equivalent to the nutrient rate above which no significant increase in yield is expected. The CNR values derived from such experiments consider factors such as the source, solubility, and availability in the soils. It is important to remember that nutrients are supplied to the crop from both the soil and the fertilizers. Supplemental nutrients should be applied

only when a properly calibrated soil test indicates a yield or quality response. Mehlich-3 is the standard soil extractant in Florida for all acid-mineral soils and calcareous soils in Miami-Dade County. For mineral soils with a pH of 7.4, the ABDTPA procedure is currently used. For vegetable production on muck soils, phosphorus is extracted using water, while potassium, calcium, and magnesium are extracted with acetic acid. More information about Mehlich-3 is available in “Extraction of Soil Nutrients Using Mehlich-3 Reagent for Acid-Mineral Soils of Florida” (<https://ask.ifas.ufl.edu/publication/SS620>).

Nitrogen recommendations are based on research data and not soil tests. A standard soil test provides soil pH, lime requirement (if needed), P, K, Ca, Mg, S, Cu, Mn, and Zn in mg/kg (ppm), and the recommendations are generated based on the interpretation specifically for the extractant used. More information about soil testing can be found in “Developing a Soil Test Extractant: The Correlation and Calibration Processes” (<https://ask.ifas.ufl.edu/publication/SS622>) and “Soil Testing for Plant-Available Nutrients—What Is It and Why Do We Use It?” (<https://ask.ifas.ufl.edu/publication/SS621>).

Plant Tissue Analysis

Analysis of plant tissues (e.g., leaves or petioles) for nutrient concentrations provides an efficient tool for monitoring the nutrient status of a crop during the growing season. There are two main approaches to plant tissue testing: standard laboratory analysis and plant sap testing procedures. Standard laboratory analysis involves analyzing the most recently matured leaf of the plant for a series of nutrients. The resulting analyses are compared against published recommended values for the same crop. Laboratory results that fall outside the adequate range for a particular nutrient may indicate either a deficiency or toxicity (especially in the case of micronutrients). The most recently matured leaf serves well for routine crop monitoring and diagnostic procedures for most nutrients. However, for immobile nutrients such as Ca, B, Zn, Fe, Mn, Cu, and Mo, younger leaves are preferred.

The second approach involves using plant sap quick-test kits that have been calibrated for N and K in several vegetables in Florida. These testing kits analyze fresh leaf petiole sap for N and K. Quick tests can be a valuable tool for on-the-spot monitoring of plant nutrient status. Diagnostic information for leaf and petiole sap testing can be found in “Plant Tissue Analysis and Interpretation for Vegetable Crops in Florida” (<https://ask.ifas.ufl.edu/publication/EP081>) and “Plant Petiole Sap-Testing for Vegetable Crops” (<https://ask.ifas.ufl.edu/publication/CV004>). However, the standard plant tissue test at a laboratory is the primary tool for ground-truthing results to overcome inadequacies in field calibration of these alternate tools.

Understanding the “Per Acre” Rate of Fertilizer Recommendations

Most public (including Extension) and private soil testing laboratories express fertilizer rates as an amount per real estate (gross) acre. The “per acre” expression in the context of crop fertilization often leads to confusion. Farming systems have different bed center spacing, different numbers of rows per bed, and different configuration of roads and irrigation/drainage ditches. These differences vary by the amount of cropped area per gross acre for each system and must be considered when calculating fertilizer needs.

To standardize fertilizer recommendations for a crop across varying systems, UF/IFAS and the UF/IFAS Extension Soil Testing Laboratory (ESTL) use the Linear Bed Foot (LBF) system. LBF is defined as the linear distance of 1 ft measured along a bed, and the total number of LBF in a particular system is the cropped area expressed as the LBF per acre.

To determine fertilizer application rates with the LBF system, a grower must know the “typical bed configuration” for the crop. This is based on the traditional configuration of the crop and is the configuration that was used for significant nutrient rate research. Table 5 illustrates the typical bed configuration for several vegetable crops and the associated LBF per acre. To calculate the LBF of an alternative configuration, use the following formulas:

Step 1:

Alternative #1 LBF per acre = 43,560 square feet per acre / Alternative bed spacing (ft)

Step 2:

Alternative #2 LBF per acre = Alternative #1 LBF per acre × Alternative plant rows per bed / Typical plant rows per bed

To calculate the fertilizer application rate for an alternative configuration, use either of the following formulas, depending on fertilizer application methods used:

Alternative fertilizer rate = Lab fertilizer rate × Alternative #2 LBF per acre / Typical LBF per acre

LBF rate = Alternative fertilizer rate / Alternative #2 LBF per acre

A thorough discussion of the LBF system and examples of calculations for various scenarios can be found in “Calculating Recommended Fertilizer Rates for Vegetables Grown in Raised-Bed, Mulched Cultural Systems” (<https://ask.ifas.ufl.edu/publication/ss516>). Note that this Ask IFAS publication illustrates the LBF concept for various configurations on a 100 LBF basis.

Right Source

N, P, and K Sources

Nitrogen is the most limiting nutrient in agriculture. The amount of nitrogen required by vegetable plants must be applied in each growing season, as residual N is lost to the environment through several pathways. Nitrogen requirements vary among crops (Table 6) and are not dependent on soil test results. All other nutrients must be supplied based on soil test results (as described above) to comply with the BMP guidelines. The interpretations of Mehlich-3 (low, medium, and high) are shown in Table 7. UF/IFAS standardized nutrient recommendations based on Mehlich-3 testing include P_2O_5 and K_2O (Table 8) and nutrient management using fertigation (Table 9). More information on Mehlich-3 can be found in “Extraction of Soil Nutrients Using Mehlich-3 Reagent for Acid-Mineral Soils of Florida” (<https://ask.ifas.ufl.edu/publication/SS620>). Nutrient recommendations listed in Tables 8–11 were derived from field rate studies that evaluated a wide range of nutrient applications across various soil pH levels. Factors such as crop plant development, crop yield, and vegetable quality were considered to *determine* the optimum nutrient levels for UF/IFAS recommendations.

Nitrogen can be supplied in various forms, including nitrate, ammoniacal (e.g., ammonium sulfate), and ammonium-forming (such as urea). Because the mineralization rate of conversion is reduced in cold, fumigated, or strongly acidic soils, it is recommended that under such conditions 25%–50% of the N be supplied from nitrate sources. This ratio is not critical for unfumigated soils under warm conditions.

Phosphorus (P) can be supplied from several sources, such as diammonium phosphate (DAP), monoammonium phosphate (MAP), or monopotassium phosphate, based on the soil pH and other factors. Initial soil reaction pH with DAP is about 8.5, which favors ammonia production and volatilization. This ammonia production causes seedling injury and inhibits root growth. Adequate separation of seed and DAP is needed to eliminate any seedling damage. DAP should not be used on calcareous or high-pH soils. MAP’s reaction pH is 3.5, so it does not have the above problems and is better suited for acidic and lower-pH soils.

Potassium (K) can also be supplied from several sources, including potassium chloride (muriate of potash—60%), potassium sulfate (sulfate of potash—50%), potassium nitrate, and potassium-magnesium sulfate. If adhering to the amounts of K fertilizer recommended by soil tests, there should be no concern about the K source or its relative salt index. However, when applying chloride-containing sources, crop sensitivities must be considered.

Ca, Mg, and S Sources

Florida soils have sufficient quantities of secondary nutrients, including calcium (Ca), magnesium (Mg), and sulfur (S). Calcium is ubiquitous in Florida soils due to their genesis from limestone base. Depending on the location, Ca tends to occur remarkably close to or on the surface and typically within the root zone. Therefore, Ca levels are not typically assessed in soil tests. Additionally, irrigation water generally contains dissolved Ca, thus maintaining optimum moisture levels in the soil via irrigation will ensure adequate supply of Ca to the roots. Calcium is not easily mobile within plants; therefore, foliar sprays of Ca are unlikely to correct deficiencies effectively. It is difficult to provide enough foliar-applied Ca at the growing point of the plant on a timely basis.

Magnesium deficiency may be a problem for vegetable production; however, when the Mehlich-3 soil test index for Mg is below 20 ppm, an application of 35 lb Mg/A will satisfy the crop Mg requirement. If lime is also needed, Mg can be added using dolomite as the liming material. If no lime is needed, the Mg requirement can be fulfilled through magnesium sulfate or Sul-Po-Mag. Blending of the Mg source with other fertilizer(s) that are applied to the soil is an excellent way of ensuring uniform supplement of soil Mg.

Although S deficiencies are not common in Florida soils, sulfur deficiency may occur in sandy soils that are low in organic matter. If a Mehlich-3 soil test determines that the S level is <6 mg/kg, or ppm, then S deficiency may be developed that can be corrected by using S-containing fertilizers, such as magnesium sulfate, ammonium sulfate, potassium sulfate, or potassium-magnesium sulfate. Using one of these materials in the fertilizer blends at levels sufficient to supply 20 lb S/A or higher which should prevent S deficiencies.

Micronutrient Sources

It has been common in Florida vegetable production to routinely apply a micronutrient package. This practice is justified because these nutrients are inexpensive and because their application seems to provide “insurance” for high yields. In addition, there has been little research data and a lack of soil test calibrations to guide judicious application of micronutrient fertilizers. Confounding the problem has been the vegetable industry’s use of micronutrient-containing pesticides for disease control.

Copper (Cu), manganese (Mn), and zinc (Zn) from pesticides have tended to accumulate in the soil. This situation has forced some vegetable producers to over lime in an effort to reduce availability and avoid micronutrient toxicities. Table 11 provides guidelines for the above micronutrients on sufficient levels, toxicities, and soil pH dependencies. It is unlikely that micronutrient fertilizers will be needed on old vegetable land, especially where

micronutrients have been applied regularly via recommended pesticides. A standard soil test report includes micronutrients.

Manures and Composts

Waste organic products, including animal manures and composted organic matter, contain nutrients that can be recovered by crops. These materials, when applied to the soil, are gradually decomposed, releasing nutrients to be utilized by vegetable crops. These materials must comply with food safety requirements, such as those of the Produce Safety Alliance (PSA). The key to proper use of organic materials as fertilizers lies in the knowledge of the nutrient content and the decomposition rate of the material. Growers interested in using organic materials as fertilizer sources should have conducted an analysis of the material composition to determine the rate of application. Sludge is not permitted for land application in vegetable production. Decomposition rates of organic materials are rapid in warm, sandy soils in Florida. Residual nutrient levels in soils beyond the crop season are limited. Usually, application rates of organic wastes are determined largely by the N content, which will also result in inadvertent P applications. Excessive rates of organic waste materials can contribute to groundwater or surface water pollution; therefore, it is important to understand the nutrient content and the decomposition rate of the organic waste material and the P-holding capacity of the soil. For more information about using manure for vegetable production, see “Using Composted Poultry Manure (Litter) in Mulched Vegetable Production” (<https://ask.ifas.ufl.edu/publication/SS506>) and “Introduction to Organic Crop Production” (<https://ask.ifas.ufl.edu/publication/CV118>).

As a soil amendment, compost improves soil's physical, chemical, and biological properties, thus making it more productive. To eliminate or minimize human and plant pathogens, nematodes, and weed seeds, the composting temperature must be kept in a range from 131°F–170°F for three days in an in-vessel or static aerated pile. Most of the nitrogen in compost is in organic form. Thus, before being mineralized, compost N is not as readily bioavailable as synthetic N fertilizers. Compost N mineralization rate varies with feedstock, soil characteristics, and composting conditions. Compost N fertilizer releases only 5%–30% bioavailable N to crops in the first year. Contrarily, compost P and K are as bioavailable as chemical fertilizers. Composting converts raw organic materials to humus-stable forms, thereby minimizing possible adverse impacts on the environment.

Right Place

Fertilizer Placement

Fertilizer rates and placement must be considered together. Banding low amounts of fertilizer too close to plants can result in the same or greater amount of damage as broadcasting excessive amounts of fertilizer on the field. Because P is immobile in soil, it should be banded alongside the plant rows. Micronutrients can be broadcast with the P and incorporated in the bed area. In calcareous soils, micronutrients, such as Fe, Mn, and B, should be banded or foliar applied. Because N and K are easily prone to leaching in sandy soils, they must be managed properly to maximize crop uptake. Both N and K should be supplied in split applications in unmulched production systems to minimize losses below the root zone. Hence, one-third to one-half of the N and K may be applied to the soil at planting or shortly thereafter. The remaining fertilizer can be applied in one or two applications during the early part of the growing season. Split applications will also help reduce the potential for fertilizer burn, which is defined as leaf scorch resulting from overfertilization. In mulched beds with fertigation, both N and K should be applied in 10–14 equal split installments for efficient uptake by plant roots and minimized leaching.

When using plastic mulch, fertilizer placement options depend on the type of irrigation system (seepage or drip) and on whether drip tubing or the liquid fertilizer injection wheels are to be used. With seepage irrigation, all P and micronutrients should be incorporated in the soil during bed preparation. Apply 10%–20% (but not more) of N and K with P and other pre-plant fertilizers for soil incorporation. The remaining N and K could be placed in narrow bands on the bed shoulders, the number of which depends on the crop and number of rows per bed. These bands should be placed in shallow (2 to 2½ in. deep) grooves. This placement requires that adequate bed moisture be maintained so that capillarity is not broken. Otherwise, fertilizer nutrients will not move to the root zone. Excess moisture can result in fertilizer leaching. Fertilizer and water management programs are linked. Maximum fertilizer efficiency is achieved only with close attention to water management. When supplemental side-dressing of mulched crops is needed, applications of liquid fertilizer can be made through the mulch with a liquid fertilizer injection wheel. This implement is mounted on a tool bar and, using 30–40 psi, injects fertilizer through a hole pierced in the mulch.

When beds are not covered with plastic mulch, split applications are recommended to avoid the risk of nutrient leaching or salinity damage. Split applications can also minimize P fixation in acidic soils containing high levels of aluminum and iron or in alkaline soils containing high levels of calcium and magnesium.

Right Time

Supplemental Fertilizer Applications and BMPs

In practice, supplemental fertilizer applications, when growing conditions require them, allow vegetable growers to stay within BMP guidelines while numerically applying fertilizer rates higher than the standard UF/IFAS-recommended rates. Conditions that may require supplemental fertilizer applications are leaching from excessive rainfall, cooler planting seasons, and extended harvest periods. Applying additional fertilizer under the following four circumstances is part of the current UF/IFAS fertilizer recommendations and BMPs: (1) If grown on bare ground with seepage irrigation, a 30 lb/A of N and/or 20 lb/A of K₂O supplemental application is allowed after a leaching rain, defined as when it rains at least 3 inches in three days or 4 inches in seven days; (2) potatoes planted in cooler seasons may receive a supplemental application of 25 lb/A P₂O₅; (3) if nutrient levels in the leaf or in the petiole fall below the sufficiency ranges, the supplemental amount allowed for bare-ground production is 30 lb/A of N and/or 20 lb/A of K₂O, and for drip-irrigated crops, 1.5 to 2.0 lb/A per day for N and/or K₂O for one week; or (4) for economic reasons, the harvest period has to be longer than the typical harvest period. When the results of tissue analysis or petiole testing are below the sufficiency ranges, a supplemental 30 lb/A of N and/or 20 lb/A of K₂O may be applied for each additional harvest for bare-ground production. For drip-irrigated crops, the supplemental fertilizer application is 1.5–2.0 lb/A per day for N and/or K₂O until the next harvest.

Fertigation

Common irrigation systems used for fertigation include drip systems, sprinkler systems, and pivot systems. Advantages of fertigation over conventional fertilizing methods are (1) more efficient delivery of nutrients, (2) more precise localized application, (3) more flexible control of application rate and timing, and (4) lower application cost. Liquid and water-soluble fertilizers are more commonly used for fertigation than dry fertilizers. The most common liquid N fertilizers for fertigation are ammonium nitrate (20-0-0), calcium ammonium nitrate (17-0-0), and urea ammonium nitrate (32-0-0). Complete fertilizers (e.g., 8-8-8 and 4-10-10) are also commonly used. For commercial vegetable production in south Florida, a formula of 4-0-8 or 3-0-10 is the most common in fertigation. To develop a more precise fertilizer application strategy, growers can request a custom blend at a local fertilizer dealer based on soil test results and crop nutrient requirements. For more information, consult "Fertigation for Vegetables: A Practical Guide for Small Fields" (<https://ask.ifas.ufl.edu/publication/HS1206>) and "A Practical Guide for Adjusting Fertigation Water pH in Specialty Crop Production" (<https://ask.ifas.ufl.edu/publication/HS1490>).

The basic components for a fertigation system include a fertilizer tank, an injector, a filter, a pressure regulator, a pressure gauge, and a backflow prevention device. All components must be resistant to corrosion. In most situations, N and K are the nutrients injected through the irrigation tube. Split applications of N and K through the irrigation system offer a means to capture management potential and reduce leaching losses. Other nutrients, such as P, are usually applied to the soil rather than by injection. This is because chemical precipitation can occur with these nutrients and the high calcium carbonate content of our irrigation water in Florida.

Nutrient management through irrigation tubes involves precise scheduling of N and K applications. Application rates are determined by crop growth and the corresponding nutrient demand. Demand early in the season is small, and thus rates of application are small, usually in the order of 1/2 to 3/4 lb of N or K₂O per acre per day. As the crop grows, nutrient demand increases rapidly, and for some vegetable crops, such as tomatoes, the demand might be as high as 2 lb of N or K₂O per day. Schedules of N and K applications have been developed for most vegetables produced with drip irrigation in Florida (Table 8).

Irrigation water with high and alkaline pH can be acidified using injections of sulfuric acid, phosphoric acid, hydrochloric acid, urea-sulfate, and so forth.

Foliar Fertilization

Foliar fertilization should be used as the last resort for correcting nutrient deficiency (Table 12). The plant leaf is structured so that it naturally resists fertilizer infiltration. Foliar fertilization is most appropriate for micronutrients but not appropriate for macronutrients, such as N, P, and K. In certain situations, temporary deficiencies of Mn, Fe, Cu, or Zn can be corrected by foliar application. For example, micronutrients should be foliar applied in the following situations: (1) during winter, when soils are cool, and roots cannot extract adequate micronutrients; and (2) in high-pH soils (marl and Rockdale soils) that immobilize broadcast micronutrients. There is a fine line between adequate and toxic amounts of micronutrients. Indiscriminate application of micronutrients may reduce plant growth and yields because of toxicity. The micronutrients can accumulate in the soil and may cause yield and economic losses in vegetable production. If you are not sure if your crop requires micronutrients or how much you should apply, contact your local UF/IFAS Extension agent.

The 5th R, Right Irrigation

Fertilization and irrigation go hand in hand, with fertilizers included in irrigation schedules and systems. Water is the solvent of all nutrients and the carrier of every pollutant. Keeping moisture and fertilizer primarily in the root zone by managing irrigation inputs and drainage minimizes nutrient-related impacts. Irrigating more than the soil's

water-holding capacity leads to increased runoff or leaching and may result in greater production costs or smaller marketable yields. Similarly, insufficient water supply to crops can reduce nutrient bioavailability for vegetable production. Please read "Implementing the Five Rs of Nutrient Stewardship for Fertigation in Florida's Vegetable Production" for more information at <https://ask.ifas.ufl.edu/publication/HS1386>.

Table 1. A general guideline to crop tolerance of mineral soil acidity.¹

Slightly Tolerant (pH 6.8–6.0)	Moderately Tolerant (pH 6.8–5.5)	Very Tolerant (pH 6.8–5.0)
Beet, broccoli, cabbage, cauliflower, celery, chard, leek, lettuce, muskmelon, okra, onion, spinach	Bean (lima), bean (snap), brussels sprout, carrot, collards, corn, cucumber, eggplant, kale, mustard, pea, pepper, pumpkin, radish, squash, strawberry, tomato, turnip	Endive, potato, shallot, sweetpotato, watermelon
¹ From Donald N. Maynard and George Hochmuth, <i>Knott's Handbook for Vegetable Growers</i> , 5th edition (2007). Reprinted by permission of John Wiley & Sons, Inc.		

Table 2. Liming materials.

Material	Formula	Amount of Material to Be Used to Equal 1 Ton of Calcium Carbonate ¹	Neutralizing Value ² (%)
Calcium carbonate, calcite, Hi-Cal lime	CaCO ₃	2,000 lb	100
Calcium-magnesium carbonate, dolomite	CaCO ₃ , MgCO ₃	1,850 lb	109
Calcium oxide, burnt lime	CaO	1,100 lb	179
Calcium hydroxide, hydrated lime	Ca (OH) ₂	1,500 lb	136
Calcium silicate, slag	CaSiO ₃	2,350 lb	86
Magnesium carbonate	MgCO ₃	1,680 lb	119
¹ Calculate as (2000×100)/neutralizing value (%).			
² The higher the neutralizing value, the greater the amount of acidity that is neutralized per unit weight of material.			

Table 3. Effect of some fertilizer materials on soil pH.

Fertilizer Material	Approximate Calcium Carbonate Equivalent (lb) ¹
Ammonium nitrate	–1,200
Ammonium sulfate	–2,200
Anhydrous ammonia	–3,000
Diammonium phosphate	–1,250 to –1,550
Nitrogen solutions	–759 to –1,800
Normal (ordinary) superphosphate	0
Potassium chloride	0
Potassium nitrate	+520
Potassium sulfate	0
Potassium-magnesium sulfate	0
Sodium-potassium nitrate	+550
Triple (concentrated) superphosphate	0
Urea	–1,700
¹ A minus sign indicates the number of pounds of calcium carbonate needed to neutralize the acid formed when one ton of fertilizer is added to the soil. A positive sign means that applying the fertilizer can increase soil pH as much as the number of pounds of calcium carbonate applied.	

Table 4. Nutrient elements are required by plants.

	Nutrient	Deficiency Symptoms	Occurrence
Macronutrients	Nitrogen (N)	Stems thin, erect, hard. Leaves small, yellow; on some crops (tomatoes), undersides are reddish. Lower leaves affected first.	On sandy soil especially after heavy rain or after overirrigation. Also on organic soil during cool growing seasons.
	Phosphorus (P)	Stems thin and shortened. Leaves develop a purple color. Older leaves affected first. Plants stunted and maturity delayed.	On acidic soil or very basic soil. Also, when the soil is cool and wet.
	Potassium (K)	Older leaves develop gray or tan areas on leaf margins. Eventually a scorch appears on the entire margin.	On sandy soil following leaching rains or overirrigation.
Secondary nutrients	Calcium (Ca)	Growth is restricted to the growing points of shoots and roots. Specific deficiencies include blossom-end rot of tomato, pepper, and watermelon; brown heart of escarole; celery blackheart; and cauliflower or cabbage tip burn.	On strongly acidic soil or during severe droughts.
	Magnesium (Mg)	Initially older leaves show yellowing between veins, followed by yellowing of young leaves. Older leaves soon fall.	On strongly acidic soil or on leached sandy soils.
	Sulfur (S)	General yellowing of younger leaves and growth.	On very sandy soil, low in organic matter, especially following continued use of sulfur-free fertilizers and especially in areas that receive little atmospheric sulfur.
Micronutrients	Boron (B)	Growing tips die and leaves are distorted. Specific diseases caused by boron deficiency include brown curd and hollow stem of cauliflower, cracked stem of celery, blackheart of beet, and internal browning of turnip.	On soil with pH above 6.8, on sandy, leached soil, or for crops with very high demand, such as cole crops.
	Copper (Cu)	Yellowing of young leaves and stunting of plants. Onion bulbs are soft with thin, pale scales.	On organic soil or occasionally new mineral soil.
	Chlorine (Cl)	Deficiencies are rare.	Usually only under laboratory conditions.
	Iron (Fe)	Distinct yellow or white areas between veins on youngest leaves.	On soil with pH above 6.8.
	Manganese (Mn)	Yellow mottled areas between veins on youngest leaves, not as intense as iron deficiency.	On soil with pH above 6.4.
	Molybdenum (Mo)	Pale, distorted, narrow leaves with some interveinal yellowing of older leaves, e.g., whiptail disease of cauliflower. Rare.	On very acidic soil.
	Nickel (Ni)	Deficiencies are rare. See more in "Nickel Nutrition in Plants" (https://ask.ifas.ufl.edu/publication/HS1191).	Usually only under laboratory conditions.
	Zinc (Zn)	Small reddish spots on cotyledon leaves of beans; light areas (white bud) of corn leaves.	–

Table 5. Typical bed spacing and number of rows per bed for some vegetable crops.

Vegetable Crop	Typical Bed Spacing (ft) ¹	No. of LBF per Acre	Number of Rows of Plants on a Bed
Bean: Snap, lima	2.5	17,424	1
Broccoli	6	7,260	2
Brussels sprout	6	7,260	2
Cabbage	6	7,260	2
Carrot	1	43,560	3
Cauliflower	6	7,260	2
Celery	4	10,890	2
Collards	6	7,260	2
Cucumber	6	7,260	2
Eggplant	6	7,260	1
Greens: Mustard, turnip	6	7,260	4
Herbs: Parsley, cilantro	6	7,260	4
Kale	6	7,260	2
Lettuce	4	10,890	2
Muskmelon	5	8,712	1
Okra	6	7,260	2
Onion	6	7,260	4
Pea	2.5	17,424	1
Pepper	6	7,260	2
Potato	3.5	12,446	1
Radish	6	7,260	6
Spinach	6	7,260	4
Squash, summer	6	7,260	2
Squash, winter	6	7,260	2
Strawberry	4	10,890	2
Sweet corn	3	14,520	1
Tomato	6	7,260	1
Watermelon	8	5,445	1
¹ The bed spacing is measured from the center of one bed to the center of the adjacent bed.			

Table 6. Target pH and nitrogen (N) fertilization recommendations for selected vegetable crops in mineral soils of Florida.

Crops	Target pH	N (lb/Acre)
Tomato, pepper, potato, celery, sweet corn, crisphead lettuce, endive, escarole, romaine lettuce, and eggplant	6.0 (potato) and 6.5	200
Snapbean, lima bean, and pole bean	6.5	100
Broccoli, cauliflower, brussels sprout, cabbage, collards, Chinese cabbage, carrots, and strawberry	6.5	175
Radish and spinach	6.5	90
Cucumber, squash, pumpkin, muskmelon, leaf lettuce, sweet bulb onion, and watermelon	6.0 (watermelon) and 6.5	150
Southern pea, snow pea, English pea, and sweetpotato	6.5	60
Kale, turnip, mustard, parsley, okra, bunching onion, leek, and beet	6.5	120

Table 7. Soil test interpretation for Mehlich-3 extractions for vegetable crops in Florida.

Nutrient	Mehlich-3 Interpretations (parts per million soil)		
	Low	Medium	High
P	=25	26–45	>45
K	=35	36–60	>60
Mg ¹	=20	21–40	>40

¹ Up to 35 lb/A may be needed when soil test results are medium or lower.

Table 8. Phosphorus (P, expressed as P₂O₅) and potassium (K, expressed as K₂O) fertigation recommendations for selected vegetable crops in mineral soils for Florida based on low, medium, and high soil test index using the Mehlich-3 soil extractant method. (For details, refer to Ask IFAS publication “UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida,” <https://ask.ifas.ufl.edu/publication/CV002>.)

Crop	P ₂ O ₅ (lb/A/crop season)			K ₂ O (lb/A/crop season)		
	Low	Medium	High	Low	Medium	High
Celery	150–200	100	0	150–250	100	0
Eggplant	130–160	100	0	130–160	100	0
Broccoli, cauliflower, brussels sprout, cabbage, collards, Chinese cabbage, carrot, kale, turnip, mustard, parsley, okra, muskmelon, leaf lettuce, sweet bulb onion, watermelon, pepper, sweet corn, crisphead lettuce, endive, escarole, strawberry, and romaine lettuce	120–150	100	0	120–150	100	0
Tomato	120–150	100	0	125–150	100	0
Cucumber, squash, pumpkin, snapbean, lima bean, pole bean, beet, radish, spinach, and sweetpotato	100–120	80	0	100–120	80	0
Bunching onion and leek	100–120	100	0	100–120	100	0
Potato ¹	120	100	0	150	–	–
Southern pea, snow pea, and English pea	80	80	0	80	60	0

¹ Potatoes planted in cool soils may respond to starter fertilization of up to 25 lb P₂O₅ applied in the furrow with the seed pieces. Additionally, in October 2022, the Deans of Research and Extension approved an interim recommendation of 120 lb acre⁻¹ P₂O₅ for phosphorus management in potato production, irrespective of soil test P values. See also Footnote 253 in Table 4 in “UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida” (<https://ask.ifas.ufl.edu/publication/CV002>).

Table 9. Fertigation¹ and supplemental fertilizer¹ recommendations for selected vegetable crops grown on mineral soils testing low in potassium (K₂O) based on the Mehlich-3 soil extraction method.

Crop	Fertilizer and Timing Information	Preplant ² (lb/A)	Injection Rate ³ (lb/A/day)					Low Plant Content ^{4,5}	Extended Season ^{4,6} (lb/A/day)
			1–2	3–4	5–10	11–13	–		
Eggplant	Wk after transplanting ⁷	–	1–2	3–4	5–10	11–13	–	–	–
	N	0–70	1.5	2.0	2.5	2.0	–	1.5–2.0	1.5–2.0
	K ₂ O	0–55	1.0	1.5	2.5	1.5	–	1.5–2.0	1.5–2.0
Okra	Wk after transplanting	–	1–2	3–4	5–12	13	–	–	–
	N	0–40	1.0	1.5	2.0	1.5	–	1.5–2.0	1.5–2.0
	K ₂ O	0–50	1.0	1.5	2.0	1.5	–	1.5–2.0	1.5–2.0
Pepper	Wk after transplanting	–	1–2	3–4	5–11	12	13	–	–
	N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
	K ₂ O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
Tomato ⁸	Wk after transplanting	–	1–2	3–4	5–11	12	13	–	–
	N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
	K ₂ O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0

¹ A = 7,260 linear ft/A (6 ft bed spacing); for soils testing “low” in Mehlich-3 potassium (K₂O), seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10–15 lb/A for N and P₂O₅ and applied through the plant hole or near the seeds.

² Applied using the modified broadcast method (fertilizer is broadcast only where the beds will be formed, not over the entire field). Preplant fertilizer cannot be applied to double/triple crops because of the plastic mulch, hence all fertilizers must be injected.

³ This fertigation schedule is applicable when no N and K₂O are applied preplant. Reduce the schedule proportionally to the amount of N and K₂O applied preplant. Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterward.

⁴ Plant nutritional status may be determined with tissue analysis, fresh petiole-sap testing, or any other calibrated method. The “low” diagnosis needs to be based on UF/IFAS interpretative thresholds.

⁵ Plant nutritional status must be diagnosed every week to repeat supplemental fertilizer application.

⁶ Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see “Evapotranspiration-Based Irrigation Scheduling for Agriculture” at <https://ask.ifas.ufl.edu/publication/AE457>). Supplemental fertilizations are to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied “in advance” with the preplant fertilizer.

⁷ For standard 13-week-long transplanted tomato crop.

⁸ Some of the fertilizer may be applied with a fertilizer wheel through the plastic mulch during the tomato crop when only part of the recommended base rate is applied preplant. Rate may be reduced when a controlled-release fertilizer source is used.

Table 10. Fertigation recommendations for strawberry grown on mineral soils testing low in potassium (K₂O) based on the Mehlich-3 soil extraction method.

Nutrient	Injection Rate ¹ (lb/A/day)							Low Plant Content ²
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	
N*	1.5–2.0	1.0–2.0	1.0–1.5	0.75–1.0	0.5–1.0	0.5–0.75	0.5–0.75	1.5–2.0
K ₂ O	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8

¹ Planting date of October 1st and end-of-harvesting date of April 30th. Recommendations are for bare-root transplants with no preplant N or K. The total N rate may increase or decrease, depending on the length of the growing season. Growers may choose to omit N fertilization when sprinkler irrigation is used for the establishment of transplants (typically 10–12 days after transplanting). If preplant N and K are to be applied, growers are encouraged to use controlled-release or slow-release fertilizers to minimize the risk of nutrient leaching or runoff.

² Plant nutritional status may be determined with tissue analysis, fresh petiole-sap testing, or any other calibrated method. The “low” diagnosis needs to be based on UF/IFAS interpretative thresholds.

*The target total season N rate is 175 lb/A. Plants on high-organic matter soils may require less N, whereas plants on sandy soils, prone to leaching, may require slightly more, but no more than 200 lb/A. Extra seasonal N applications should depend on plant leaf or petiole sap testing, leaching rainfall, or extended-season needs. The optimum N rate also varies among strawberry cultivars. Growers should choose N rates that are appropriate for the cultivar and soil within the ranges shown in the table.

Table 11. Soil test guidelines for micronutrients.

Guidelines	Soil pH (Mineral Soils Only) (parts per million)		
	5.5–5.9	6.0–6.4	6.5–7.0
Test level below which there may be a crop response to applied copper	0.1–0.3	0.3–0.5	0.5
Test level above which copper toxicity may occur	2.0–3.0	3.0–5.0	5.0
Test level below which there may be a crop response to applied manganese	3.0–5.0	5.0–7.0	7.0–9.0
Test level below which there may be a crop response to applied zinc	0.5	0.5–1.0	1.0–3.0

When soil tests are low or known deficiencies exist, apply per acre 5 lb Mn, 2 lb Zn, 4 lb Fe, 3 lb Cu, and 1.5 lb B (higher rate needed for cole crops).

Table 12. Foliar fertilizer sources and rates for vegetable production in Florida.

Nutrient	Source	Foliar Application (lb/A)
Boron	Borax ¹	2–5
	Solubor	1–1.5
Copper	Copper sulfate	2–5
Iron	Ferrous sulfate ²	2–3
	Chelated iron	0.75–1
Manganese	Manganous sulfate	2–4
Molybdenum	Sodium molybdate	0.25–0.50
Zinc	Zinc sulfate	2–4
	Chelated zinc	0.75–1
Calcium	Calcium chloride	5–10
	Calcium nitrate	5–10
Magnesium	Magnesium sulfate	10–15

¹ Mention of a trade name does not imply a recommendation over similar materials.

² Ferrous sulfate (FeSO₄) is rapidly oxidized to ferric sulfate (Fe₂[SO₄]₃) in water, rendering the latter form unavailable for most vegetable crops. Therefore, it is advisable to use chelated iron fertilizers instead of ferrous sulfate.

Chapter 3. Principles and Practices of Irrigation Management for Vegetables¹

Lincoln Zotarelli, Michael D. Dukes, and Eric H. Simonne²

This section contains basic information on vegetable water use and irrigation management, along with some references on irrigation systems. Proper water management planning must consider all uses of water, from the source of irrigation water to plant water use. Therefore, it is very important to differentiate between crop water requirements and irrigation or production-system water requirements. Crop water requirements refer to the actual water needs for evapotranspiration (ET) and plant growth, and they primarily depend on crop development and climatic factors, which are closely related to climatic demands. Irrigation requirements are primarily determined by crop water requirements, but they also depend on the characteristics of the irrigation system, management practices, and the soil characteristics in the irrigated area.

Best Management Practices (BMP) for Irrigation

BMPs have historically been focused on nutrient management and fertilizer rates. However, because rainfall or irrigation water is the vector of off-site nutrient movement of nitrate in solution and phosphate in sediments as well as other soluble chemicals, proper irrigation management directly affects the efficacy of a BMP plan. The irrigation BMPs in the *Water Quality and Water Quantity Best Management Practices for Florida Vegetable and Agronomic Crop (VAC) Operations* manual (download at <https://ccmedia.fdacs.gov/content/download/77230/file/vegAgCropBMP-loRes.pdf>) cover all major aspects of irrigation, such as irrigation system design, system maintenance, erosion control, and irrigation scheduling.

Uses of Irrigation Water

Irrigation systems have several uses in addition to water delivery for crop ET. Water is required for a preseason operational test of the irrigation system to check for leaks and to ensure proper performance of the pump and power plant. Irrigation water is also required for field preparation, crop establishment, crop growth and development, within-season system maintenance, delivery

of chemicals, frost protection, and other uses, such as dust control.

Field Preparation

Field preparation water is used to provide moisture to the field soil for tillage and bed formation. The water used for field preparation depends on specific field cultural practices, initial soil moisture conditions, the depth to the natural water table, and the type of irrigation system. Drip-irrigated fields on sandy soils often require an additional irrigation system for field preparation because drip tubes are not installed until after the beds have been formed. Thus, many drip-irrigated vegetable fields may also require an overhead or subirrigation system for field preparation. For example, many strawberry production fields have sprinkler irrigation systems already installed for frost protection. These systems are also used for field preparation and may apply one or more inches of water for this purpose. Subirrigated (seepage) fields use the same system for field preparation as for crop establishment, plant growth needs, and frost protection. Subirrigation water management requirements depend on the soil characteristics within the irrigated field and surrounding areas. Sufficient water must be provided to raise the water table level as high as 18–24 in. below the soil surface. Water is required to fill the pores of the soil and to satisfy evaporation and subsurface runoff requirements. As a rough guide, 1.0–2.5 in. of water are required for each foot of water table rise. For example, a field with a preirrigation water table 30 in. deep may need about 2 in. of water to raise the water table to 18 in., while a preirrigation water table at 48 in. may require 5 in. of water for the same result.

Crop Establishment

Vegetables that are set as transplants, rather than direct seeded, require irrigation for crop establishment in excess of crop ET. Establishment irrigations are used either to keep plant foliage wet by overhead sprinkler irrigation (to avoid desiccation of leaves) or to maintain high soil moisture levels until the root systems increase in size and plants start to actively grow and develop. Establishment irrigation practices vary among crops and irrigation systems. Strawberry plants set as bare-root transplants

may require 7 to 14 days of frequent intermittent overhead irrigation for establishment prior to irrigation with the drip system. Practices like intermittent irrigation, use of low-volume sprinklers, and use of crop protectants can reduce the volume of irrigation water required for establishment of strawberries. The amount of water required for crop establishment can range widely depending on crop, irrigation system, and climate demand. Adequate soil moisture is also needed for the uniform establishment of direct-seeded vegetable crops.

Crop Growth and Development

Irrigation requirements to meet the ET needs of a crop depend on the type of crop, field soil characteristics, irrigation system type and capacity, and crop growth stage. Crops vary in growth characteristics that result in different relative water-use rates. Soils differ in texture and hydraulic characteristics such as available water-holding capacity (AWHC) and capillary movement. Because sands generally have very low AWHC values (3% to 6% is common), a 1% change in AWHC affects irrigation practices.

Water Application (Irrigation Requirement)

Irrigation systems are generally rated with respect to application efficiency (Ea), which is the fraction of water that has been applied by the irrigation system and that is available to the plant for use (Table 1). Applied water that is not available to the plant may have been lost from the crop root zone through evaporation or wind drifts of spray droplets, leaks in the pipe system, surface runoff, subsurface runoff, or deep percolation within the irrigated area. Irrigation requirements (IR) are determined by dividing the desired amount of water to provide to the plant (ETc) by the Ea as a decimal fraction (Eq. [1]). For example, if it is desired to apply 0.5 in. to the crop with a 75% efficient system, then $0.5/0.75 = 0.67$ in. would need to be pumped. Hence, when seasonal water needs are assessed, the amount of water needed should be based on the irrigation requirement and all the needs for water, not only on the crop water requirement. For more information, consult “Field Evaluation of Microirrigation Water Application Uniformity” (<https://ask.ifas.ufl.edu/ae094>). Catch cans can be used in the field to measure the actual amount of water applied.

Eq. [1] Irrigation requirement = Crop water requirement / Application efficiency

$$IR = ETc/Ea$$

Fertigation/Chemigation

Irrigation systems are often used for the delivery of chemicals such as fertilizers, soil fumigants, or insecticides. The crop may require nutrients when irrigation is not required (e.g., after heavy rainfall). Fertilizer injection

schedules based on soil test results are provided in [chapter 2 of this production guide](#). Fertigation should not begin until the system is pressurized. It is recommended to always end a fertigation/chemigation event with a short flushing cycle with clear water and/or to rinse crop foliage to avoid the accumulation of fertilizer or chemical deposits in the irrigation system. The length of the flushing cycle should be 10 minutes longer than the travel time of the fertilizer from the irrigation point to the farthest point of the system.

System Maintenance

Irrigation systems require periodic maintenance throughout the growing season. These activities may require system operation during rainy periods to ensure that the system is ready when needed. In addition, drip irrigation systems may require periodic maintenance to prevent clogging and system failure. Typically, cleaning agents are injected weekly, but in some instances, more frequent injections are needed.

Frost Protection

For some crops, irrigation is used for frost protection during winter growing seasons. For strawberry production, sprinkler irrigation is primarily used with application rates of about 0.25 in. per hour during freeze events. Water freezes at 32°F, while most plant tissues freeze at lower temperatures. Overhead freeze protection is effective for air temperatures as low as 26°F–28°F, but seldom below. For vegetable fields with subirrigation systems, the relatively higher temperature of groundwater can be used for cold protection. Growers may also irrigate to raise the water table throughout the field. Frost protection water requirements vary depending on the severity and duration of freeze events, the depth to the existing water table level, and field hydraulic characteristics. For more information, consult “Microsprinkler Irrigation for Cold Protection of Florida Citrus” (<https://ask.ifas.ufl.edu/ch182>) and “Citrus Cold Weather Protection and Irrigation Scheduling Tools Using Florida Automated Weather Network (FAWN) Data” (<https://ask.ifas.ufl.edu/ss509>).

Other Uses

Other irrigation uses vary according to the type of crop, system characteristics, and field location. Some examples include periodic overhead irrigation for dust control, wetting of dry row middles to settle dust and prevent sand from blowing during windy conditions, and wetting of roadways and drive aisles to provide traction for farm vehicles.

Irrigation Scheduling

Irrigation scheduling consists simply of applying water to crops at the *right* time and in the *right* amount, and it is considered an important BMP. The characteristics of the

irrigation system, crop needs, soil properties, and atmospheric conditions must all be considered to properly schedule irrigations. Poor timing or insufficient water application can result in crop stress and reduced yields from inappropriate amounts of available water or nutrients. In sandy soils, excessive water applications may reduce yield and quality and increase the risk of nutrient leaching.

A wide range of irrigation scheduling methods is used in Florida, with corresponding levels of water management (Table 2). The recommended method (level 5) for scheduling irrigation (drip or overhead) for vegetable crops is to combine the crop water requirement method, which considers the plant growth stage associated with measurements of soil water status, with guidelines for splitting irrigation (see below). A typical irrigation schedule contains (1) a target crop water requirement adjusted to growth stage and actual evaporative demand, (2) adjustment of irrigation application based on soil moisture, (3) a rule for splitting irrigation, (4) a method to account for rainfall, and (5) recordkeeping (Table 3). For seepage irrigation, the water table should be maintained near the 18 in. depth (measured from the top of the bed) at planting and near the 24 in. depth when plants are fully grown. Water tables should be maintained at the proper level to ensure optimum moisture in the bed without leading to oversaturation of the root zone and potential losses of nutrients. Water tables can be monitored with a section of PVC pipe sunk in the soil with a calibrated float inside the PVC pipe. The calibrated float can be used to determine the exact level of the water table.

Soil Water Status, Soil Water Tension, and Soil Volumetric Water Content

Generally, two types of sensors may be used to measure soil water status: those that measure soil water potential (also called tension or suction) and those that measure volumetric water content. Soil water tension (SWT) represents the magnitude of the suction (water potential, negative pressure) that the plant roots must create to free soil water from the attraction of the soil and move it into the root cells. The drier the soil, the higher the suction needed, and hence the higher SWT. SWT is commonly expressed in centibars (cbar) or kilopascals (kPa) (1 cbar = 1 kPa; 7 kPa = 1 psi). For most vegetable crops grown on the sandy soils of Florida, SWT in the rooting zone should be maintained between 6 (slightly above field capacity) and 15 cbar. Because of the low AWHC of Florida soils, most full-grown vegetable crops will need to be irrigated daily. During early growth, irrigation may be needed only two to three times weekly. SWT can be measured in the field with moisture sensors or tensiometers.

Within the category of volumetric sensors, capacitance-based sensors have become common in recent years due to a decrease in cost of electronic components and increased

reliability of these types of sensors. However, sensors available on the market have substantially different accuracies, responses to salts, and costs. Soil moisture sensors and tensiometric instruments are detailed in the publication “Field Devices for Monitoring Soil Water Content” (<https://ask.ifas.ufl.edu/ae266>). All methods under this definition estimate the volume of water in a sample volume of undisturbed soil (ft³/ft³ or percentage). This quantity is useful for determining how saturated the soil is (i.e., what fraction of total soil volume is filled with the soil aqueous solution). When expressed in terms of depth (volume of water in soil down to a given depth over a unit surface area [inches of water]), it can be compared with other hydrologic variables like precipitation, evaporation, transpiration, and deep drainage.

Practical Determination of Soil Field Capacity Using Volumetric Soil Moisture Sensors

It is very important that the irrigation manager understands the concept of “field capacity” to establish an irrigation strategy that provides optimum soil moisture for plant growth, productivity, and reduction of fertilizer nutrient leaching. Figure 1 represents volumetric soil water content (VWC) at a depth of 0–6 in. measured by a capacitance sensor over a period of four days. For the soil field capacity point determination, it is necessary to apply an irrigation depth (or observe a rainfall event) that saturated the soil layer, in this case, 0–6 in. The depth of irrigation applied in a single irrigation event was 4,645 gal/A (equivalent to 0.17 in. for overhead or seepage irrigation, or 34 gal/100 ft for drip irrigation with 6 ft bed centers in plasticulture). Right after the irrigation events, there was a noticeable increase in soil moisture content. The degree to which the VWC increases, however, is dependent upon the volume of irrigation, which is normally set by the duration of the irrigation event. For plastic-mulched drip irrigation in sandy soils, long irrigation events result in a relatively large increase in soil moisture in the area below the drip emitter. The spike in soil moisture appears to only be temporary because the irrigation water rapidly drains down beyond the 6 in. zone (observed by the decrease in VWC). This rapid spike in soil water content indicates that the VWC rapidly reaches a point above the soil water-holding capacity, and the water percolated down to deeper soil layers. For sandy soils, the change in the slope of drainage and extraction lines, in other words, changing from “rapid” to “slower” decrease in soil water content, can be assumed as the “field capacity point.” At this time, the water has moved out from the large soil pores (macropores), and air has taken its place. The remaining pore spaces (micropores) are still filled with water and will supply the plants with needed moisture. Between the end of day 1 and day 3, the VWC declined at a constant rate as a result of drainage, but most of the water extraction was due to evapotranspiration during the day.

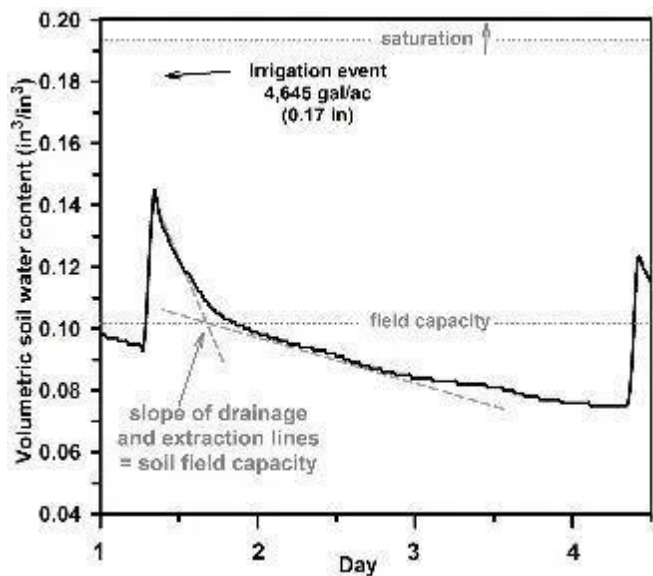


Figure 1. Example of practical determination of soil field capacity at 0–6 in. soil depth after an irrigation event using soil moisture sensors.

Examples of Irrigation Scheduling Using Volumetric Soil Moisture Sensor Devices

In this section, two examples of irrigation management of vegetable crops in sandy soils using soil moisture sensor readings are provided: one example with excessive (“over”) irrigation (Figure 2) and one with adequate irrigation (Figure 3) using plasticulture. In Figure 2, the irrigation events consisted of a single application of a daily irrigation event at 4,718 gal/A (equivalent to 0.18 in. for overhead or seepage irrigation, or 36 gal/100 ft for drip irrigation with 6 ft bed centers in plasticulture). After each irrigation event, there was an increase in the soil water content followed by rapid drainage. Large rainfall events may lead to substantial increases in soil moisture content. On day 2, right after the irrigation, a large rainfall of 0.44 in. occurred, which resulted in a second spike of soil water content in the same day. The following irrigation (day 3) started when the volumetric soil water content was above the soil field capacity. In this case, the irrigation event on day 3 could have been safely skipped. Between days 3 and 6, no irrigation was applied to the crop. The volumetric water content decreased from 0.14–0.08 in³/in³. Due to the very low water-holding capacity of the sandy soils, skipping irrigation for several days could lead to unneeded crop water stress, especially during very hot or very windy days (when high evapotranspiration rates may occur), or during flowering/fruit development stage. Between days 6 and 10, large daily irrigation events were repeated, exceeding the “safe irrigation zone” and leading to more water drainage and nutrient leaching.

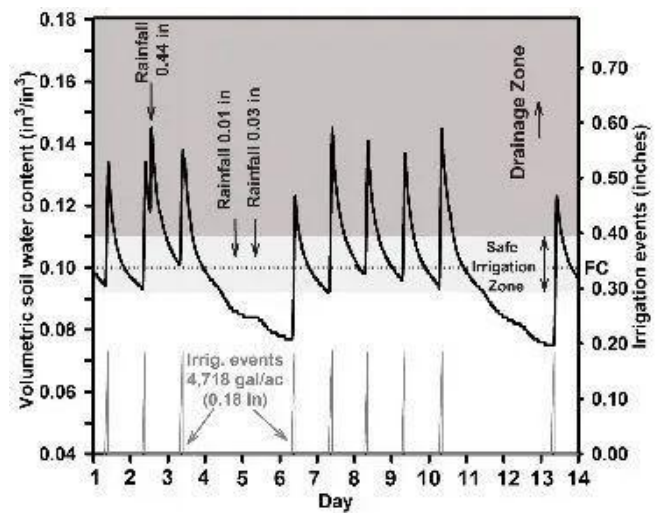


Figure 2. Example of excessive (“over”) irrigation of the upper soil layer (0–6 in. depth) moisture content for drip irrigation under plastic-mulched conditions for sandy soils. The black line indicates volumetric soil water content using soil moisture sensors. The gray line indicates irrigation events, each single daily irrigation event having a volume application of 65 gal/100 ft (0.18 in.). The dotted line indicates soil field capacity. Arrows indicate rainfall events.

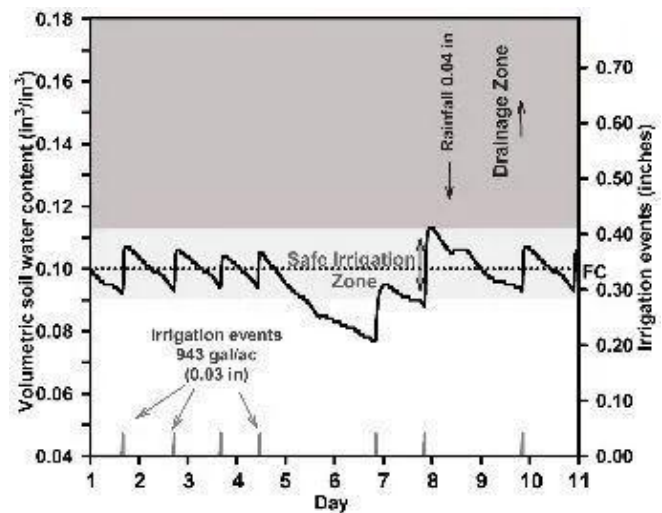


Figure 3. Example of adequate irrigation management using soil moisture sensors for monitoring the volumetric soil moisture content in the upper soil layer (0–6 in. depth) on drip irrigation under plastic-mulched conditions for sandy soils. The black line indicates volumetric soil water content using soil moisture sensors. The gray line indicates irrigation events, each single daily irrigation event having a volume application of 943 gal/A (0.03 in.). The dotted line indicates soil field capacity (FC). Arrows indicate rainfall events.

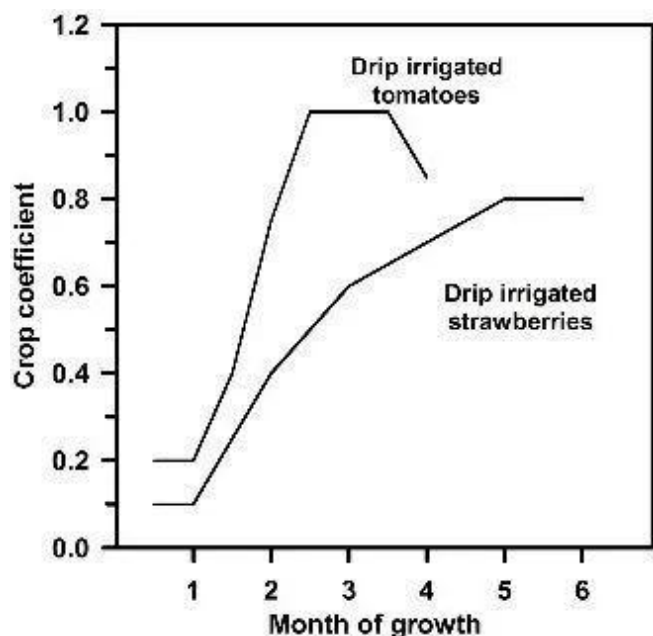


Figure 4. Crop coefficient of drip-irrigated tomato and strawberry.

Conversely, Figure 3 shows “adequate” irrigation applications for a 10-day period. In this case, the irrigation event started exclusively when the volumetric soil water content reached a set threshold. The soil field capacity was known, so the irrigation events started when the volumetric soil moisture content reached values below field capacity ($0.09 \text{ in}^3/\text{in}^3$). However, to maintain the soil volumetric water content in the “safe irrigation zone,” a previous determination of the length of the irrigation is necessary to avoid overirrigation. Additional information about irrigation depths can be obtained in “Microirrigation in Mulched Bed Production Systems: Irrigation Depths” (<https://ask.ifas.ufl.edu/ae049>).

The example in Figure 3 received irrigation of 943 gal/A (equivalent to 0.03 in. for overhead or seepage irrigation, or 6 gal/100 ft for drip irrigation with 6 ft bed centers in plasticulture). This irrigation depth was sufficient to increase the volumetric water content to a given moisture without exceeding the “safe irrigation zone.” On average, the volumetric soil water content was maintained close to the field capacity, keeping water and nutrients in the root zone. For this example, there was no deep water percolation. In addition, with the information of the soil water status, the irrigation manager might decide not to irrigate if the soil moisture content is at a satisfactory level. For example, on day 8, due to a rainfall event of 0.04 in., there was no need for irrigation because the soil moisture was above the field capacity, and therefore, the irrigation event of day 8 was skipped. This “precise” irrigation management still requires very close attention by the irrigation manager. For a given reason (such as pump issue), the irrigation was ceased on day 5 and resumed late in day 6. As a result, soil water storage decreased below

the safe irrigation zone, and if the water shortage was prolonged, the plants could become water-stressed.

Installation and Placement of Soil Moisture Sensor Devices

The use of soil moisture monitoring devices (volumetric or soil water tension) has potential to save irrigation water in a given vegetable area by reducing the number of unnecessary irrigation events. However, the effectiveness of these sensors depends on proper installation in representative locations within vegetable fields. These sensors may be used to monitor water table levels in seepage irrigation.

Sensors should be installed in the root zone of the plants to be irrigated. Most of the vegetable crops have 80% to 90% of the root zone in the upper 12 in., which generally is the soil layer with higher water depletion by evapotranspiration. For vegetable crops cultivated in rows and irrigated by drip tapes, the sensors should be installed 2–3 in. away from the plant row. For single-row crops (such as tomato, eggplant, or watermelon), the sensor should be placed on the opposite side from the drip tape; for double-row crops (pepper, squash), the sensors should be placed in between the drip tape and plant rows.

Sensors need to be in good contact with the soil after installation; there should be no air gaps surrounding the sensor. Soil should be packed firmly but not excessively around the sensor. Alternatively, sensors can be installed in a slurry of wetted soil that was removed for the sensor installation. Using a slurry, the consistency of cake batter, can also provide the user with an initial calibration of the sensor for the determination of field capacity seen in Figure 1. In plasticulture, after the installation, the area above the sensor should be re-covered with plastic and sealed with tape.

Soil Moisture Sensor Data Interpretation

Soil moisture sensors can provide information on the depth of an irrigation or rainfall event, at what depth and in what quantity crop roots are extracting water from the soil, when irrigation is necessary, and more. However, this information is not always intuitive without some guidance. For a closer look at various soil moisture sensors and their data interpretation, visit the UF/IFAS North Florida Research and Education Center—Suwannee Valley YouTube channel and view the soil moisture sensors playlist (<https://www.youtube.com/playlist?list=PLnumAc9HXgDyMWN-dstplSR9QWUiu9H8>).

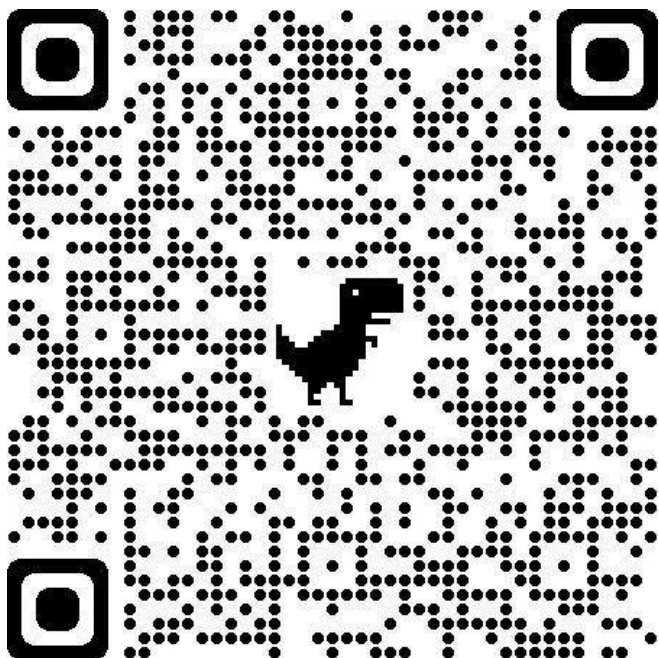


Figure 5. QR code for soil moisture sensor playlist on UF/IFAS North Florida Research and Education Center—Suwannee Valley YouTube channel.

Crop Water Requirement (ET)

Crop water requirements depend on crop type, growth stage, and evaporative demand. Evaporative demand is termed evapotranspiration (ET) and may be estimated using historical or current weather data. Generally, reference evapotranspiration (ET_o) is determined for use as a base level. By definition, ET_o represents the water use from a uniform green cover surface that is actively growing and well-watered (such as turf or a grass-covered area).

Historical daily averages of Penman-method ET_o values, expressed in units of acre-inches and gallons per acre, are available for six Florida regions (Table 4). While these values are provided as guidelines for management purposes, actual values may vary above and below these values, requiring individual site adjustments. Actual daily values may be as much as 25% higher on days that are hotter and drier than normal or as much as 25% lower on days that are cooler or more overcast than normal. Real time ET_o estimates can be found at the Florida Automated Weather Network (FAWN) internet site (<https://fawn.ifas.ufl.edu>). For precise management, SWT or soil moisture should be monitored daily in the field.

Crop water use (ET_c) is related to ET_o by a crop coefficient (K_c), which is the ratio of ET_c to the reference value ET_o (Eq. [2]). Because different methods exist for estimating ET_o, it is very important to use K_c coefficients that were derived using the same ET_o estimation method as will be used to determine the crop water requirements. Also, K_c values for the appropriate growth stage (Tables 5 and 6; Figure 3) and production system (Tables 7 and 8) must be used.

With drip irrigation, where the wetted area is limited and plastic mulch is often used, K_c values are lower to reflect changes in row spacing and mulch use. Plastic mulches substantially reduce evaporation of water from the soil surface. Associated with the reduction of evaporation is a general increase in transpiration. Even though the transpiration rates under mulch may increase by an average of 10%–30% over the season as compared to no-mulch systems, overall water-use values decrease by an average of 10%–30% due to the reduction in soil evaporation. ET_o may be estimated from atmometers (also called modified Bellani plates) by using an adjustment factor. ET_o may be estimated from evaporation from an ET gauge (E_a) during days without rainfall as ET_o = E_a/0.89 and on rainy days (>0.2 in.) as ET_o = E_a/0.84.

Eq. [2] Crop water requirement = Crop coefficient × Reference evapotranspiration

$$ET_c = K_c \times ET_o$$

Soil Water-Holding Capacity and the Need to Split Irrigations

Appropriate irrigation scheduling and matching irrigation amounts with the water-holding capacity of the effective root zone may help minimize the incidence of excess leaching associated with overirrigation. In Florida sandy soils, the amount of water potentially available to the plants that can be stored in the root zone is limited. Usually, it is assumed that approximately 0.75 in. of water can be stored in every foot of the root zone. Only half of that should be used before the next irrigation to avoid plant stress and yield reduction. (This will help maintain SWT below 15 cbar.) Any additional water will be lost by deep percolation below the root zone.

Table 8 gives the approximate amount of water that can be applied at each event in Florida sandy soil under different production systems. When the calculated volume of water to be applied in one day exceeds the values in Table 7, then it is necessary to split applications. The number of split irrigations can be determined by dividing the irrigation requirement (Eq. [1]) by the numbers in Table 8 and rounding up the result to the nearest whole number. Splitting irrigation reduces risks of water loss through deep percolation and nutrient leaching. Sandy soil with the available water-holding capacity of 0.75 in./ft was assumed in these calculations. If a soil contains more clay or organic matter, the amount of water applied during one irrigation event and stored in the root zone can be increased. To ensure that the water is not lost from the roots, it is recommended to check the depth of wetting after irrigation by digging out a perpendicular profile to the drip line and observing the wetted pattern.

Example

As an example, consider drip-irrigated tomatoes on 6 ft center beds, grown under a plastic mulch production system in the central west area (sandy soils). For plants in growth stage 5, the crop coefficient is 0.85 (Table 7). If this period of growth had occurred in May, the corresponding ETo value would be 4,887 gal/A per day (Table 4). Daily crop water use would be estimated as

$$\text{ET}_{\text{crop}} = (0.85) \times (4,887 \text{ gal/A/day}) = 4,153 \text{ gal/A/day}$$

If the drip irrigation system can apply water to the root zone of the crop with an application efficiency of 80%, the irrigation requirement would be

$$\text{Irrigation Requirement} = (4,153 \text{ gal/A/day}) / (0.80) = 5,192 \text{ gal/A/day}$$

If the maximum water application in one irrigation event for this type of soil is 1,700 gal/A per irrigation, then the irrigation will have to be split:

$$\begin{aligned} \text{Number of events} &= (5,292 \text{ gal/A/day}) / (1,700 \\ &\text{gal/A/day/irrigation event}) = 3.1, \text{ rounded up to } 4 \\ \text{irrigation events each of } &5,292/4 = 1,323 \text{ gal/A} \end{aligned}$$

Therefore, in this example, four irrigations of 1,323 gal/A each would be needed to replace ETc without exceeding the soil water-holding capacity. This amount of water would be a good estimate for scheduling purposes under average growth and average May climatic conditions. However, field moisture plant status should also be monitored to determine if irrigation levels need to be increased or reduced. While deficit irrigation will reduce fruit size and plant growth, excessive irrigation may leach nutrients from the active root system. This may also reduce plant growth and yield.

Table 1. Application efficiency for water delivery systems used in Florida.

Irrigation System	Application Efficiency (Ea)
Overhead	60%–80%
Seepage ¹	20%–70%
Drip ²	80%–95%
¹ Ea greater than 50% is not expected unless tailwater recovery is used.	
² With or without plastic mulch.	

Table 2. Levels of water management and corresponding irrigation scheduling method.

Water Mgt. Level	Irrigation Scheduling Method
0	Guessing (irrigate whenever); not recommended
1	Using the “feel-and-see” method
2	Using systematic irrigation (Example: 0.75 in. every 4th day, or 2 hr every day)
3	Using a soil water tension measuring tool or soil moisture sensor to start irrigation
4	Scheduling irrigation, applying amounts based on a budgeting procedure, and checking actual soil water status
5 ^a	Adjusting irrigation to plant water use (ET _o), and using a dynamic water balance based on a budgeting procedure and plant stage of growth, together while using a soil water tension measuring tool or soil moisture sensor
^a Recommended method	

Table 3. Summary of irrigation scheduling guidelines for vegetable crops grown in Florida.

Irrigation Scheduling Component	Irrigation System ¹	
	Seepage ²	Drip ³
1—Target water application rate	Keep water table between 18 and 24 in. depth.	Historical weather data or crop evapotranspiration (ET _c) calculated from reference ET or Class A pan evaporation
2—Fine-tune application with soil moisture measurement	Monitor water table depth with observation wells.	Maintain soil moisture level in the root zone between 8 and 15 cbar (or 8% and 12% available soil moisture)
3—Determine the contribution of rainfall	Typically, 1 in. of rainfall raises the water table by 1 ft.	Poor lateral water movement on sandy and rocky soils limits the contribution of rainfall to crop water needs to (1) foliar absorption and cooling of foliage and (2) water funneled by the canopy through the plan hole.
4—Rule for splitting irrigation	Not applicable. However, a water budget can be developed.	Irrigations greater than 12 and 50 gal/100 ft (or 30 min and 2 hr for drip tapes with medium flow-rate) when plants are small and fully grown, respectively, will likely push the waterfront below the root zone
5—Recordkeeping	Irrigation amount applied and total rainfall received ⁴ Days of system operation	Irrigation amount applied and total rainfall received ⁴ Daily irrigation schedule
¹ Efficient irrigation scheduling also requires a properly designed and maintained irrigation system.		
² Practical only when a spodic layer is present in the field.		
³ On deep sandy soils.		
⁴ Required by the BMPs.		

Table 4. Historical Penman method reference evapotranspiration (ET_o) for six Florida regions expressed in (A) inches per day and (B) gallons per acre per day.¹

	Month	Northwest	Northeast	Central	Central West	Southwest	Southeast
Inches per day (A)	Jan	0.06	0.07	0.07	0.07	0.08	0.08
	Feb	0.07	0.08	0.10	0.10	0.11	0.11
	Mar	0.10	0.10	0.12	0.13	0.13	0.13
	Apr	0.13	0.14	0.16	0.16	0.17	0.17
	May	0.16	0.16	0.18	0.18	0.18	0.18
	Jun	0.17	0.16	0.18	0.18	0.18	0.17
	Jul	0.17	0.16	0.17	0.17	0.18	0.18
	Aug	0.15	0.15	0.17	0.16	0.17	0.16
	Sep	0.13	0.13	0.14	0.14	0.15	0.14
	Oct	0.09	0.10	0.11	0.11	0.12	0.12
	Nov	0.07	0.07	0.08	0.08	0.09	0.09
	Dec	0.05	0.06	0.06	0.07	0.07	0.07
Gallons per acre per day² (B)	Jan	1,629	1,901	1,901	1,901	2,172	2,172
	Feb	1,901	2,172	2,715	2,715	2,987	2,987
	Mar	2,715	2,715	3,258	3,530	3,530	3,530
	Apr	3,530	3,801	4,344	4,344	4,616	4,616
	May	4,344	4,344	4,887	4,887	4,887	4,887
	Jun	4,616	4,344	4,887	4,887	4,887	4,616
	Jul	4,616	4,344	4,616	4,616	4,887	4,887
	Aug	4,073	4,073	4,616	4,344	4,616	4,344
	Sept	3,530	3,530	3,801	3,801	4,073	3,801
	Oct	2,444	2,715	2,987	2,987	3,258	3,258
	Nov	1,901	1,901	2,172	2,172	2,444	2,444
	Dec	1,358	1,629	1,629	1,629	1,901	1,901

¹ Assuming water application over the entire area, i.e., sprinkler or seepage irrigation with 100% efficiency. See Table 1 for the conversion used to account for irrigation system efficiency.

² Calculation: For overhead or seepage irrigation, (B) = (A) × 27,150. To convert values for drip irrigation (C), use (C) = (B) × bed spacing/435.6. For example, for 6 ft bed spacing and a single drip line, (C) in southwest Florida in January is (C) = 2,172 × 6/435.6 = 30 gal/100 ft/day.

Table 5. Description of growth stages (plant appearance and estimated number of weeks) for most vegetable crops grown in the spring in Florida.¹

Crop	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Expected Growing Season (Weeks)
Bean	Small plants 2–3	Growing plants 3–4	Pod enlargement 2–3	Pod maturation 2–3	–	9–10
Cabbage, cauliflower, Chinese cabbage	Small plants 2–3	Growing plants 5–6	Head development 3–4	–	–	10–12
Cantaloupe (muskmelon)	6 in. vine 1–2	12 in. vine 3–4	First flower 3–4	Main fruit production 2–3	Late fruit production 2–3	11–12
Carrot	Small plants 1–2	Growing plants 3–4	Root development 5–7	Final growth 1–2	–	10–13

Crop	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Expected Growing Season (Weeks)
Cucumber	6 in. vine 1-2	12 in. vine 2-3	Fruit production 6-7	Late season 1-2	-	10-12
Eggplant	Small plants 2-3	Growing plants 2-3	Fruit production 6-7	Late season 2-3	-	12-13
Potato	Small plants (after hilling) 2-4	Large plants (vegetative growth) 4-6	First flower (tube initiation and bulking) 3-5	Maturation (top dies) 2-4	-	12-14
Okra	Small plants 2-3	Growing plants 2-3	Pod production 7-8	Late season 1-2	-	12-13
Onion	Small plants 2-4	Growing plants 4-5	Bulb development 6-8	Maturation (top falls) 1-2	-	13-16
Pepper	Small plants 2-3	Growing plants 2-3	Pod production 7-8	Last bloom 1-2	Last harvest 1	13-15
Potato	Small plants (after hilling) 2-4	Large plants (vegetative growth) 4-6	First flower (tube initiation and bulking) 3-5	Maturation (top dies) 2-4	-	12-14
Pumpkin (bush)	Small plants 2-3	First flower 2-3	Fruit enlargement 5-6	Harvest 1-2	-	9-11
Pumpkin (vining)	6 in. vines 2-3	12 in. vines 2-3	Small fruit 3-4	Large fruit 2-3	Harvest 1-2	13-15
Radish	Small plants 1-2	Rapid growth 2-4	-	-	-	3-5
Strawberry	Young plants October	Growing plants November	Early harvest December-January	Main harvest period February-March	Late harvest April	23-30
Summer squash (crookneck, straightneck, zucchini)	Small plants 1-2	Growing plants 2-3	Fruit production 3-4	Late fruit production 1	-	7-9
Sweet corn	Small plants 3-4	Large plants 5-8	Ear development 2-3	-	-	10-15
Sweetpotato	Early vine growth 2-3	Expanding vines 5-6	Storage root enlargement 6-10	-	Late season	13-17
Tomato	Small plants 2-3	1st bloom 2-3	2nd, 3rd bloom 6-7	Harvest 1-2	Late harvest 1-2	12-14
Watermelon	6 in. vines 2-3	12 in. vines 2-3	Small fruit 3-4	Large fruit 2-3	Harvest 1-2	13-15
¹ Same growth stages used for irrigation and fertilizer schedules; for south Florida, each stage may be 30% longer because of winter planting during short days.						

Table 6. Crop coefficient estimates for use with the ETo values in Table 4 and growth stages in Table 5 for unmulched crops. (Actual values will vary with time of planting, soil conditions, cultural conditions, length of growing season, and other site-specific factors.)

Crop	Growth Stage	Crop Coefficient ¹
All field-grown vegetables	1	0.20 ² –0.40 ³
	2	Stage 1 ⁴ value to Stage 3 value (see Figure 4)
Beet	3	1.00
	4	0.90
Carrot	3	1.00
	4	0.70
Celery	3	1.00
	4	0.90
Cole crops: broccoli, brussels sprout, cabbage, cauliflower	3	0.95
	4	0.80 ⁵
Cole crops: collards, kale, mustard, turnip	3	0.90 ⁵
	4	1.00 ⁵
Cucurbits: cucumber, cantaloupe, pumpkin, squash, watermelon	3	0.90
	4	0.70
Legumes: snapbean, lima bean, and southernpea	3	0.95 ⁵
	4	0.85 ⁵
Lettuce, endive, escarole	3	0.95
	4	0.90
Okra	3	1.00 ⁵
	4	0.90 ⁵
Onion (dry)	3	0.95
	4	0.75
Onion (green)	3 and 4	0.95
Parsley	3	1.00 ⁵
Potato	3	1.10
	4	0.70
Radish	3	0.80
	4	0.75
Spinach	3	0.95
	4	0.90
Sweet corn	3	1.10
	4	1.00
Sweetpotato	3	1.10 ⁵
	4	0.70 ⁵

¹ Adapted from Doorenbos, J., and W. O. Pruitt. 1977. "Crop Water Requirements." Food and Agriculture Organization of the United Nations (FAO) Irrigation and Drainage Paper No. 24, (rev.); and Allen, R. G., L. S. Pereira, D. Raes, and M. Smith. 1998. "Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements." Food and Agriculture Organization of the United Nations (FAO) Irrigation and Drainage Paper No. 56.

² low plant population; wide row spacing.

³ high plant population; close row spacing.

⁴ 0.30 or Kc value from Stage 1.

⁵ values estimated from similar crops.

Table 7. Crop coefficient estimates (Kc) for use with ETo values in Table 4 and growth stages in Table 5 for selected crops grown in a plasticulture system.¹

Crop	Growth Stage	Crop Coefficient (Kc)
Cantaloupe ¹	1	0.35
	2	0.6
	3	0.85
	4	0.85
	5	0.85
Cucumber ¹	1	0.25
	2	0.5
	3	0.9
	4	0.75
Summer squash ¹	1	0.3
	2	0.55
	3	0.9
	4	0.8
Strawberry (4 ft bed centers) ²	1	0.4
	2	0.5
	3	0.6
	4	0.8
	5	0.8
Tomato (6 ft bed centers) ³	1	0.4
	2	0.75
	3	1.0
	4	1.0
	5	0.85
Watermelon (8 ft bed center) ¹	1	0.3
	2	0.5
	3	0.7
	4	0.9
	5	0.8
¹ Adapted from Tables 12 and 25 in Allen, R. G., L. S. Pereira, D. Raes, and M. Smith. 1998. "Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements." Food and Agriculture Organization of the United Nations (FAO) Irrigation and Drainage Paper No. 56. ² Adapted from Clark et al. 1993. "Water Requirements and Crop Coefficients for Tomato Production in Southwest Florida." Southwest Florida Water Management District. ³ Adapted from Clark et al. 1996. "Water Requirements and Crop Coefficients of Drip-Irrigated Strawberry Plants." <i>Transactions of the ASAE</i> 39: 905–913.		

Table 8. Maximum water application (in gal/A and in gal/100 ft) in one irrigation event for various production systems on sandy soil (available water-holding capacity 0.75 in./ft and 50% soil water depletion). Split irrigations may be required during peak water requirement.

Vegetable Crop	Bed Spacing (ft)	Bed Length (100 lb/Acre)	Wetting Width (ft)	Gallon/ 100 ft to Wet Depth of 1 ft	Gallon/ 100 ft to Wet Depth of 1.5 ft	Gallon/ 100 ft to Wet Depth of 2 ft	Gallon/ Acre to Wet Depth of 1 ft	Gallon/ Acre to Wet Depth of 1.5 ft	Gallon/ Acre to Wet Depth of 2 ft
Lettuce, strawberry	4	109	1.0	24	36	48	2,600	3,800	5,100
Muskmelon	5	87	1.0	24	36	48	2,100	3,100	4,100
Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato	6	73	1.0	24	36	48	1,700	2,600	3,500
Pumpkin (vining), watermelon	8	55	1.0	24	36	48	1,300	1,900	2,600
Lettuce, strawberry	4	109	1.5	1.5	36	54	3,800	5,800	7,600
Muskmelon	5	87	1.5	1.5	36	54	3,100	4,700	6,200
Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato	6	73	1.5	1.5	36	54	2,600	3,900	5,200
Pumpkin (vining), watermelon	8	55	1.5	1.5	36	54	1,900	3,000	3,900

Chapter 4. Integrated Pest Management¹

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Disease Management

The health of vegetable crops is best maintained through management practices that integrate different techniques. When making management decisions, it is important to consider the economics of the crop, the cost of the management practice, the history of the production area, weather and climatic conditions, and the potential risk for a disease to develop. Integrated management strategies are more likely to successfully control diseases than nonintegrated ones because they reduce disease risk through multiple techniques, often before infection begins. Nonintegrated strategies can also adequately manage a disease; however, producers must limit expectations about the probability that they will see significant economic return from a crop. Ultimately, integrated management strategies provide a means for producers to reduce the risk that they will have significant economic losses from disease.

Economics

Often, the top priority of any producer is the economic benefit they will see from the application of a specific management strategy (e.g., fungicide application). These benefits will depend upon the market price of the crop as well as the cost of the specific management strategy. Typical costs include the price of a cultivar, labor, machinery, fuel, and various consumables used in an integrated disease management strategy. All these costs are variable, and it is up to the producer to assess the inputs required for managing specific diseases so they can calculate the economic returns from their decisions, if any.

Disease Identification

Proper management of any plant disease starts with an accurate identification of the pathogen or pest causing the problem. Many different types of pathogens (i.e., fungi, bacteria, viruses, and nematodes) are involved in diseases of vegetable crops, which can require very different management strategies. To assess which management strategy is most appropriate, there needs to be information about the pathogen present in a field. This information can be gained by assessing the crop either yourself or with the aid of a professional. Many guides and applications are available for disease identification; however, proper

identification often requires the use of a microscope to identify key structures or the use of a more complex test (e.g., DNA/RNA-based and serological). Many printed and electronic resources (e.g., Ask IFAS/EDIS, UF/IFAS Extension) are available for disease identification, but if a producer is unsure about how to identify a disease, they should contact their local UF/IFAS Extension office or nearest UF/IFAS Plant Diagnostic Clinic for help.

Disease Risk

Once a pathogen has been identified, monitoring the disease is critical for collecting the information needed to make an effective management decision. The distribution of a disease within a field can inform a producer about where and when the disease may be a problem. Monitoring is also critical to determine the risk of a producer's crop experiencing significant economic impacts from a disease. For example, if a disease is affecting only 5% of a production area, it is likely that a combination of multiple low-cost strategies will effectively manage the disease. However, if a disease is causing a problem in 50% or more of the field, then different management strategies will likely be needed to adequately reduce its impact.

Many integrated management methods are available for disease control, and many of these methods are often chosen even before the crop is planted. Three important preplant tools are site determination and preparation, crop rotation, and cultivar selection. Site determination and crop rotation are two excellent methods for reducing a pathogen population within a specific site. For example, fields with a history of a disease are more likely to have that disease again, especially if it has been continuously planted with susceptible host plants. Removal of debris through tillage or the planting of a nonhost plant can limit the pathogens present and thus reduce a disease's overall impact. Cultivar selection is also critical for determining how likely a disease is to continue developing and spreading within a field. Resistant cultivars will most likely require less inputs than susceptible cultivars after disease establishment.

Multiple postplant management options are also available to producers. These include, but are not limited to, weed control, irrigation management, nutrient management, soil amendments, sanitation practices, and canopy regulations (e.g., staked tomatoes). These management options are aimed at reducing plant stresses and limiting mechanical movement of the pathogen within a field site. For instance, weeds can serve as alternate hosts for a pathogen and can stress plants by competing for essential nutrients such as calcium. Stressed plants are more prone to pathogen infections, and alternate weed hosts create local inoculum sources that can cause problems under the right environmental conditions. These management strategies provide better results when used as prevention methods, and they are even more useful when combined with preplant methods.

Inoculum is the pathogen propagule that can cause infection in vegetable crops. The amount of inoculum present is critical to the development and spread of disease. Monitoring provides producers with an initial assessment of the pathogen's inoculum; however, the production of further inoculum is highly dependent on the environment. Environmental conditions that are conducive to pathogen development vary, but with proper identification, one can assess the risk of continued inoculum production. Many disease models and decision support systems (e.g., for strawberry) are available to evaluate disease risk based on environmental conditions. When determining the risk of further disease development, it is important to consider the environment and the likelihood that disease will continue to develop. Biological and chemical products are an important component of many disease management programs. These products provide postinfection management options; however, they should be integrated with all other techniques mentioned in this chapter. The efficacy of these products will vary depending on the timing of the application and the physical mode of action of the product. Often these products will be more efficacious when applied early in a disease epidemic, before the pathogen has produced significant amounts of inoculum. All of these products should be used following recommended rates and application frequencies, and within all labeled requirements. It is important to consider the cost of these products and what average yield savings will equal the cost of a product application. In general, product application is most costly when there is no disease present or when a product does not affect the disease afflicting the crop. However, preventative applications can be beneficial, particularly when the disease risk is high. Thus, proper disease assessment is critical for any management strategy.

The following are three key factors for successful integrated pest management:

- **Economics:** Successful programs are not only effective but also cost-effective.
- **Diagnosis:** Proper disease identification is a critical first step to determining proper management.
- **Disease risk:** Management strategies will be more effective in high-risk situations.

Summary

Successful disease management starts with assessing the economics of the cropping system and understanding the disease risk. Diagnosis of the disease is the first step in any management plan because it can affect the techniques that can be used in the current growing season as well as in the future. Many pre- and postplanting management techniques that can be used to reduce disease risk are available to producers. Ultimately, integrated plant disease management strategies provide producers with the tools to obtain acceptable yields with adequate economic returns that are more sustainable than the results achievable with a single management method. For a more detailed resource, consult “Integrated Disease Management for Vegetable Crops in Florida” (<https://doi.org/10.32473/edis-pp111-2012>).

Pest Management

The management and control of insect and mite pests can be challenging even under optimum conditions. Integrated pest management (IPM) is a useful approach for protecting vegetables from multiple pests. It involves integration of cultural, physical, biological, and chemical methods to maximize productivity in a way that is ecologically sound and safe. Often, but not always, it means limiting the use of broad-spectrum insecticides and miticides. IPM implies management of all crop pests, including insects, mites, diseases, nematodes, and weeds; however, only insects and mites will be considered here. Where possible, the effects of measures to control diseases and weeds should enhance or, at least, not interfere with the management of insects and mites.

Many of the general IPM principles and tactics that apply to the control of plant diseases apply to the management of insects and mites. These include regular scouting or monitoring for problems, identifying pests and their life stages, keeping good records of pest management practices, using exclusion techniques, practicing good sanitation, testing soil or plants for nutrients, using biological control agents when possible, and timely application of selective pesticides when needed.

Crop Scouting and Monitoring

To detect pests and the damage they cause before a problem becomes serious, growers must visually inspect plants once or twice a week. As a first step, growers should observe the overall plant, looking for speckling or bronzing on leaves; the presence of sucking pests such as whiteflies, aphids, thrips, or mites; holes and other damage caused by chewing insects; distorted growth; and fruit damage. The next step is to carefully inspect all plant parts from ground- or stem-level up to the growing tip. Some insects will feed on roots, others on stems, leaves, flower blossoms, and fruit. The grower must become proficient at quickly examining these plant parts and recognizing the presence of pests and the damage they cause. Workers engaged in cultural practices should be trained to recognize insects and the damage they cause.

Both the upper and lower leaf surfaces must be thoroughly inspected. Many insects, as well as some diseases, begin their infestation or infection from the lower side of the leaf. Many insects and mites only feed on the underside of the leaf and may never move to the upper leaf surface or other plant parts until populations become so great that overcrowding forces movement. Attention should be given to the midrib area under the leaf and along large, lateral, lower-leaf veins. The leaf axils, growing tips, and terminal buds should be carefully inspected. Often, weeds serve as hosts for insects, mites, and diseases that can move to vegetable crops, and they should be removed (see section on sanitation).

Some insects, particularly thrips, will be found within the blossoms, so these should be included in the inspection. You can gently tap the blossoms over a white pan or card to see these tiny insects. The area under the calyx or stem end of tomatoes and cucumbers can also be an attractive hiding place for insects. Generally, insects inhabit secluded areas of the plant that provide protection.

Yellow, or blue (for thrips), sticky traps are useful for monitoring the adult (flying) stages of many insects. Traps are usually placed vertically at or just above the plant canopy. Some insects, such as thrips and leafminers, can be caught just above the surface of the growing medium. One recommendation is to use one to three cards per 1000 sq ft. Traps should be inspected weekly and replaced regularly. A system of numbered traps can facilitate sampling and simplify recordkeeping. Yellow sticky tape can be used on a larger scale to reduce insect populations by trapping and are available from many online distributors.

Many of the arthropod pests that infest vegetable crops are very small. Mites are 1/50–1/60 of an inch long. Thrips, aphids, whitefly crawlers, and the eggs of other harmful insects are not much larger. Growers should have at least a 10x hand lens (jeweler's hand lens), but a 16x–20x lens is preferred. With a hand lens, a grower can quickly identify

many of the arthropod pests that are otherwise difficult to see. If possible, growers should buy and learn to use a common dissecting microscope. These microscopes can be purchased either as a monocular (one-barrel) or binocular (two-barrel) type. They have approximately 10x–200x magnification. With a microscope, a grower can clearly see small mites, such as broad mites, and disease lesions. This tool can be very helpful in detecting and diagnosing problems early.

Identification of Insects and Mites

Proper identification of insects and mites and the damage they cause is critical. If the grower knows exactly which pests are present, proper chemical or biological controls can be implemented, and steps can be taken to exclude or limit further introductions and spread. In Florida, UF/IFAS Extension offices in each county can help with pest identification (to find an office near you, visit <https://sfyl.ifas.ufl.edu/find-your-local-office/>). The Florida Department of Agriculture and Consumer Services also provides a free insect identification service. Workshops may be offered on pest scouting and identification, and many publications and online resources are available (see <https://ipm.ifas.ufl.edu>).

Recordkeeping

Good records can help growers see trends in pest infestations, keep track of the success or failure of control efforts, and determine how the environment affected the crop. Of course, pesticide application records are essential and should include the product name, EPA registration number, active ingredient, amount used, target pest, effectiveness, and the time and date of application. Some variables that general records should include are daily minimum and maximum temperatures, measurements of plant growth and development, the pH of the growing medium, soluble salts, general root health, and other specific crop observations. Insect counts from monitored plants and sticky cards are also useful for identifying trends over time and for determining the effectiveness of control efforts. Over several seasons, it may be possible to see that certain problems occur at the same time each year. Details of releases of beneficial insects and mites should be recorded.

Management Strategies and Tactics

Exclusion

Growers need to make every effort from the beginning of a crop until the final harvest to prevent the introduction of insect and mite pests into the vegetable crop. Highly reflective or metalized plastic mulches have been used in agriculture for many purposes, but the primary use has been to repel certain insects such as thrips, psyllids, or whiteflies. Metalized mulches are effectively used in crop production by covering the narrow raised beds in a full-bed polyethylene mulch production system.

Sanitation

Sanitation should be practiced for managing insects and mites, as well as diseases that can use weeds and plant debris as temporary hosts. The following practices are strongly recommended:

- Burning, burying, or hauling away all leftover roots and other plant parts so that there is no chance that insects in the egg, larval, nymphal, pupal, or adult stages could remain in the greenhouse. Crop residues must be removed immediately after the final harvest.
- Sanitation must be practiced not only during preplant times but also throughout the growing period. Workers should immediately dispose of plant parts generated by pruning, such as leaves and stems. Culls (undesirable) or overripe fruit should be removed from the greenhouse and surrounding areas. Insects are often attracted to and can live for long periods on these plant materials.
- Weeds should not be allowed to grow around or within the greenhouse. A 10 to 30 ft vegetation-free zone around the greenhouse can be created with a heavy-duty geotextile weed barrier material typically used in the container nursery industry as a groundcover.
- A clean transplant program will aid in keeping pests out. Plants coming from other locations should be carefully inspected for insects, mites, and diseases and temporarily quarantined until ensured that the plants are free of pests. Workers should avoid wearing yellow clothing because it is highly attractive to insects, which may hitch rides into the greenhouse or from one greenhouse to another.

Biological Control

Biological control involves insect or mite predators, parasitoids (specialized parasites that ultimately kill their hosts), nematodes, or disease-causing organisms (fungi, bacteria, and viruses) that attack insect and mite pests. Some biological control agents are incompatible with insecticides. Therefore, it is important to check for the toxicity of the applied insecticides to the main predators and parasitoids associated with the pests. Elimination of natural enemies through insecticide application can result in secondary pest infestation (e.g., elimination of predatory mites with a pyrethroid application can lead to a spider mite outbreak). Reducing or eliminating chemical pesticides leads to a safer working environment, can reduce production costs, and, in the case of organic production, can result in premium prices for the crop. Biological control, however, is much more management-intensive than conventional insecticides and miticides; it requires a greater knowledge of pest biology and pest numbers. Many factors contribute to the success or failure of biological control: type and quality of the natural enemy selected, release rates, timing, placement, temperature and

humidity, and the previous use of insecticides and miticides.

Suppliers can provide technical advice on the optimum use of their products. Some have detailed websites. In general, releases must be made when or before the pest population is first detected. High pest populations will be difficult to control biologically. Some predators and parasitoids are better adapted to particular temperature and humidity conditions than others, and some do better on some crops than others. The lifespan of the parasitoid or predator will determine how often it has to be reintroduced. It is important to note that if all the pests are eliminated, the natural enemies will also be eliminated. Providing nectar sources (flowering plants) may prolong the life of parasitoid wasps. Yellow sticky cards may have to be temporarily removed to avoid trapping predators and parasitoids.

Insecticides and Miticides

Even when a good biological control program has been established, there may be times when a conventional insecticide or miticide is needed. Biorational insecticides, such as insecticidal soaps, oils, neem products, and *Bacillus thuringiensis* (Bt) can be much less harmful to beneficial insects, although active against pest species. Systemic insecticides, insect growth regulators (IGRs), repellents (essential oils or nano clays), and pheromones used for mating disruption also fall into this category. Some products are harmful to some stages of some beneficial insects and not others. Oils, for example, are toxic to lacewing eggs and adult parasitoid wasps, but they have relatively little effect on adult lady beetles and lacewings. Soaps are toxic to young lady beetle larvae. Neem and Bt products are generally safe for use with natural enemies. Other advantages of biorational insecticides are shorter reentry intervals and greater worker safety.

Conventional insecticides and miticides also have a place in IPM if biological controls and biorational insecticides do not offer sufficient control. However, these options are limited to only a few registered pesticides and applications. The development of resistance to insecticides is more likely if a product is used repeatedly. Therefore, pesticides with different modes of action should be used in a sequence that will help prevent resistance.

The following steps are suggested when using any pesticide:

Step 1: Choose the right insecticide or miticide.

Only after the grower has properly identified the pest can the best insecticide or miticide be selected. Insecticides and miticides are sometimes effective against one pest but useless against other closely related pests. Also, one pesticide may be effective against a specific developmental stage, while others may be effective against a different stage, or even against all developmental stages. For

instance, growth regulators such as Pyriproxyfen are only active against immature stages, not adults. Properly identifying the pest and understanding its biology and life cycle allow the grower to make wiser decisions when choosing an insecticide or miticide. Growers should consult UF/IFAS Extension resources, pesticide companies and dealers, published literature, and, ultimately, the pesticide label for helpful information.

Step 2: Use the correct amount of pesticide.

After choosing the pesticide, the grower must carefully read the label to determine the correct amount to use. Sometimes this decision will be based on the size or stage of the pest and whether the population is high or low. For example, small caterpillars may require the lowest recommended label rate, while large ones may require the highest.

It is critical that the quantity of pesticide be accurate; growers should buy a set of graduated cylinders that are marked in ounces (oz) and milliliters (cc or mL), as well as a set of good-quality measuring cups. Plastic syringes (minus the needles) are very useful for measuring thick liquids, such as suspension concentrate (SC) formulations. These are available in several sizes from suppliers of animal feed. A scale is essential for weighing dry flowables, wettable granules, and other dry formulations. Measuring devices, such as graduated cylinders, should have pouring lips and graduated markings that enable accurate measurements. Plastic is generally safer than glass. Accurate measurement is essential for efficacy against the target pest, a safe range of pesticide residues on the crop, efficient use of chemicals and money, and the reduction or elimination of phytotoxicity (burning).

Proper measuring devices also play an important role in the overall safety and handling of pesticides. They help prevent spills of concentrated materials. Pesticide concentrates are usually handled when the sprayer is loaded and diluted sprays are being prepared. Special handling precautions are necessary at this time. The applicator must be particularly careful in handling finished sprays but even more so in dealing with the more dangerous concentrated material. Workers must be mindful and cautious and use all pesticides according to the label.

If applicators use too much pesticide, the following problems can result:

- The crop can have more residue than the law allows, which can pose health hazards to consumers and could prevent the crop from entering the market until it has undergone special cleaning.
- The crop can be confiscated by authorities for excessive residues and destroyed without any compensation to the grower. The resulting negative

publicity can harm future markets for that commodity.

- Reentry by workers into overdosed areas could be dangerous and lead to illnesses, medical costs, and liability to the grower.
- Production costs could increase without the benefit of added profits.
- Phytotoxicity is more likely to occur.
- Populations of beneficial arthropods may decrease.

It is important not to exceed the label rates. If the maximum labeled rate is not achieving the desired results, look for other reasons for failure, such as poor coverage or resistance to the insecticide in the target insect population.

Step 3: Apply pesticides at the right time.

The chosen pesticide should be applied at the correct time. This is one of the most difficult tasks any grower faces. Determining the best time to apply chemical control is a very dynamic undertaking. Failure to treat at or near the correct time is one of the major reasons for unsuccessful pest management.

- Growers should regularly and thoroughly inspect the crop so that they are aware of the presence of insects and mites as well as any increase in numbers.
- Growers should know the pest, its behavior, and its ability to damage the crop.
- Growers should be aware of the number of insects or mites that constitute an economic or action threshold. Thresholds for each pest where information is available are discussed later in this chapter.
- Growers should know the biology of the pest so that insecticide or miticide application can be aimed at the weakest, most vulnerable stage or size. Some stages of insects and mites, such as the egg stage, can seldom be controlled. Young larval or nymphal stages are more easily controlled and require less insecticide or miticide than older stages. Pesticides generally do not affect pupae (large larvae nearing this stage are also difficult to control).

It is generally best to apply pesticides in the late afternoon or evening hours when temperatures start to decrease. (As a rule, insecticide or miticide applications should be made while temperatures are low.) This also allows for maximum exposure before “airing” out the sprayed area for employees. Also, many insects are most active at night. The risk of phytotoxicity is greater when applications are made during the middle of the day when temperatures are high. However, it has been reported that better mite control can be achieved by spraying early in the morning hours. Pesticides should not be applied when plants are water-stressed.

Step 4: Apply pesticides correctly.

There are many factors and components that add up to proper application of pesticides.

Timing is one of the most important steps in pest control efforts. It does little good to complete the first three steps properly and then fail to deliver the material to the target area at the proper time. Spray equipment must be properly calibrated. A calibration mistake can result in applying too little pesticide and not achieving control, or applying too much, which is wasteful and illegal.

Growers should purchase the proper type of equipment to meet the needs of the operation and use equipment designed for the target pest. Each pest differs in habits and behavior, and a single piece of equipment may not meet all needs.

High-volume sprayers are popular and have been used for years. They can accommodate a wide range of pesticide types and offer flexibility in their operation. However, high-volume sprayers require a lot of labor, are time-consuming to use, and are considered low in application efficiency. It has been estimated that less than 10% of the active ingredient reaches the actual target when using high-volume systems. However, most insecticides and miticides are labeled for high-volume application.

For best results, knowledge about the pest and its biology should be coupled with the capabilities of the equipment. To reach the bottom sides of the leaves in thick canopy crops, a driving, directed spray may be required. If the crop canopy is thin, a rolling fog, atomizer, or electrostatic applicator may be very effective. Many insecticides can produce vapors that aid in controlling insects even when the coverage is less than desired. However, proper coverage can further enhance their fumigating properties.

Another consideration when correctly applying insecticides and miticides is the proper maintenance of spray equipment. Many spray operations are hampered, and their effectiveness drastically reduced because the spray cannot be delivered at the proper pressure, droplet size, or pattern due to excessive wear, improper adjustment, or broken or improperly working parts. Growers should regularly check nozzles and discs for wear and tear and replace them when they do not meet specifications. Discs and nozzles wear fast when flowables, suspensions, and wettable powder formulations are used. Workers should be aware of spray pressure and have accurate gauges. Inaccurate pressure—even small errors—can result in improper droplet size and failure to deliver the desired coverage. Equipment upkeep also factors heavily in the overall success of spray operations. Most insecticides are highly corrosive and will react with hoses, lines, nozzles, tanks, and other components. The resulting corrosion affects the spray patterns and leads to the formation of foreign particles that clog the equipment.

Applicators should use the spray as soon as it is mixed and thoroughly clean and rinse the equipment as soon as they are finished spraying.

Workers must mix only the spray that is needed for the job. Leftover spray allowed to sit in the sprayer can quickly destroy it and other sprayer parts, lines, and components. Leftover spray also must be carefully and legally disposed of by application to a labeled site. Disposal of pesticides is a growing concern, with liability becoming more of a problem. Therefore, growers need to plan carefully for the amount of pesticide they need, use what is mixed, and clean up properly afterward.

Spray equipment must be properly stored after cleaning to keep it free of dust, dirt, and other foreign materials. Rust particles, pieces of rubber lines, and other unwanted particles can quickly stop up a system or cause poor spray patterns, particularly when pressure is applied.

Clean water should be used for spraying. Water is the most commonly used diluent (carrier) for pesticide sprays. Water frequently contains dirt, sand, or corrosion from the pipes or lines that may enter the spray tank. Loading hoses or pipes can be dirty. These contaminants can cause severe operational problems. Growers should filter water as many times as possible to ensure freedom from contamination. Filters should be used between the source of water, the spray tank, and where the water enters the tank. Filters are also needed between the tank and the final nozzle. This allows the spray to flow and be delivered in the pattern needed to meet the capabilities of the equipment.

Pesticides should be used as soon as they are mixed. Once mixed with water, the pesticide begins to change. The effective life of certain pesticides can be only hours once they are mixed with water. Water with a pH over 7.0, which is neutral, can be particularly detrimental to many pesticides. Generally, the higher the pH, the faster the pesticide is broken down and rendered useless. Under Florida conditions, where underground water is frequently high in calcium carbonate with a pH of 8.0–8.5, it is even more important not to allow finished spray to sit any longer than necessary.

Weed Management

Weeds compete with vegetable crops for light, water, and nutrients. This competition decreases plant vigor, yield, and crop quality. It also interferes with hand harvesting and can complicate or prevent machine harvesting. Weeds also serve as alternative hosts for diseases, viruses, and nematodes. See Ask IFAS publication HS1335, “Weeds as Reservoirs of Plant Pathogens Affecting Economically Important Crops” (<https://ask.ifas.ufl.edu/hs1335>) for a list of plant pathogens and their weed hosts. There is also a range of books and Ask IFAS publications that can help

identify weeds in Florida, such as *Weeds of the South* and *Weeds of the Northeast*.

The first step in weed management is frequent and proper scouting. Fields should be scouted frequently early in the production year when the crop is more susceptible to competition. Keep in mind that weed populations tend to be patchy, are greater along the edges of fields, and will vary within and between fields due to minor changes in site characteristics, such as increased soil moisture or changes in soil type. Scouting should be completed in a zigzag pattern that covers the entire field area. Be sure to include locations with known differences that might lead to increased weed incidence, such as low-lying areas and areas with a history of weeds. All observations should be recorded in a field manual for future reference.

Proper identification and an understanding of the life cycle is important for selecting the correct method and timing of weed control. Weeds may be annuals, biennials, or perennials. Annual weeds emerge from seeds, grow, and flower within a single year. Summer annuals emerge in the spring and grow through the heat of the summer months. Summer annuals include pigweed, morning glory, crabgrass, pusley, and goosegrass. Winter annuals emerge during the fall and grow during the winter months. Biennial weeds emerge from seed and typically form rosettes but do not flower and produce seeds until after a dormancy period. Biennial weeds include wild carrot, cutleaf evening primrose, and common mullein. Perennial weeds can grow and produce flowers for multiple years. Perennial weeds produce vegetative structures, such as stolons, rhizomes, tubers, or large roots, that generate new plants. Perennial weeds include nutsedge, bermudagrass, Brazil pusley, and creeping beggarweed.

Weed management practices can be separated into five categories: preventative, cultural, mechanical, biological, and chemical. The most successful weed management programs will incorporate multiple weed control methods.

Preventative Control

The first step is site selection. Select a field with low weed populations and treat problem areas, such as poor drainage, prior to crop establishment. Control or mow the weeds at the edges of fields or irrigation furrows to prevent seed formation. Seeds can move on equipment, on wind, on animals, and in water, and they may spread throughout the field. Weed seed can also move between fields on tractors, blades of cultivators, heads of harvest equipment, and other items. All equipment should be cleaned after completing a task in a field with a high weed population. When possible, limit travel in the field to periods when weed seeds are not mature, and work your cleanest fields first and then move toward the ones with the greatest weed populations. Purchase crop and cover-crop seed from reputable sources to limit the amount of weed-seed contamination. When possible, prevention of

weed seed production will help reduce weed seedbanks over time and reduce future problems. Keep in mind that seeds can mature on a weed in some situations after it has been hand-pulled.

Cultural Control

A healthy crop competes more effectively against weeds. Use healthy transplants or seeds with excellent germination to ensure quick canopy closure when possible. Plants stressed by diseases/nematodes or improper watering (too wet or too dry) are less competitive. Proper nutrition is important; minimize fertilizer in the row middles, where crops will not benefit but weeds will. Select the proper row spacing that will allow for quicker canopy closure.

Crop and variety selection impact weed growth. Crops that are tall or have large leaves shade the soil surface and prevent weed seed germination. Crops such as cabbage, beans, and corn are very competitive crops. Onions and carrots allow more light to the soil surface and are less competitive. The same principle of light penetration to the soil surface can be applied to crop varieties: a variety that is compact or smaller in growth will be less competitive compared to other varieties.

Multiple vegetable crops are grown with polyethylene mulch. The horticultural benefits of plasticulture are reduced water loss, improved nutrient management, and increased fumigant retention. Plastic mulches also prevent light penetration to the soil surface and inhibit weed seed germination. Weeds can germinate under clear or white plastic mulches that allow light to reach the soil surface. If white mulch is desired, select one that has a black underside to prevent light penetration. When plastic mulches are used, grass and broadleaf weed emergence is limited to the crop hole and row middle. Minimizing the size of the planting hole can reduce the number of weeds that emerge. Yellow and purple nutsedge are the only species that pierce the plastic mulch and can rapidly spread within a mulched bed.

Crop rotation is an effective weed management tool. Growing the same crop repeatedly with the same weed management practices can select for difficult-to-control weed species as well as other pests and diseases. Properly designed rotations typically include a range of (1) crop types, preferably with a mix of row and agronomic crops; (2) planting dates; (3) agrochemical inputs; and (4) weed management tools. Choose a rotation based on crop competitiveness, use of mulch or cultivation, and different herbicide modes of action. The inclusion of cover crops can be an effective weed management tool. Care must be taken to observe plant-back restrictions for herbicides, or injury may occur in subsequent crops.

Cover crops should be included in any crop rotation. Cover crops shade the soil surface and prevent weed

germination. Some cover crops such as rye have allelopathic compounds, which are plant chemicals that prevent seed germination. Additional information can be found under the Ask IFAS “Cover Crops” topic (https://ask.ifas.ufl.edu/topics/cover_crops).

Mechanical Control

Mechanical weed control includes plows, cultivators, mowers, hoes, and hand-weeding. Chisel and moldboard plows are used at the beginning of the season and cultivate deep into the soil profile. This process buries weed seeds below the germination zone. Light cultivation with a field cultivator controls small weeds by cutting them and is shallow to prevent weed seeds from being brought to the soil surface. A single cultivation provides excellent control of annual weeds; however, cultivation may break apart pieces of perennial weeds and cause the weed to spread. Repeated cultivation is important for perennial weed control because it encourages repeated growth and can reduce the carbohydrates in the storage structure of the weed, which can reduce the population over time.

Basket, tine, or finger cultivators lightly disturb the soil surface and control small weeds by breaking roots or foliage. Basket cultivators will provide control in the row middles; however, weed control in the crop row will be minimal. Tine or finger cultivators may provide better weed control in the crop row.

Use mechanical weed control only when it is most effective, as it can degrade soil structure, dry out the soil surface, and prune crop roots.

Biological Control

Biological control relies on the use of one or more biological agents to damage a weed species. This method uses plant pathogens, insects, or other animals. Several control agents are host-specific, controlling certain weed species (e.g., tropical soda apple leaf beetle and tropical soda apple, Pakistani hydrilla tuber weevil and hydrilla). Because these organisms have narrow feeding habits, this method is typically used in natural and aquatic areas for a single invasive species. Biological control is not used in vegetable production due to the multiple weed species in the field; however, research is being conducted, and new techniques may emerge in the future.

Chemical Control

Proper herbicide selection can be an effective weed control tool. Herbicides are classified by their mode of action, which is how they affect plant growth. Herbicides are separated by application placement, selectivity, and translocation.

Application placement includes foliar-applied or soil-applied herbicides. Foliar-applied herbicides control the weeds after emergence above the soil surface

(postemergence). Proper coverage of the foliage is important for foliar-applied herbicides, and a surfactant is often required for proper absorption of the herbicide. Soil-applied herbicides control the weeds before emergence above the soil surface (preemergence). Soil-applied herbicides are applied to the soil surface or require incorporation into the soil surface. Incorporation reduces vaporization of certain herbicides or places the herbicide closer to the weed seed. Incorporation tactics include irrigation, rainfall, or light cultivation. Poor incorporation will result in reduced efficacy.

Herbicide selectivity results in control of a specific type of weed, such as broadleaf or grass weeds only. Auxin herbicides (2,4-D, clopyralid) control broadleaf weeds only and thus are commonly used in grass crops or turfgrass. Carfentrazone and certain sulfonylureas have excellent control of broadleaf weeds and cause low to no injury to grass crops. Grass-only herbicides (clethodim, sethoxydim, fluazifop) control only grass weeds and can be applied over the top of broadleaf weeds.

Herbicides can be grouped as translocating or contact herbicides. Translocating herbicides (glyphosate, halosulfuron) move from the contact point to another part of the plant. This is important when controlling perennial weeds, which require root death for complete control. Contact herbicides (carfentrazone, paraquat) kill the area around the contact point; complete coverage is important for these herbicides.

Herbicide-resistant weed species have become more problematic. Paraquat-resistant American black nightshade, paraquat-resistant goosegrass, and glyphosate-resistant Palmer amaranth have been documented or observed in Florida vegetable crops. To prevent resistance, growers should incorporate nonchemical methods, rotate modes of action, use products with multiple modes of action, use correct rates, and maintain constant monitoring.

Nematode Management

Plant-parasitic nematodes are some of the most difficult pests or pathogens that growers in Florida face. They are hard to recognize, are often confused with other biotic or abiotic problems, and can cause total crop loss in many fruits and vegetables. This is especially true in Florida's warm and sandy soils, where nematodes, such as root-knot (*Meloidogyne* spp.) and sting (*Belonolaimus longicaudatus*), can build up rapidly to high, damaging levels.

Life Cycle

Plant-feeding nematodes go through six stages—an egg stage, four immature stages, and an adult stage. Many species can develop from egg to egg-laying adult in as little as 21–28 days during warm summer months. Immature males and females and adult males are long, slender

worms. Mature adult females of some species, such as the root-knot nematode, change to a swollen, pear-like shape, whereas females of other species, such as the sting nematode, remain slender worms. Nematodes are too small to be seen without a microscope. It is believed the root-knot nematode survives from season to season primarily as eggs in the soil. After the eggs hatch, the second-stage juveniles invade roots, usually at root tips, causing some of the root cells to enlarge where the nematodes feed and develop. The male nematodes eventually leave the roots, but the females remain embedded, laying their eggs into a jellylike mass that extends through the root surface and into the soil.

Damage

Root-knot nematodes usually cause distinctive swellings, called galls, on the roots of infected plants. Infestations of these nematodes are easy to identify. Dig up a few plants with symptoms, wash or gently tap the soil from the roots, and examine the roots for galls. Gall size can vary significantly and depends on the crop and nematode species. On cucurbits and tomato, they can grow as large as 1 inch in diameter; on pepper, eggplant, and strawberry, they are always much smaller. On the roots of grasses and certain legumes, root-knot nematodes can reproduce without causing galling. The formation of these root galls reduces uptake of water and nutrients. Also, galls can crack and facilitate the entry of soilborne pathogens. Root-knot nematode galls are true swellings and cannot be rubbed off the roots as can the beneficial, nitrogen-fixing nodules on the roots of legumes. On *Brassica* crops like cabbage and clubroot, a soilborne disease can also cause gall formation and distortion on roots and can be confused with root-knot nematode damage. Aboveground symptoms of a root-knot nematode infestation include stunted plants, wilting during the hottest part of the day (even when soil is moist), loss of vigor, yellowing leaves, and other symptoms similar to those associated with a lack of water or nutrients. Infested vegetable plants grow more slowly than neighboring, healthy plants, beginning in early to midseason. Plants produce fewer and smaller leaves and fruits, and those heavily infested early in the season can die. Damage is most serious in warm, irrigated, sandy soils. Symptoms are often wrongly attributed to lack of fertilizer or water, soil insect or disease damage, or plugged drip tapes. In fumigated fields, nematode symptoms often show up at the bed ends when the fumigant rig was pulled up too early or inserted too late.

Root injury from other nematode species can produce aboveground symptoms like those from root-knot nematodes. However, the actual injury to the roots is more difficult to detect. Roots can be short and stubby-looking and have slightly swollen root tips, as can be the case with sting nematodes, or show dark spots or necrosis, which can be caused by lesion nematodes (as well as certain soil pathogens). In all such cases, nematode infestation should

be confirmed by collecting soil and root samples and sending the material to a laboratory for positive identification.

Nematicides

Nematicides can be separated into fumigant and nonfumigant nematicides. Fumigants will be discussed in the next section of this chapter. Until recently, nonfumigant nematicides were either organophosphate or carbamate insecticides/nematicides, such as ethoprophos (Mocap), terbufos (Counter), and oxamyl (Vydate). Other similar nematicides, like fenamiphos (Nemacur) and aldicarb (Temik), are no longer registered due to their generally high toxicity and environmental risk. Recently, some new products—fluensulfone (Nimitz), fluopyram (Velum), and fluazaindoline (Salibro)—have become available. These new nematicides are less toxic than the older nematicides, having a caution label instead of a danger label. They also more specifically target nematodes and should not be considered fumigant replacements. Unlike fumigants, which will control all or most soilborne pests and diseases, nonfumigant nematicides will only or mostly target nematodes, and additional measures need to be taken to manage soilborne diseases and weeds. Biological nematicide options include live organisms like *Purpureocillium lilicanum*, bacterial fermentation products from *Burkholderia rinojensis*, and several plant extracts (see chapter 19, “[Biopesticides and Alternative Disease and Pest Management Products](#)”).

Whereas fumigants need to be applied several weeks before planting, nonfumigant nematicides are typically applied shortly before or at planting of the crop. In-crop (postplant) applications are allowed for Vydate, Velum, Salibro, and most of the biological nematicides (see chapter 19).

Crop destruction practices and using end-of-season nematicides or fumigants can also help to reduce nematode levels. Plant-feeding nematode populations in annual crops are always low at the start of the season because nematodes are dormant and often hiding in deeper soil layers, waiting for new roots to feed on. Populations will gradually increase during the cropping season and tend to be at their highest at the end of the crop.

Applying a nematicide at that time would likely kill nematodes at the peak of their population: while they are still active and feeding and are thus more exposed. Nematodes are much more difficult to target during the off-season, especially in the middle of summer in Florida, when they tend to move deeper into the soil waiting for the next crop to be planted. In such cases, deep injection of fumigants (about 18 in. deep) can be done to target nematodes hiding in deeper soil layers, making a big difference, especially in heavily infested fields (see Fumigant section).

Other Nematode Management Options

Ideally, nematode management should adopt a year-round approach, from seedling production, through field preparation and while growing the crop, to off-season nematode management. Nematodes usually are introduced into new areas with infested soil or plants. The first approach is to prevent nematodes from entering the field by using only nematode-free plants. To prevent the spread of nematodes, avoid moving plants and soil from infested parts of the field. Do not allow irrigation water from around infested plants to run off because this also spreads nematodes. Nematodes can also be present in soil attached to farm equipment, tires, and boots.

Field preparation in Florida often includes soil fumigation. It can also include compost, manure, or other organic amendment applications. These may not directly kill nematodes but will stimulate soil biology and may increase nematode predators, parasites, and antagonists. Organic amendments also will increase the water- and nutrient-holding capacity of the soil, especially in sandy soils. Because nematodes will cause more damage to water-stressed plants, this can lessen the effects of nematode injury without reducing levels of damaging nematodes. During the growing season, biostimulants, compost teas, and other organic materials can be applied as well and may help for the same reasons.

For certain crops, such as tomato, cultivars resistant to root-knot nematodes are available, and they have been shown to provide good protection against most root-knot nematode species in Florida. Although resistant tomato varieties can still exhibit some root galling under high nematode levels, they usually maintain their yield. An additional benefit of growing a resistant variety is that the nematode levels in the soil decline rather than increase, making it more feasible to grow a susceptible crop the following season, that is, a double crop.

Growing a crop on which the nematode cannot reproduce is a good way to help manage some nematodes. Unfortunately, rotation is not as easy for managing root-knot and sting nematodes because so many vegetable crops and weeds are hosts for these nematodes. However, if a rotation schedule can be found, rotation in combination with fallowing and other available practices can reduce root-knot nematode numbers. Annual crops that are useful in a rotation plan for reducing root-knot nematode populations include small grains and resistant tomato varieties. Fallowing is the practice of leaving the soil bare; it tends to be more effective when the soil is kept moist, which induces nematode eggs to hatch and emerging nematodes to starve because there is no food source. It is also important to control weeds on which nematodes can survive during the fallow period. During the off-season, frequent tillage can also reduce nematode populations by bringing nematodes to the surface and exposing them to the sun. Solarization, covering the soil with clear plastic for

four to six weeks, is another method that can be used, although nematode control tends to be limited to the upper soil layers.

Cover crops are always a good tool to include in a nematode management plan. Cover crops can have multiple benefits, from soil improvement and weed suppression to disease and nematode control. Florida's climate allows for a wide range of cover crops to be planted. A common summer cover crop in Florida is sunn hemp (*Crotalaria juncea*), which not only fixes nitrogen in the soil but is also a poor host for many nematodes, including root-knot nematodes. (There are several Ask IFAS publications on cover crops and nematodes.) Certain plants, such as marigolds (*Tagetes* spp.), also have direct nematicidal properties and could be used in rotations or as intercrops.

Fumigation

Soil fumigation is a preplant chemical treatment of soil using a pesticide product (typically a liquid) that converts to a volatile gas once released into the soil. The gas can diffuse through open pore space throughout the soil to provide pest and disease control. All the fumigants are phytotoxic to plants, and the fumigant gases must dissipate from soil, usually taking from a few days to well over a month (depending on environmental conditions), before seeding or transplanting can occur without risk of crop injury. They are used globally on a wide range of annual and perennial crops and can be used alone or in combination to expand control of a wide range of soil-inhabiting pest species, including various insects, nematodes, fungi, and weeds. Because of their wide range of pesticidal activity, they are often called "multipurpose" or "broad-spectrum" fumigants.

In Florida, soil fumigants are most commonly used in high-value cropping systems to protect investment in crops where pest pressure is so high that it would be economically unfeasible to grow a crop without the use of a fumigant. As such, preplant soil fumigants have had a profound influence on production agriculture in Florida and have catalyzed the development of many high-value, raised-bed, and plasticulture cropping systems. Fumigants are also used in a variety of other lower-value fruit, vegetable, and agronomic crops such as potato, sweet corn, brassicas, melon, and other cucurbit crops to manage nematodes and other soilborne pests and diseases. In some cases, fumigants have been adopted almost to the exclusion of all other soil pest management strategies because of their superior broad-spectrum pest control efficacy and consistent enhancement of crop growth, uniform development, fruit quality, and yield.

Methods of Application

Fumigants are formulated and applied to soil in a number of different ways. Liquid fumigants can be applied either by directly injecting them into the soil using shanks or chisels or via direct injection into the irrigation system (drip fumigation). The portion of the field that is fumigated can also vary. For example, in the production of some crops, the entire field is treated, and this represents an overall or broadcast treatment. In other situations, fumigants are only applied in the plant row or raised plant bed. In this situation, only a portion of the field is treated; this is termed a strip, band, or in-row treatment. Most liquid fumigants with high vapor pressure are shanked or knifed into the soil. As liquids with relatively high vapor pressure, they are usually stored and applied as liquids (under pressure) and begin to vaporize shortly after injection in the soil. Narrow knifelike shanks are tractor-drawn through the soil at the required depth to inject the fumigant into soil. Metal delivery tubes attached to the trailing edges of the shanks provide the conduit for injection into soil. Delivery tubes release the fumigant in the bottom of the furrow made when pulling the shank through the soil. Fumigant flow rate to the soil shanks is regulated using various combinations of pressure, metering valves, nozzle orifices, shank spacing, and speed of travel. Errors in field application are typically attributed to mistakes in calculation of treated acreage, metering, and calibrated flow rates through properly sized delivery lines.

Metam sodium, metam potassium, allyl isothiocyanate, and emulsified concentrate formulations of 1,3-dichloropropene and chloropicrin can be metered and applied through a low-volume trickle or drip irrigation system. Drip fumigation (chemigation) is the most common method of application for some fumigants like metam sodium, metam potassium, or allyl isothiocyanate. Once these fumigants are applied to soil in the presence of water, they decompose to form MITC or AITC. Because of the slow and limited diffusion of MITC or AITC gases and high affinity for the water phase, continuous delivery in irrigation water following premixing has generally resulted in more uniform soil distribution with enhanced nematode control and crop yield for these products when compared with conventional chisel injection methods. MITC distribution in soil initially follows water distribution patterns, but unlike with other fumigants, these distribution patterns do not change over time. Moreover, MITC and AITC disappear from the soil gaseous phase at faster rates than most other fumigants.

The proximity of the plant to the drip tube has also been demonstrated to be very important in defining pest control efficacy and plant growth response with a drip-chemigated fumigant. Given the sandy nature of most Florida soils, narrower bed widths, two drip tubes per bed, drip tubes with closer drip emitter spacing (mostly in the range of 8–12 in.), and planting practices that place plants closer to

the drip tube are needed to more effectively utilize the drip tape for chemigation purposes.

Other formulations, like those marketed for shank applications of chloropicrin and 1,3-dichloropropene, are premixed and sold in compressed gas cylinders. In most cases, these fumigants are shank-injected into the soil 8–15 in. deep using a positive-pressure closed system in which the fumigant cylinders are pressurized with nitrogen. Nitrogen is an inert gas used to propel liquid flow from the cylinder through the metering systems and through armored lines to the rear shanks or chisels, exiting through a steel delivery tube welded to the back side of the shank or chisel. Deep placement is not only a requirement of the fumigant label but is essential for prolonged fumigant retention in soil. In general, the closer to the soil surface a fumigant is applied, the faster the outgassing or escape from soil, and in general the poorer the pest control response. A plastic polyethylene tarp may be laid down over the soil immediately behind the injection equipment to provide a diffusion barrier for containment of the fumigant.

In most field surveys, a dense, highly compacted zone (traffic pan) occurs just below the base of the raised bed (or the depth of the deepest tillage operation or implement used in the field). Studies have demonstrated the barrier properties of a traffic pan to shank-applied fumigants. Fumigant gases applied above the traffic pan do not provide control of nematodes occurring below the traffic pan. Studies in Florida have determined that high population densities of plant-parasitic nematodes can be broadly distributed to depths 3 ft below the plant bed surface. Subsequent studies have demonstrated the importance of deep shank fumigant applications, which destroy the traffic pan and place fumigants within deeper soil horizons, where upwardly mobile nematodes reside. The physical and practical challenge that remains to be resolved is how to achieve fumigant movement in lethal concentrations to the lowest soil depths where nematodes reside.

The Importance of Fumigant Placement

Proper fumigant placement is another critical element that must be considered when using any of the different soil fumigant compounds because of the large difference in vapor pressure (Table 1). In some instances, application depth and placement vary with the formulation of the fumigant product, giving the grower the opportunity to choose between a drip or shank application. For the 3-Way system approach that utilizes 1,3-dichloropropene, chloropicrin, and metam, there are essentially three different locations to consider for fumigant placement. Placement of pre-bed applications of Telone II are made on the flat to a soil depth that places the fumigant 12–15 in. from the top of the bed or nearest soil interface. If fumigants are placed at this depth and used in conjunction with a seepage irrigation system, growers should ensure

that the soil is not wet at this depth. Otherwise, poor nematode control and longer aeration times and crop plant-back intervals may be observed. Chloropicrin, applied over the top of the Telone treatment, is then applied 8–10 in. deep into soil as the beds are being formed and compressed. Metam sodium (Vapam) or metam potassium (K-Pam) should be applied 4 in. from the top of the bed and 4 in. apart using multiple coulters or shanks. After application, the bed must be recompressed and mulched immediately to prevent rapid escape of volatilizing gases. The primary objective for such shallow placement is to achieve maximum control of weeds. Most other fumigants should be placed 8–12 in. deep with shanks no further than 9–12 in. apart.

While methyl bromide rapidly diffuses as a gas across a bed, many of the currently proposed alternatives lack the vapor pressure or chemical properties to move as fast and effectively throughout the bed. Their movement in the bed is clearly limited and must be accounted for in fumigant placement. For example, if the shanks are not close enough together for some fumigants, an overlap in the area between shanks may not occur, leaving streaks of pests down the length of the bed. Many products are formulated for shank or drip applications. To maximize efficacy via drip application, proper placement of the fumigant generally mandates two drip tapes per bed to improve bed coverage.

The vertical and horizontal distribution of diseases, weeds, and nematodes in correlation with spatial movement of soil fumigants from their points of injection are now considered as some of the primary causes of fumigant treatment inconsistency and origins of bed-recolonizing populations of pests. For example, field research has demonstrated that additional streams of fumigant placed under the tuck areas of the plastic mulch at the bed shoulders result in a significant reduction of *Fusarium* wilt incidence and severity within the tomato planted row compared with the standard in-the-row grower application practice. Additional streams of fumigants deeply shanked below the mulch-covered plant bed and traffic pan have also demonstrated significant reductions in plant damage by nematodes and improvements to crop yield.

Physical and Chemical Properties

After application, the fumigants penetrate the soil and quickly become partitioned in liquid, gas, and adsorbed soil phases. Immediately after soil injection, fumigant movement in soil is driven by density and pressure gradients from a narrow, linear band of concentrated product deposited directly below the chisel path. As the fumigant's partial pressure falls, soil movement via mass flow becomes less important than simple gas diffusion processes. Fumigant persistence, volatility, and degradation are influenced by many factors, including chemical properties, soil properties, and environmental

conditions. A partial listing of some of the physical and chemical properties of the primary soil fumigants available in Florida is provided in Table 1.

Volatilization continues as long as the fumigant remains in soil, and upward movement of the fumigant occurs as long as a concentration difference exists between the soil surface and soil atmosphere. Vapor pressure is a measure of the tendency of a fumigant compound to change into the gaseous or vapor state. The temperature at which the vapor pressure at the surface of a liquid becomes equal to the pressure exerted by the surroundings is called the boiling point of the liquid. The lower the boiling point, the more volatile the fumigant compound. Note the differences between methyl bromide and all the other fumigants listed. Hot and dry soil conditions favor more rapid escape of fumigants like methyl bromide and chloropicrin, particularly within surface soil horizons. Fumigant products with high solubility and low vapor pressures are typically better suited for drip application rather than shank, which is why metam sodium, potassium, and allyl isothiocyanate are described as being better suited for drip fumigation.

Mode of Action and Lethal Dose

Fumigant mode of action refers to the lethal action of a chemical on vital life processes of an organism. For example, a broad-spectrum fumigant can penetrate the body wall of a nematode directly and does not have to be eaten to be effective. Once inside the body cavity of the nematode, different internal organs are affected because they are bathed by body fluids containing the fumigant compound. Metam sodium and potassium are very soluble compounds that become activated in water. The fumigants and their products interfere with many different vital processes, including enzymatic, nervous, and respiratory systems. Death of the nematode is rapid under these conditions, and development of tolerant or resistant populations of nematodes to the chemical is unlikely because so many integral bodily functions are affected simultaneously. This is not to say that all organisms are equally affected, because in fields with a history of repeated applications, metam sodium can disappear rapidly and fail to provide a lethal dose following application, indicating the key role of microorganisms in accelerated degradation of the product. In general, however, the fumigant concentrations within internal body fluids of nematodes frequently reach equilibrium with soil concentrations within about 30 minutes to 4 hours. In some cases, fumigant concentration may accumulate to much greater levels within the nematode than in soil.

In general, the lethal effect of a fumigant is determined by two components. The first is concentration (C) of the fumigant in soil air or soil solution, usually expressed as parts per million (PPM). The second is the length of time (T) the pest organism is exposed, expressed in minutes, hours, or days. The level of pest control is then related to

dosage, the amount of fumigant pesticide placed in the environment of the soilborne pest for a known length of exposure time (concentration $\times$ time). Total exposure is the sum of CT products. Computed in this way, the cumulative dosage, or concentration-time index (CT), is often used as a criterion with which to evaluate the effectiveness of soil fumigation. For most organisms, there is a concentration level below which kill is not obtained regardless of the length of exposure. For most nematodes, long exposures to low concentrations of fumigant nematicides above the minimum concentration seem to be more effective than short exposures to higher concentrations.

Fumigants move through soil air, dissolve in the soil water, and kill in the soil water. Fumigants are volatile substances that change into gases upon injection into the soil as liquids. The vapors can only move through continuous soil air space. Pest and disease organisms normally exist within surface films of water surrounding soil particle grains. Even as fumigants move through open air passages, fumigant molecules dissolve into these surface water films and establish a dynamic equilibrium, moving back and forth from the air to the water phase as the fumigant diffuses through the soil mass. The portion of the fumigant dissolved in the soil water establishes the concentrations responsible for the kill of most soilborne organisms.

In practice, fumigants are commonly injected through a series of uniformly spaced shanks into soil. As the liquid volatilizes, gases begin moving in mass flow, diffusing outward in all directions from the point of injection. Because diffusion is greater in air above the soil surface, upward mass flow and diffusion are usually greater than downward movement, and much of the gas may escape the soil and enter the atmosphere. As the fumigant front moves through soil, gaseous molecules are adsorbed onto soil particle surfaces, redissolve into soil solution, and fill empty air spaces between soil particles. Maximum fumigant concentration decreases, as do the sums of CT products, with distance from the point of injection. Eventually, with time and distance, concentrations fall below an immediate killing level. The number of pests or disease propagules killed by fumigant treatment within these areas depends on the number of CT units that develop within the fumigant treated zone. The relationship between fumigant application rate and pest control efficacy is therefore not only a measure of fumigant toxicity but of chemical dispersion. If dispersal is good, increases in fumigant application rates will result in higher CT values and provide control to a greater soil volume. If dispersal is poor, increases in application rates will not provide control to a larger soil volume. Reducing volatilization losses from soil is an effective way to increase CT values and improve fumigant pest control efficacy. It is for this reason that water seals and impermeable plastic mulches (VIF, TIF) are used to increase fumigant diffusion resistance near the soil surface.

This serves both to promote downward diffusion of the fumigant and to enhance residence time and gas phase persistence in soil.

Pest Control Efficacy

Since their introduction to Florida agriculture, many different soil fumigants have been evaluated in field research trials to characterize pest control efficacy and crop yield response. The results from many of these research trials, particularly those to evaluate methyl bromide alternatives, have provided the basis for overall generalization of pesticidal activity for the various fumigant chemicals (see Table 2). In general, this research has repeatedly demonstrated methyl bromide to be very effective against a wide range of soilborne pests, including nematodes, diseases, and weeds. Chloropicrin has proved very effective against diseases but seldom nematodes or weeds. Although fumigants provide some bacterial pathogen suppression, they have not been satisfactorily controlled by any of the soil fumigants. Historically, most of the research conducted to evaluate 1,3-dichloropropene (Telone) has repeatedly demonstrated consistently effective nematode control with little or no control provided for soilborne disease or weeds. Metam sodium, metam potassium, and Dazomet are all nonselective preplant soil fumigants that provide measures of fungicidal, herbicidal, insecticidal, and nematicidal activity. Pest control efficacy of metam sodium and metam potassium has proved inconsistent, earning good to excellent ratings in some trials but poor ratings in others. Field research continues to evaluate modifications of rate, placement, and improved application technology to resolve problems of fumigant inconsistency with these compounds. Metam sodium and metam potassium can provide good control of weeds when placed properly in the bed; however, research to evaluate modification of rate, placement, and improved application technology has not resolved all problems of inconsistent pest control. Dimethyl disulfide (DMDS) has demonstrated good to excellent control of nematodes, disease, and weeds when coapplied with chloropicrin, but as of 2020, the product is no longer registered in the United States.

Because of their target pest specificity, many of the soil fumigants are formulated together or coapplied to increase their overall level and spectrum of pest control. For example, chloropicrin is used both as a stand-alone soil fumigant, as a chemical warning agent in formulation with methyl bromide, and in formulation with 1,3-dichloropropene to increase its disease control effectiveness. Examples of coformulated or sequential application include 1,3-dichloropropene plus chloropicrin formulated together as Telone C17 or Telone C35, or sequential applications involving a broadcast or pre-bed application of 1,3-dichloropropene, followed later by chloropicrin and/or metam sodium in separate soil applications.

Research conducted in Florida and areas of the Southeast appear to support the general conclusion that reasonably consistent soilborne pest and disease control can be obtained with in-row or pre-bed applications of Telone C35 (35 gal/A) or Telone II, applied at 12 gal/treated acre, followed by chloropicrin applied in the bed at 150 lb/treated acre. In combination with Telone II, Telone C35, or chloropicrin, use of a high barrier virtually impenetrable film (VIF) or totally impermeable (TIF) mulch film will generally improve fumigant performance and reduce soil gas emissions. Currently, the EPA only recognizes use of specific high-barrier VIF or TIF mulch films where the film's permeability (mass transfer coefficients) to the different fumigant gases has been measured and meets EPA-approved emission reductions to qualify for buffer-zone-reducing credits. With use of the more impermeable plastic TIF or VIF mulches, fumigant rates can be reduced 25%–40% from maximum labeled application rates. Due to use restrictions for all Telone products in Dade County, either metam sodium or metam potassium at 75 and 60 gal per acre, respectively, in combination with shank injections of chloropicrin (150 lb/treated acre) and appropriate herbicide(s) are currently defined as the best alternatives to methyl bromide.

Given the general lack of herbicidal activity associated with the alternative fumigants, weed control is usually assigned the highest pest management priority for most methyl bromide alternative chemical systems. Regardless of crop, separate application of one or more herbicides is a requirement for effective weed control with any of the different fumigants. In general, weed control with these different fumigants (including Vapam or KPam) plus herbicides is reportedly as good as or better than with methyl bromide. There are, however, numerous examples of less-than-ideal herbicide performance in which various grasses and broadleaf weeds were not effectively controlled. The problems incurred usually demonstrate the importance of soil conditions, incorporation method, and proper rate calibration for good weed control.

Herbicide Partners

In addition to Telone II plus chloropicrin, Telone C35, or PicClor 60, additional applications of appropriate herbicides will be necessary to provide weed control for any CUE crop (Table 3). For tomato, follow the fumigant pre-bed application of Telone C35 or Telone II and chloropicrin with a tank mix of napropamide (2 lb/treated acre) and S-metolachlor (0.95 lb/treated acre); apply the tank to the top of the raised bed at plastic laying for weed control. An additional application of halosulfuron (0.024 lb) as a postemergent, directed spray for nutsedge control may be necessary. For strawberries, the fumigant application of Telone C35 is supplemented by an herbicide tank mix of oxyfluorfen (0.5 lb/treated acre) plus napropamide (4 lb/treated acre) to the raised bed surface at plastic laying. (Note: A minimum 30-day interval is

required before transplanting when using oxyfluorfen.) In pepper, an herbicide tank mix of napropamide (2 lb) and S-metolachlor (0.71 lb; third party label obtained through FFVA) per treated acre is applied for weed control after the Telone II pre-bed and chloropicrin injection to the raised bed at plastic laying. Recent research on soil application technologies in Florida and Georgia have demonstrated improved nutsedge control with metam sodium or potassium applied through a series of minicoulters to the established plant bed just before installation of the plastic mulch.

Avoiding Plant Phytotoxicity

All fumigants, including the gas and water phases of these fumigants, are toxic to plants. Soil dissipation and the persistence of toxic residues are strongly influenced by environmental conditions. Any change in soil condition that promotes a cooler and/or wetter soil condition will typically delay dissipation of a fumigant compound from soil. As a result, soil applications must always be made well in advance of a seeding or planting date to ensure sufficient time for dissipation of fumigant residues from soil. The problem is usually most severe with fumigants of low vapor pressure, where longer-term planning horizons must be adopted to avoid problems of phytotoxicity or to avoid long unscheduled delays in planting after the plants have arrived from the nursery. Growers who use fumigants typically adopt planning horizons that consider beginning field preparation and soil application two to three weeks earlier than normal. This early consideration helps growers avoid problems of potential phytotoxicity that may result from use of impermeable mulches or from unexpected cold fronts or storms producing abundant rainfall. Recent studies have also demonstrated that the addition of chloropicrin in the fumigant mix can destroy microbial populations in soil that digest fumigants like DMDS, thereby contributing to longer persistence in soil and potential delays in plant-back into the bed than would have occurred with DMDS alone.

High-Barrier/Gas-Impermeable Plastic Mulch Films (VIF, TIF)

Fumigant Containment

Historically, most field research conducted to evaluate the use of soil fumigation has repeatedly demonstrated effective soilborne pest and disease control when applications were made under optimal soil conditions, uniformly applied at the appropriate dosage and depth, and using containment systems that prevented rapid escape of gases from soil. Any system designed to contain fumigant gases must first ensure immediate closure and seal of chisel traces as they are produced behind the tractor moving across the field. Left undisturbed, the chisel traces act as chimney vents for volatilizing fumigant gases. This can be accomplished with press wheels behind the chisel or chisel injections immediately in front of bed-

forming equipment. The treated field area may also be rolled to compact surface soil to increase soil density and reduce air passage size and volume. Irrigation is also often applied over the top of the treated area and/or rolled surface to form a surface water seal to further inhibit fumigant outgassing from soil. In some instances, repeated irrigations may be necessary to manage fumigant containment and off-site movement of fumigant gases.

After a fumigant is applied, the treated soil may also be tarped with a polyethylene plastic mulch to provide an additional measure of fumigant containment to soil. The plastic mulches, often a prerequisite for fumigant use, are not only a barrier in themselves but also act as a condensation surface for the formation of water droplets, which redeposit to soil as a water layer, adding another barrier to soil volatilization loss. A range of different mulches can be used to reduce fumigant emissions from soil. Low-density polyethylene (LDPE) or high-density polyethylene (HDPE) tarps have been used extensively in combination with soil fumigation as a soil covering to reduce fumigant emissions from soil. Unfortunately, the barrier properties of LDPE and HDPE to fumigant gases are quite poor, and depending on the fumigant, much of it may quickly escape the soil. In general, the permeability of a plastic mulch to a fumigant gas is directly related to its thickness, density, and chemical composition. Significant resistance to fumigant outgassing has been achieved with use of virtually impermeable mulch films (VIF) and totally impermeable mulch films (TIF). VIF mulches are typically manufactured as multilayer films that are composed of barrier polymers such as ethylene vinyl alcohol (EVOH) or polyamide (nylon) sandwiched between other polymer layers (typically LDPE), or that have metalized coatings to reduce the amount of fumigant that can move through the film and into the atmosphere. VIF mulch is thus typically defined as a five-layer film where the outer two layers are LDPE. The innermost layer is nylon and surrounded by a bridging layer on each side. TIF mulch is generally manufactured similarly to VIF, except the center layer that produces the barrier is made of EVOH instead of nylon.

Compared to LDPE, certain VIF and TIF mulches are over 20,000 times less permeable to fumigant compounds and, as a result, significantly increase the residence time of fumigants in soil. Because of their excellent barrier properties, fumigant application rates can often be reduced as much as 30%–50% without loss of pest control activity or crop yield. These mulches, although not completely impervious to fumigant gases, reduce the dissipation rate of gases into the air, thus increasing the overall efficacy of the treatment by subjecting soil pests to greater cumulative dosage levels of the fumigant. With such efficient and near-complete retention of gases to soil, these same mulch films are known for causing plant-back issues, often requiring extended periods to allow for soil water and air concentrations to fall below levels phytotoxic to seedlings and transplants. To use the high-barrier mulch

technology, plantings may have to be delayed to ensure soil residues have dissipated and plant injury will not occur. A monitoring program using colorimetric detector tubes (GasTek, Kitagawa, Sensidyne) or MiniRae-type VOC meters to assess residual fumigant gases in soil should be considered before a commitment to planting is made.

Due to increased environmental and regulatory scrutiny, VIF or TIF high-barrier plastic mulch films are now mandated for use with some fumigants to receive buffer-zone-reducing credits (20%–60%) to allow fumigant applications within certain proximities of human-occupied structures. They are also extensively used to allow for reduced-rate applications of the different fumigants without compromising concentration and time dosages, thereby maintaining pest control efficacy. Today, over a hundred different manufacturers or product lines can be identified with high-barrier, VIF, or TIF status with current EPA approval for buffer-zone credit. Additional information regarding EPA-approved tarps can be found at <https://www.epa.gov/soil-fumigants/tarps>.

Reduced-Rate Application Technologies

Currently, soil injection equipment for many of the different fumigant compounds is designed to dispense as much as 20–40 gal of a liquid fumigant compound through armored lines from the gas cylinder to the flow meter and rear manifold, and then through each of three chisels per bed. The system is designed and calibrated to do this while moving at 3½–5 mph, uniformly dispensing multiple liquid streams of fumigant within 7,260–10,890 linear ft of row per acre. With such high rates, the flow lines are full, with liquids moving as continuous streams without in-line voids or bubbles. At 30%–50% reduced rates of application, such as those demanded for use with high-barrier VIF or TIF films, the situation may be vastly different, particularly if metered flow rates are low and do not exceed the total capacity of the delivery tubing and manifold system. With reduced flow and presence of bubbles or even voids in flow within lines, a significant loss of back pressure occurs at the chisel orifices. The dramatic fall in back pressure with reduced rate prevents accurate and uniform flow of the fumigant between chisels. This occurs at the point where total internal volume (flow capacity) of nine chisel tubes, typically 1/4 inch in diameter, exceeds the flow capacity of a 3/4-inch armored delivery hose from the flow meter. When the outflow potential is greater than the inflow, there is a significant loss of pressure, and without back pressure, the system becomes one of gravity flow. With the existing on-farm systems, accuracy cannot be achieved at such low volumes and without significant back pressure. To resolve the back-pressure problem, it is extremely important to reduce total line volume and/or diameter of the delivery tubes from the manifold to the chisels so as to guarantee adequate back pressure at the point of fumigant release. With a high-barrier mulch, reducing the field application rate of a fumigant results in a greatly reduced

rate of liquid flow. Some chisels are so reduced in flow that accuracy and uniformity of application along and between the rows are compromised along with pest control efficacy.

In all probability, use of these more gas-retentive mulches will require changes in field application and soil injection equipment to ensure accurate and uniform dispensing of

such low fumigant application rates (10–15 gal/A). These required changes include smaller delivery tubing size (1/8 to 1/16 in. diameter), installation of sight gauges to monitor flow uniformity among chisel streams, and installation of a low-pressure gauge upstream of the flow divider to monitor overall back pressure (at least 15 psi) at the flow divider (Table 4).

Table 1. Physical and chemical properties of various soil fumigants.

Fumigant Compound and Physical State	Boiling Point (°C)	Vapor Pressure (mm/Hg)	Soil Degradation Half-Life (d)	Solubility (mg L ⁻¹)
1,3-Dichloropropene	120	28	3–5	2,250
Chloropicrin	112.4	18	1–2	2,270
Methyl bromide*	3.6	1,420	12–20	13,400
Metam sodium	112	0.4	4–5	578,290
Metam potassium	114	24	4–5	complete
Allyl isothiocyanate (AITC)	112	20	4–5	89,400
*Methyl bromide is only allowed for use in certain nurseries.				

Table 2. Generalized summary of maximum use rate and relative effectiveness of various soil fumigant alternatives to methyl bromide for nematode, soilborne disease, and weed control in Florida.

Fumigant Chemical ¹	Maximum Use Rate	Relative Pesticidal Activity		
		Nematode	Disease	Weed
Chloropicrin	300 lb	Some to poor	Excellent	Poor
Metam sodium (Vapam)	75 gal	Good to erratic	Erratic	Erratic
Telone II	18 gal	Good to excellent	None to poor	Poor
Telone C17	26 gal	Good to excellent	Good	Poor
Telone C35	35 gal	Good to excellent	Good to excellent	Poor to fair
Pic-Clor 60	300 lb	Good to excellent	Good to excellent	Fair to good
Potassium N methyldithiocarbamate (Kpam)	60 gal	Good to erratic	Poor to good	Poor to good
¹ All currently within EPA Fumigant Reregistration review with potential for new restrictions and applicator requirements.				

Table 3. Recommended fumigant and herbicide treatment regimens for Florida¹ fruit and vegetable growers for fields in which nematodes are considered a major pest. All rates are expressed per treated acre. Other pre- and postemergent herbicides may be required for weed control. To achieve maximum weed control, an application of metam sodium (Vapam®—75 gal/A) or metam potassium (Kpam®—60 gal/A) should be considered as a supplemental herbicide treatment using a minicoulter applicator or through a drip application using double drip tapes.

Fumigant Product, Rate, Application Sequence, and Procedure			Possible Supplemental Herbicide
Broadcast	Pre-Bed	In-Row During Bedding	
Deep Shank Telone® II (12–15 gal/A) (12–15" deep) <i>Applied to the flat and soil sealed with tillage and rolling.</i>	–	Telone® C35 (35 gal/A) or Pic-Clor 60 (300–350 lb/A) or Chloropicrin (150 lb/A) <i>Applied in-bed under LDPE, High-Barrier VIF or TIF Mulch Film³; applied 3–5 weeks before transplanting.</i>	Napropamide (Devrinol®) S-metolachlor (Dual Magnum®) Postemergent halosulfuron (Sanda®) Oxyfluorfen (Goal®) Vapam® HL Kpam® HL
–	Deep Shank Telone® II (12–15 gal/A) (12–15" deep) <i>Applied pre-bed² to the flat, under LDPE, High-Barrier VIF or TIF Mulch Film³; applied 3–5 weeks before transplanting.</i>	Telone® C35 (35 gal/A) or Pic-Clor 60 (300–350 lb/A) or Chloropicrin (150 lb/A) <i>Applied in-bed under LDPE, High-Barrier VIF or TIF Mulch Film³; applied 3–5 weeks before transplanting.</i>	

¹ Crop recommendations for Pic-Clor 60, Telone® II, and Telone® C35 do not apply to the Homestead, Miami-Dade County, production region of south Florida or where certain soil types, absence of impermeable layers, and water tables currently prohibit product use.

² Inject Telone® II, Telone® C35, or Pic-Clor 60 to flat soil prior to any soil mounding or bed operation (pre-bed) to a depth of at least 12 in. below the final bed top.

³ In combination with fumigant, one must use an EPA-approved high-barrier mulch film, such as virtually impermeable (VIF) or totally impermeable (TIF) mulch films. Fumigant rates can be reduced 25%–40% from the maximum pesticide labeled application rate, depending on the selected impermeable film.

For some crop uses of S-metolachlor®, a third-party label obtained through FFVA must be in the user's possession.

Table 4. Summary of recommended fumigant injection equipment modifications required for use of high-barrier TIF and VIF mulches and reduced-rate applications of soil fumigants.

(1) Replace tubing from manifold to chisels with smaller-diameter poly tubing to compensate for the new reduced flow capacity requirement and to increase line back pressure needed to ensure accurate, uniform flow among all chisel streams.
(2) To the manifold-flow divider, install individual sight gauges to observe uniformity of fumigant liquid flow to each chisel outlet.
(3) Install a low-pressure gauge (0–30 psi) immediately upstream of the manifold or flow divider to ensure at least 15 psi of back pressure.
(4) Ensure that the flow meter registers a minimum of 10% flow.

Chapter 5. Ethnic Vegetable Production¹

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Ethnic vegetable production in Florida has significantly enhanced the market and diversity of the state's agricultural industry. More than 40 types of ethnic/Asian vegetables are commercially grown each year across Florida. In recent years, growing consumer demand has rapidly expanded ethnic vegetable production throughout Florida, particularly from the northeast to southern regions. The ethnic vegetable growing area is rapidly increasing because of the demand and the niche market. Though availability, profitability, and competitiveness have increased, one of the concerns creating confusion between producers and consumers is that many of the ethnic vegetable crops have different names in different countries and cultures. Additionally, for many ethnic vegetable crops, science-based production recommendations remain unavailable. This unavailability of recommendations may limit the production of these crops as local growers attempt to determine crop requirements with limited guidance. However, before specific recommendations are developed for these specialty crops, ethnic vegetable growers should follow recommendations that are available for crop species closely related to these Asian or ethnic vegetables. This is especially important for pest control and pest management because it is usually very difficult to find pesticides labeled specifically for certain Asian or ethnic vegetable species.

The objectives of this chapter are to

1. provide various names of some ethnic/Asian vegetable crops;
2. list related chapters in this handbook, which provide recommendations for crops close to these ethnic vegetables grown in Florida; and
3. list Ask IFAS publications currently available for these crops.

Growers are strongly encouraged to adhere to UF/IFAS recommendations for related crops until guidelines tailored specifically to ethnic vegetables are developed. In addition, the following publications focusing on Asian or ethnic vegetable crops are available on Ask IFAS and may be helpful to relevant growers:

1. "Bitter Melon—an Asian Vegetable Expanding in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1271>)
2. "Bok Choy, an Asian Leafy Green Vegetable Emerging in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1337>)
3. "Chayote—a Potential Vegetable Crop for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1454>)
4. "Chinese Mustard Cultivation Guide for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1402>)
5. "Daikon Radish Cultivation Guide for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1370>)
6. "Fingered Citron—a Fragrant, Ornamental Citrus Tree for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1427>)
7. "Florida Cultivation Guide for Malabar Spinach"
(<https://ask.ifas.ufl.edu/publication/HS1371>)
8. "Goji Berry—a Novel Nutraceutical 'Superfruit' for Florida Master Gardeners"
(<https://ask.ifas.ufl.edu/publication/HS1391>)
9. "Leek Cultivation Guide for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1388>)
10. "Long Bean—an Asian Vegetable Emerging in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1268>)
11. "Long Squash—an Asian Vegetable Expanding in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1272>)
12. "Luffa—an Asian Vegetable Emerging in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1285>)
13. "Production Guide for Choy Sum—an Emerging Asian Vegetable in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1380>)
14. "Production Guide of Vegetable Amaranth for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1407>)
15. "Tong Hao—an Asian Vegetable Expanding in Florida"
(<https://ask.ifas.ufl.edu/publication/HS1276>)
16. "Waterleaf, a Potential Leafy Vegetable for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1434>)
17. "Yacon, a Potential Tuberous Crop for Florida"
(<https://ask.ifas.ufl.edu/publication/HS1435>)
18. "Edamame Growth Stages in Miami-Dade County"
(<https://ask.ifas.ufl.edu/publication/HS1498>)
19. "Plant-Parasitic Nematodes Associated with Asian Vegetables in Florida"
(<https://ask.ifas.ufl.edu/publication/IN1378>)
20. "Symptoms of Nitrogen and Iron Deficiency in Luffa"
(<https://ask.ifas.ufl.edu/publication/HS1475>)

Table 1. Common name and botanical classification for selected Asian or ethnic vegetables.

Vegetable Type	Common Name	Other Names	Family Name	Related Crop Grown in Florida
Root	Daikon radish	Long white radish, Oriental radish, white radish, winter radish	Brassicaceae (Cruciferae)	Radish (chapter 15)
	Galangal	Galanga, galangale, laos, blue ginger	Zingiberaceae	Unknown
	Ginger	Canton ginger, stem ginger, red ginger, ginger pop, <i>Zingiber officinale</i> , ginger ale flavor	Zingiberaceae	Unknown
	Lobok radish	Chinese radish	Brassicaceae (Cruciferae)	Radish (chapter 15)
	Turmeric	Western ginger	Zingiberaceae	Root crops (chapter 15)
Corm	Indian taro	Dasheen, yautia, eddo, kalo, giant elephant ear	Araceae	Unknown
	Yacon	Peruvian ground apple	Asteraceae (Compositae)	Unknown
Leafy	A choy	Taiwanese lettuce	Asteraceae (Compositae)	Lettuce (chapter 9)
	Callaloo ¹	Callaloo, calaloo, calaloo, kallaloo, Xian choy, amaranth, taro, <i>Xanthosoma</i>	Amaranthaceae/Araceae	Lettuce (chapter 9)
	Long napa	Peking cabbage, celery cabbage	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Malabar spinach	Vine spinach, red vine spinach, climbing spinach, creeping spinach, buffalo spinach, Ceylon spinach	Basellaceae	Lettuce (chapter 9)
	Napa	Napa cabbage	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Shalihon	Xue li hong, mustard green	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Shanghai bok choy	Bok choy, pak choi, bok choi, pok choy	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Taiwan cabbage	Taiwan flat cabbage, Li-Sun cabbage, flathead cabbage	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Thai Basil	Chi neang vorng, anise basil, licorice basil	Lamiaceae	Unknown
	Tong Hao	Tahn ho, Shungiku, crown daisy, garland daisy, edible chrysanthemum, garland chrysanthemum, chrysanthemum greens	Asteraceae (Compositae)	Lettuce (chapter 9)
	Tossa Jute	Jew's mallow, bush okra, nalta jute, jute mallow	Malvaceae	Unknown
	U choy	Yu choy, Chinese greens	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
	Vietnamese coriander	Hot mint, Vietnamese cilantro, phak phai, Cambodian mint	Polygonaceae	Unknown
	Water spinach ²	Kangkung	Convolvulaceae	Unknown
	Wawa choy	Baby Chinese cabbage	Brassicaceae (Cruciferae)	Cabbage (chapter 6)
Flower	Gailon	Chinese broccoli (kale)	Brassicaceae (Cruciferae)	Broccoli (chapter 6)
Fruit/pod	Chinese eggplant	Aubergine, brinjal	Solanaceae	Eggplant (chapter 8)
	Edamame	Maodou, mukimame, vegetable soybean, immature soybean	Fabaceae	Soybean (chapter 11)
	Fuzzy squash	Hairy gourd, fuzzy melon	Cucurbitaceae	Cucumber (chapter 7)

Vegetable Type	Common Name	Other Names	Family Name	Related Crop Grown in Florida
	Indian eggplant	Brinjal	Solanaceae	Eggplant (chapter 8)
	Kabocha	Japanese pumpkin, kabocha squash, Kent pumpkin	Cucurbitaceae	Cucumber (chapter 7)
	Lablab beans	Hyacinth bean, bonavist bean/pea, dolichos bean, seim bean, Indian bean, cluster bean	Fabaceae	Cluster bean (chapter 11)
	Long bean, dark green	Asparagus bean, Chinese long bean, long-podded cowpea, yardlong bean	Fabaceae	Legume (chapter 10)
	Long bean, white	Chinese long bean, haricot asperge, pea bean, dow gauk	Fabaceae	Legume (chapter 10)
	Long squash	Po gua, poo gua, hu gua, opo squash, birdhouse gourd, bottle gourd, calabash gourd, hard-shelled gourd, dolphin gourd, long melon, trumpet gourd, white-flower gourd	Cucurbitaceae	Cucumber (chapter 7)
	Luffa	Loofa, loofah, Chinese okra, angled loofah, dishcloth sponge	Cucurbitaceae	Cucumber (chapter 7)
	Thai eggplant	Thai purple, Thai green, Thai yellow, Thai white	Solanaceae	Eggplant (chapter 8)
¹ “Callaloo” is a culturally diverse term used in different regions to refer to leafy vegetables and dishes prepared from them. In the Caribbean, callaloo commonly refers to leaves of amaranth species (e.g., <i>Amaranthus</i>) or taro (<i>Colocasia esculenta</i>), while in other regions it may include additional leafy greens. ² Prohibited from use in Florida according to the Federal Noxious Weed List, the Florida Department of Agriculture and Consumer Services (FDACS) 5B-64.011 Prohibited Aquatic Plants, or FDACS 5B-57.007 Noxious Weed List.				

Chapter 6. Cole Crop Production¹

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Botany and Planting

Broccoli—*Brassica oleracea* Italica group, Brassicaceae (Cruciferae).

Cabbage—*Brassica oleracea* Capitata group.

Cauliflower—*Brassica oleracea* Botrytis group.

Chinese broccoli—Gailan or gai lan/kalian or kai lan/flowering kale—*Brassica oleracea* var. *alboglabra*.

Chinese cabbage—Napa (tight headed), chi-hili (semi-loose headed)—*Brassica rapa* var. *pekinsis*.

Chinese mustard—Bok choy, shanghai choy, baby bok choy, yuchoi, yuchoy, u-choi, choy sum—*Brassica rapa* subsp. *chinensis*.

Collards—*Brassica oleracea* Acephala group.

Kohlrabi—*Brassica oleracea* var. *gongylodes*.

Mustard—*Brassica juncea*.

Oriental radish—Daikon (Japanese), lobok or lo bok (Chinese)—*Raphanus sativus* var. *longipinnatus*.

Turnip—*Brassica rapa* Rapifera group.

Table 1. Planting dates for cole crops.

Planting Region	Broccoli	Brussels Sprout	Cabbage	Cauliflower	Collards	Kale	Mustard	Turnip
North Florida	Sept–Feb	Aug–Feb	Sept–Feb	Aug–Feb	Aug–Feb	Aug–Feb	Aug–Feb	Aug–Feb
Central Florida	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb
South Florida	Oct–Jan	Oct–Jan	Sept–Jan	Sept–Jan	Sept–Jan	Sept–Jan	Sept–Jan	Sept–Jan

Table 2. Planting information for cole crops.

Planting Information	Broccoli	Brussels Sprout	Cabbage ¹	Cauliflower ¹	Collards	Kale	Mustard	Turnip
Distance between rows (in)	24–40	24–40	24–40	24–40	24–36	18–24	12–36	12–36
Distance between plants (in)	10–15	16–24	8–16	12–18	12–24	8–12	5–10	2–6
Seeding depth (in)	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5
Seeding per acre for field (lb)	1–2	1–2	1–2	1–2	2–4	2–4	3–5	2–3
Seeding per acre for transplant (lb)	1.25–1.5	1.25–1.5	1	1.25–1.5	1.25–1.5	N/A ²	N/A ²	N/A ²
Days to maturity from seed	75–90	120–140	85–110	75–90	70–90	50–70	40–50	40–60
Days to maturity from transplant	50–70	90–120	70–90	50–70	50–70	—	—	—
Plant populations (acre)	10,400–26,000	Up to 15,500	Up to 29,400	Up to 29,000	Up to 21,800	Up to 43,500	Up to 116,200	Up to 261,400

¹ Can be planted in double rows (15–24 inches between rows; 10–12 inches within rows; 40–60-inch bed centers).

² Direct seeded.

Cultivars

Table 3. Cabbage cultivars.

Cabbage	Cultivars
Green	Botran (H), Bravo (H), Bronco (H), Bruno (H), Capture (H), Cheers (H), Expat (H), Grand Vantage (H), Ramada (H), Superstar (H)
Red	Cairo (H), Garnet (H), Red Dynasty (H), Red Hawk (H), Red Jewel (H), Rio Grande (H)
Savoy	Clarissa (H), Melissa (H), Savoy Ace (H), Savoy King (H)

Table 4. Broccoli, brussels sprout, cauliflower, collards, kale, mustard, and turnip cultivars.

Crop	Cultivars
Broccoli	Abrams (H), Burney (H), DuraPak 19 (H)*, Eastern Crown (H), Emerald Crown (H), Green Magic (H), Imperial (H), Packman (H)
Brussels sprout	Dagan (H), Marte (H)
Cauliflower	Alcala (H), Bermeo (H), Flamenco (H), Majestic (H), Whistler (H), White Passion (H)
Collards	Bull Dog (H), Flash (H), Georgia, Hi Crop (H), Top Bunch (H), Vates
Kale	Blue Ridge (H), Darkibor (H), Oldenbor (H), Starbor (H), Vates, Winterbor (H)
Mustard	Florida Broad Leaf, Green Wave, Red Giant, Southern Giant Curled, Tendergreen
Turnip	Just Right (H), Purple Top, Royal Crown (H), Southern Green
Turnip greens	All Top (H), Top Star (H), Topper (H)
H = hybrid, * = for northeast Florida	

Asian Crucifers

The term “Asian crucifers” is a broad category that encompasses Asian crucifer vegetables grown in the countries that comprise Asia and those eaten mainly by people of Asian extraction or who like Asian cuisine. Many of the Asian crucifers described in this chapter belong to the crucifer family, which is covered in depth in chapter 5, “[Ethnic Vegetable Production](#).” However, there are still some overlaps between these two chapters.

This group of Asian crucifer vegetable species includes crops with edible leaves, like cabbage, broccoli, and bok choy, but also kohlrabi, which has edible swollen stems or tubers, and daikon, which is an edible root. These crops can be grown on raised beds with or without mulch and with drip, overhead, or subsurface irrigation. Fertilizer recommendations for these crops can be found in chapter 2, “[Fertilizer Management for Vegetable Production in Florida](#),” as general information. For pest-control products, these crops are included under this chapter, with the exception of daikon, for which refer to information on radish in chapter 15, “[Root Crop Production](#).”

Table 5. Planting dates for Asian crucifers.

Planting Region	Chinese Broccoli	Chinese Cabbage	Chinese Mustard	Daikon
North Florida	Aug–Feb	Aug–Feb	Aug–Feb	Sept–Mar
Central and south Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr

Table 6. Planting information for Asian crucifers.

Planting Information	Chinese Broccoli	Chinese Cabbage	Chinese Mustard	Daikon
Number of rows/44 in. wide beds (6 ft centers)	3–4	2–3	4	3 (fall/spring) 4 (winter)
Distance between rows (in)	11	14 or 24	14–mustard 11–others (below)	11
Distance between plants (in)	3–5	14–18	12–18 (mustard) 8–12 (Shanghai/choy sum) 6–10 (baby bok choy) 2–4 (u-choy)	6–9
Seeding depth (in)	0.25–0.5	0.25–0.5	0.25–0.5	0.25
Plant populations (acre)	116,160	18,671	29,040 (mustard) 43,560 (Shanghai/choy sum) 58,080 (baby bok choy) 174,240 (u-choy)	58,080

Table 7. Asian crucifer cultivars.

Asian Crucifer	Cultivars
Bok choy	Bopak, Joy choy
Chinese broccoli	Dark Green Gailan, Green Jade, Green Lance (H), Kaliburi, Kichi, Suiho, Te You
Chinese cabbage—Napa (tight head)	Blues Hybrid (H), China Express, China Pride, Emiko, Minuet, Pacifiko, SF-65, WR-70 days (H)
Chinese cabbage—Chihili (semi-loose head)	Green Rocket (H), Jade Pagoda, Michihili, Monument, Rubicon, Tainong Nanjing
Chinese mustard	Canton Choice, Ching-Chiang, Crown Jewel, Dwarf, Dynasty, Extra Dwarf, Fortune King, Long White, Lucky Choi, Mei Quing Choi, San Fran, Shanghai Green
Kohlrabi	Green Beauty, Kolibri, Kolibri Hybrid (H), Peking Purple, Purple Vienna, Winner
Oriental radish	April Cross, Daikon (Japanese), Everest, Green Meat, Mantanghong Hybrid (H), Mikura Cross, Mino Early, Minowase, Red Meat, Relish Lobok/lo bok (Chinese), Shunko
H = hybrid	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 8. Herbicides approved for managing weeds in cole crops. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Peter Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE/ PRETRANSPLANT	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Head and stem and leafy brassica	Annual broadleaf and grass weeds. Fair to poor control of lambsquarter, purslane, and some amaranth. Mechanically incorporate 1–2 in. or irrigate 2–4 in. deep within 36 hr.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Head and stem and leafy brassica	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Clomazone 0.25 0.25–0.38	(Command) 3ME direct seeded: 0.67 pt transplanted: 0.67–1.0 pt	13	Cabbage	Annual broadleaf and grass weeds. On coarse soils, use lower rates. No more than 1 application per season. PHI 45 days.
	Flumioxazin 0.096	(Zaltus SX)	14	Broccoli, brussels sprout, cabbage, Chinese cabbage, napa cabbage, cauliflower	Broadleaf weeds. No more than 3 oz/A per application. No more than 6 oz per year. Row middles only between plastic-covered rows. Beds should be at least 4 inches tall and 24 inches wide. Apply with a covered sprayer to limit contact to the bottom inch of the bed prior to planting.
	Glyphosate	(various formulations) consult label	9	Head and stem and leafy brassica	Actively growing broadleaf and grass weeds. Use as a preplant burndown.
	Napropamide 2.0	(Devrinol DF-Xt) 4 lb (Devrinol 2-Xt) 4 qt	15	Broccoli, brussels sprout, cauliflower, cabbage	Annual broadleaf and grass weeds. Apply in transplanted crops. Irrigate within 24–72 hr to a soil depth of 4–8 in. No more than 2 lb a.i./A per season.
	Oxyfluorfen 0.25–0.5	(Galigan, Goal 2XL) 2 EC 1–2 pt (Galigan, GoalTender) 4 E 0.5–1.0 pt	14	Broccoli, cauliflower, cabbage	Certain annual broadleaf weeds. Transplants less than 5 weeks old or in containers less than 1 sq in. may result in more crop injury. Injury will occur as leaf cupping or crinkling. DO NOT apply in fields where acentanilide herbicides (Dual Magnum, Lasso, or Ramrod) have been applied in the same growing season.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Broccoli, cabbage, cauliflower, cavolo broccoli, Chinese cabbage, turnip	Emerged broadleaf and grass weeds. Use as a preplant burndown. Crop plants that have emerged will be injured.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Use as a preplant burndown.
	Pyraflufen ethyl 0.0008–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Cole crops	Broadleaf and grass weeds. Burndown preplant application 1 day before planting. Include a NIS or COC in the spray solution. Allow 30 days between applications. No more than 3 applications or 5.5 fl oz/A per season.
	S-metolachlor mineral: 0.64–1.91 muck: 1.91	(Dual Magnum) 7.62 EC mineral: 0.80–4.0 pt muck: 4.0 pt	15	Head and stem brassica	Annual broadleaf and grass control. Apply immediately after planting. Label is a Third-Party Registration (TPR, Inc.), and grower must sign an indemnification agreement. Use a higher rate on fine-textured soils or high in organic matter. No more than 1.91 lb a.i./A of Dual Magnum per crop on sandy soils. Chinese varieties are more sensitive to Dual Magnum injury. PHI 60 days.
	Sulfentrazone 0.07–0.09	(Willowood sulfentrazone) 4SC 2.25–3.0 fl oz	14	Brassica head and stem (broccoli and cabbage), brassica leafy greens	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. No more than 6.4 fl oz/A within a 12-month period. Should be trialed on a small area to find suitable rate for the soil type in your area.
	Trifluralin 0.5–0.75	(Treflan HFP, Trifluralin) 4 EC 1.0–1.5 pt (Treflan) 4 L 1.0–1.5 pt	3	Broccoli, brussels sprout, cabbage, cauliflower	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in. within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents.
POSTEMERGENCE/ POSTTRANSPLANT	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz (Aim) 1.9 EC up to 2 fl oz	14	Head and stem and leafy brassica	Emerged broadleaf weeds. Apply with a hooded sprayer to row middles. No more than 4.1 fl oz/A per season as a row-middle application. PHI 0 days.
	Clethodim 0.07–0.12	(Select Max) 1 EC 9–16 fl oz	1	Head and stem and leafy brassica	Emerged grass weeds. Include crop oil concentrate at 1% v/v in finished spray volume. Head and stem brassica PHI 30 days. Leafy brassica PHI 14 days.
	Clpyralid 0.09–0.19	(Stinger) 3 EC 0.25–0.5 pt	4	Cabbage, Chinese cabbage (bok choy, napa), Chinese mustard cabbage	Broadleaf weeds. No more than 0.5 pt/A per year. Check plant-back dates. PHI 30 days.
	Glyphosate	(various formulations) consult label	9	Head and stem and leafy brassica	Broadleaf and grass weeds. Use a hooded sprayer and direct to row middles only.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Paraquat 0.3–0.5	(Gramoxone) 2 SL 1.2–1.9 pt	22	Cabbage	Emerged broadleaf and grass weeds. Direct spray solution to row middles only. Do not allow spray contact with crop because injury or excessive residues may result. Outer leaves should be stripped at the time of harvest. Do not apply where paraquat products have been used as preplant application.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Apply as hooded spray to row middles only. Include a residual herbicide to broaden the spectrum of weed control.
	Pendimethalin 0.48–0.71	(Prowl H2O) 3.8 1.0–1.5 pt	3	Broccoli, brussels sprout, cabbage, cauliflower	Broadleaf and grass weeds. Apply after crop emergence (2- to 4-leaf stage) or after transplanting (1–3 days) and prior to weed emergence. Direct the spray to the base of the plant to limit contact to the foliage. PHI 60 days. PHI 7 days for cabbage and head and stem brassica.
	Sethoxydim 0.28	(Poast) 1.5 EC 1.5 pt	1	Broccoli (including Chinese and raab), brussels sprout, cabbage (bok choy, Chinese mustard, napa), cauliflower, collards, kale, kohlrabi, mustard/rape greens	Annual and perennial weeds. Include a crop oil concentrate or methylated seed oil in spray solution. No more than 3.0 pt/A per season. PHI 30 days.

Table 9. Insecticides labeled for management of arthropod pests of cole crops. Contact: De-Fen Mou, UF/IFAS Everglades Research and Education Center.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	*Dibrom 8 EC (naled)	1 pt	10 pt	48	1	Broccoli, cabbage, cauliflower, brussels sprout, kale, and collards. Reapplications at least 7 days apart. Maximum 5 applications per season.
	1B	Dimethoate 4 EC (dimethoate)	Broccoli, cauliflower: 0.5-1 pt Kale, mustard greens, turnip: 0.5 pt	Broccoli, cauliflower: 3 pt per year Kale, mustard greens: 1 pt per year Turnip: 3.5 pt per year	48	Broccoli, cauliflower: 7 Kale, mustard greens, turnip: 14	Highly toxic to bees. Broccoli, cauliflower, kale, mustard greens, and turnip greens and roots only.
	1B	Malathion 5EC, 8F (malathion)	Broccoli, brussels sprout, cabbage, cauliflower: 1-2 pt (5EC) or 1.25 pt (8F) Collards, kale, mustard greens: 1.6 pt (5EC) or 1pt (8F)	Broccoli, brussels sprout, cabbage, cauliflower, turnip greens and roots: 32 fl oz Collards, kale, mustard greens: 25 fl oz	Broccoli, brussels sprout, cabbage, cauliflower: 48 Collards, kale, mustard greens, turnip greens and roots: 12	7 All except Broccoli: 3	See label for application limitations—varies by crop.
	1B	*MSR Spray Concentrate (oxydemeton-methyl)	1.5-2 pt Cabbage: 1.5-3	6 pt	7 days	7 Brussels sprout: 10	Broccoli, broccoflower, broccolini, brussels sprout, cauliflower, and cabbage only. Reapplications at least 7 days apart.
	3A	*Ambush 25W3 (permethrin)	Brussels sprout, cauliflower: 3.2-6.4 oz Broccoli, cabbage, Chinese broccoli, Chinese cabbage: 3.2-12.8 oz	Brussels sprout, cabbage, cauliflower, Chinese cabbage: 25.6 oz Broccoli, Chinese broccoli: 51.2 oz	12	1	Head and stem brassica crops only.
	3A	*Brigade 2 EC (bifenthrin)	2.1-6.4 fl oz Turnip roots: 5.12-6.4 fl oz	Head and stem brassicas, turnip roots: 32 fl oz Leafy brassicas: 25.6 fl oz	12	7 Turnip roots: 21	Reapplications at least 7 days apart.
	3A	*Mustang (zeta-cypermethrin)	3.4-4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 7 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. Can be used in greenhouses. OMRI-listed. ³
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz per year	24	3	Highly toxic to bees. Reapplications at least 5 days apart. Head and stem brassica only.
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	Head and stem: 0 Leafy: 7	Highly toxic to bees. Foliar application. Do not use if other 4A insecticide has been applied. Reapplication at least 7 days apart.
	4A	Admire Pro (imidacloprid)	Soil: 4.4–10.5 fl oz Foliar: 1.3 fl oz	Soil: 10.5 fl oz Foliar: 6.5 fl oz	12	Soil: 21 Foliar: 7	Most effective as a soil application. Do not apply to both soil and foliage.
	4A	Assail 30SG (acetamiprid)	Head and stem brassica: 2.0–4.0 fl oz Leafy brassica, turnip greens: 2.0–5.3 oz	20 oz per year	12	Head and stem: 7 Leafy brassica, turnip greens: 3	Turnip roots cannot be used for food/feed.
	4A	Belay Insecticide (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Do not use for seed production. Toxic to bees. Foliar applications at least 10 days apart. Exclude turnip.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7 Soil: apply at planting.	Foliar applications at least 10 days apart. Do not use adjuvant. Includes turnip greens.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz Turnip: 1.7–4.01 oz	3.67 oz Turnip: 4.01 oz	12	30	Soil application.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application. No more than 1 application per season.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	Head and stem: 3 Leafy brassica greens: 7	Toxic to bees. Reapplications at least 7 days apart.
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz	4	1	Soil or foliar application. No more than 3 crop seasons per year.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	Apply when aphids first appear. Reapplications at least 7 days apart. No more than 2 applications per crop.
	9B	PQZ (pyrifluquinazon)	Soil only: 2.4–3.2 fl oz	9.6 fl oz	12	7	Reapplications at least 7 days apart.
	23	Movement (spirotetramat)	4–5 fl oz	10 fl oz	24	1	Only use a spreading-penetrating adjuvant known to be safe for the target crop.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products	12	1	Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products per year	4	Soil at planting: N/A Drip chemigation: 1	No more than 13.5 fl oz at planting. The pH should be pH 4–6. Drip chemigations at least 10 days apart.
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz per year	12	0	Begin applications before pests reach damaging levels. Reapplications at least 7 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (including diamondback moth, cabbage looper, imported cabbageworm, corn earworm, cross-striped cabbageworm, cabbage webworm, armyworms)	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1 lb	LV: 15 pt SP: 5 lb	48	Cabbage: 1 Broccoli, cauliflower: 3 Others: 10	No more than 10 applications per crop (8 for collards, kale, and mustard and turnip greens). Broccoli, cabbage, cauliflower, Chinese cabbage, fresh market collards, kale, mustard and turnip greens.
	1A	Sevin 80S XLR Plus, 4F (carbaryl)	80S: 0.625–2.5 lb XLR, 4F: 0.5–2 qt	80S: 7.5 lb XLR, 4F: 6 qt	12	3 or 14, depending on specific crop	–
	1B	*Diazinon AG-500 *50 W (diazinon)	AG500 preplant: 1–4 qt 50W: 2–8 lb	–	96	preplant	Root maggot, cutworms only. Broccoli, cabbage, cauliflower, collards, kale, and mustard greens. See label for depth to incorporate. No more than 5 applications.
	1B	*Dibrom 8 EC (naled)	1 pt	10 pt	48	1	Broccoli, cabbage, cauliflower, brussels sprout, kale, and collards. Reapplications at least 7 days apart. No more than 5 applications per season.
	1B	Malathion 5EC, 8F (malathion)	Broccoli, brussels sprout, cabbage, cauliflower: 1–2 pt (5EC) or 1.25 pt (8F) Collards, kale, mustard greens: 1.6 pt (5EC) or 1pt (8F)	Broccoli, brussels sprout, cabbage, cauliflower, turnip greens and roots: 32 fl oz Collards, kale, mustard greens: 25 fl oz	Broccoli, brussels sprout, cabbage, cauliflower: 48 Collards, kale, mustard greens, turnip greens and roots: 12	7 All except broccoli: 3	See label for application limitations—varies by crop.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Ambush 25W3 (permethrin)	Brussels sprout, cauliflower: 3.2–6.4 oz Broccoli, cabbage, Chinese broccoli, Chinese cabbage: 3.2–12.8 oz	Brussels sprout, cabbage, cauliflower, Chinese cabbage: 25.6 oz Broccoli, Chinese broccoli: 51.2 oz	12	1	Head and stem brassica crops only.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz	Head and stem brassicas: 0.4 lb a.i. Collards: 0.2 lb a.i.	12	Head and stem: 3 Collards, mustard greens: 7	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz Mustard greens: 9.6 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz Turnip roots: 5.12–6.4 fl oz	Head and stem brassicas, turnip roots: 32 fl oz Leafy brassicas: 25.6 fl oz	12	7 Turnip roots: 21	Reapplications at least 7 days apart.
	3A	*Capture LFR (bifenthrin)	3.4–8.5 fl oz	0.1 lb a.i. per year	12	At planting	For mixing directly with liquid fertilizer to control soil insect pests.
	3A	*Danitol (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Head and stem brassica only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	12.3 fl oz	24	1	First and second instars only. Head and stem brassica only.
	3A	*Mustang (zeta-cypermethrin)	Corn earworm, diamondback moth: 2.4–4.3 fl oz Cabbage looper, cabbage webworm, armyworm: 3.4–4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Toxic to bees. Can be used in greenhouses. OMRI-listed. ³

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	1	1st and 2nd instar only. For head and stem brassica only.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz Cabbage looper, cabbage webworm: 5–8 fl oz	31 fl oz per year	24	3	Toxic to bees. Head and stem brassica only. Reapplications at least 5 days apart.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application. No more than 1 application per season.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	Head and stem brassicas: 3 Leafy brassicas: 7	Toxic to bees. Reapplications at least 7 days apart.
	5	Radiant SC (spinetoram)	6–10 fl oz	34 fl oz per year	4	1	Do not apply to seedlings grown for transplant. No more than 2 consecutive applications of Group 5 insecticides. Recommended to reserve for thrips where they are a problem.
	6	*Proclaim (emamectin benzoate)	3.2–4.8 oz	19.2 oz per year	12	Head and stem brassicas: 7 Leafy brassicas, turnip greens: 14	No more than 2 sequential applications. Reapplications at least 7 days apart. Do not apply by aircraft. Not for turnips grown for roots.
	15	Rimon 0.83 EC (novaluron)	6–12 fl oz	Head and stem brassicas: 24 fl oz per year Leafy brassicas, turnip greens: 36 fl oz per year	12	7	Not for turnip root or for livestock.
	18	Intrepid 2F (methoxyfenozide)	4–10 fl oz, depending on pest	64 oz	4	1	-
	22	Avaunt 30 WG (indoxacarb)	2.5–3.5 oz	14 oz	12	3	-

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	22	Avaunt eVo (indoxacarb)	2.5–3.5 oz	14 oz	12	3	No more than 4 applications per year. Reapplications at least 3 days apart.
	28	Coragen (rynaxypyr)	3.5–7.5 fl oz	15.4 fl oz	4	3	For best results, use an adjuvant when using as a foliar spray. Can be applied to soil at planting or by drip chemigation. See label for diamondback moth resistance management.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz Diamondback moth: 7 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products	12	1	Reapplications at least 5 days apart.
	30	Incipio (isocycloseram)	2.1–4.1 fl oz Diamondback moth: 2.1 fl oz	8.2 fl oz per year	12	1	Reapplications at least 30 days apart. No more than 2 applications per year.
	7A	Extinguish (S-methoprene)	1.0–1.5 lb	–	4	0	Slow-acting IGR (insect growth regulator). Apply early spring and fall. May be applied by ground equipment or aerially.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	0.134 lb a.i.	12	1	Apply when ants are actively foraging.
	1A	Sevin 80S XLR Plus, 4F (carbaryl)	80S: 0.625–2.5 lb XLR, 4F: 0.5–2 qt	80S: 7.5 lb XLR, 4F: 6 qt	12	3 or 14, depending on specific crop	See label for specific crops.
Flea beetles	1B	*Lorsban Advanced (chlorpyrifos)	Preplant, at-plant, postplant soil application: See label. Foliar: 1–2 pt	See label for crop and application method specifics.	24 Cauliflower: 72	Preplant: 30 Foliar: 21	Foliar: No more than 3 applications of products containing chlorpyrifos.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	1B	Malathion 5EC, 8F (malathion)	Broccoli, brussels sprout, cabbage, cauliflower: 1–2 pt (5EC) or 1.25 pt (8F) Collards, kale, mustard greens: 1.6 pt (5EC) or 1pt (8F)	Broccoli, brussels sprout, cabbage, cauliflower, turnip greens and roots: 32 fl oz Collards, kale, mustard greens: 25 fl oz	48 Collards, kale, mustard greens: 12	Head and stem brassicas except cabbage: 2 Turnip greens and cabbage: 7	See label for application limitations—varies by crop.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz Mustard greens: 9.6 fl oz	Head and stem brassicas: 0.4 lb a.i. Collards: 0.2 lb a.i.	12	Head and stem brassicas: 3 Collards, mustard greens: 7	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz Turnip roots: 5.12–6.4 fl oz	Head and stem brassicas, turnip roots: 32 fl oz Leafy brassicas: 25.6 fl oz	12	7 Turnip roots: 21	Reapplications at least 7 days apart.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	12.3 fl oz	24	1	First and second instars only. Head and stem brassicas only.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 7 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Toxic to bees. Can be used in greenhouses. OMRI-listed. ³
	3A	*Warrior II and generics (lambda-cyhalothrin)	0.96–1.92 fl oz	–	24	1	No more than 0.24 lb a.i./A or 15.36 fl oz/A per season. 1st and 2nd instar only. For head and stem brassica only.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz per year	24	3	Toxic to bees. Reapplications at least 5 days apart. Head and stem brassica only.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	Head and stem brassicas: 0 Leafy brassicas: 7	Toxic to bees. Do not use if other 4A insecticide has been applied. Reapplications at least 7 days apart.
	4A	Belay Insecticide (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Do not use for seed production. Toxic to bees. Foliar applications at least 10 days apart. Exclude turnip.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7 Soil: apply at planting	Foliar applications at least 10 days apart. Do not use adjuvant. Includes turnip greens.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz Turnip: 1.7–4.01 oz	3.67 oz Turnip: 4.01 oz	12	30	Soil application.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 oz Soil: 9–13 oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method. Head and stem brassicas only.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz	6 oz	12	1	Head and stem brassicas only.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application. No more than 1 application per season.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	Head and stem brassicas: 3 Leafy brassica greens: 7	Toxic to bees. Reapplications at least 7 days apart.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products	12	1	Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products per year	4	Soil at planting: N/A Drip chemigation: 1	No more than 13.5 fl oz at planting. The pH should be 4–6. Drip chemigations at least 10 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	30	Incipio (isocloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	Reapplications at least 30 days apart. No more than 2 applications per year.
Grasshoppers	3A	*Asana XL (0.66 EC) (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz Mustard greens: 9.6 fl oz	Head and stem brassicas: 0.4 lb a.i. Collards: 0.2 lb a.i.	12	Head and stem: 3 Collards, mustard greens: 7	No more than 0.4 lb a.i./A per season for head and stem brassica or 0.2 lb a.i./A per season for collards and mustard greens.
	3A	*Mustang (zeta-cypermethrin)	3.4–4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 7 days apart.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz per year	24	3	Highly toxic to bees. Head and stem brassicas only. Reapplications at least 5 days apart.
	1A	Sevin 80S XLR Plus, 4F (carbaryl)	80S: 0.625–2.5 lb XLR, 4F: 0.5–2 qt	80S: 7.5 lb XLR, 4F: 6 qt	12	3 or 14, depending on specific crop	See label for specific crops.
Harlequin bug, stink bug, plant bugs	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Head and stem brassicas, turnip roots: 32 fl oz Leafy brassicas: 25.6 fl oz	12	7	Reapplications at least 7 days apart.
	3A	*Danitol (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Head and stem brassicas only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	12.3 fl oz	24	1	First and second instars only. Head and stem brassicas only.
	3A	*Mustang (zeta-cypermethrin)	3.4–4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 7 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. Can be used in greenhouses. OMRI-listed. ³

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	1	First and second instar only. Head and stem brassica only.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz per year	24	3	Highly toxic to bees. Head and stem brassicas only. Reapplications at least 5 days apart.
	4A	Assail 30SG (acetamiprid)	4.0–5.3 oz	20 oz per year	12	3	Brassica leafy greens only. Turnip roots cannot be used for food/feed.
	4A	Belay Insecticide (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Do not use for seed production. Toxic to bees. Foliar applications at least 10 days apart. Exclude turnip.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7 Soil: apply at planting	Foliar applications at least 10 days apart. Includes turnip greens.
	4A	Scorpion 35SL (dinotefuran)	2–7 oz	10.5 fl oz	12	1	Head and stem brassicas only.
	4A	Venom Insecticide (dinotefuran)	1–4 oz	6 oz	12	Foliar: 1 Soil: 21	Head and stem brassicas only.
	15	*Dimilin 2L (diflubenzuron)	2–4 fl oz	16 fl oz per year	12	7	Not effective against adult stage. No more than 4 applications per season. May be applied only to turnip varieties that do not produce a harvestable root.
	15	Rimon 0.83 EC (novaluron)	6–12 fl oz	Head and stem brassicas: 24 fl oz per year Leafy brassicas, turnip greens: 36 fl oz per year	12	7	No more than 2 applications for thrips or whiteflies. Head and stem brassicas only.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	30	Incipio (isocloseram)	3.1–4.1 fl oz	8.2 fl oz per year	12	1	Reapplications at least 30 days apart. No more than 2 applications per year.
Leafminers	1B	Dimethoate 4 EC (dimethoate)	0.5 pt	Kale, mustard greens: 1 pt per year Turnip greens and roots: 3.5 pt per year	48	14	Highly toxic to bees. Kale, mustard greens, turnip greens and roots only.
	4A	Belay Insecticide (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Do not use for seed production. Toxic to bees. Foliar applications at least 10 days apart. Exclude turnip.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7 Soil: apply at planting	Foliar applications at least 10 days apart. Do not use an adjuvant. Includes turnip greens.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–13 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Head and stem brassicas only. Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6 oz	Foliar: 6 fl oz Soil: 12 fl oz	12	Foliar: 1 Soil: 21	Head and stem brassicas only. Use only 1 application method.
	5	Radiant SC (spinetoram)	6–10 fl oz	34 fl oz per year	4	1	Do not apply to seedlings grown for transplant. No more than 2 consecutive applications of Group 5 insecticides. No more than 6 applications per year. Reapplications at least 4 days apart.
	6	*Proclaim (emamectin benzoate)	3.2–4.8 oz	19.2 oz per year	12	Head and stem brassicas: 7 Leafy brassicas, turnip greens: 14	No more than 2 sequential applications. Reapplications at least 7 days apart. Do not apply by aircraft. Not for turnips grown for roots.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	15	Rimon 0.83 EC (novaluron)	12 fl oz	Head and stem brassicas: 24 fl oz per year Leafy brassicas, turnip greens: 36 fl oz per year	12	7	Not for turnip root or for livestock.
	17	Trigard (cyromazine)	2.66 oz	1 lb per year	12	7	No more than 6 applications. Reapplications at least 7 days apart. Includes turnip greens, not grown for roots.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products per year	4	Soil at planting: N/A Drip chemigation: 1	No more than 13.5 fl oz at planting. The pH should be 4–6. Drip chemigations at least 10 days apart.
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	Reapplications at least 30 days apart. No more than 2 applications per year.
	4A	Actara (thiamethoxam)	3.0–5.5 oz	11 oz	12	Head and stem brassicas: 0 Leafy brassicas: 7	Highly toxic to bees. Do not use if other 4A insecticide has been applied.
	4A	Admire Pro (imidacloprid) (see appropriate labels for other brands)	Soil: 4.4–10.5 fl oz Foliar: 1.3 fl oz	Soil: 10.5 fl oz Foliar: 6.5 fl oz	12	Foliar: 7 Soil: 21	Do not apply to both soil and foliage.
	4A	Assail 30SG (acetamiprid)	Head and stem brassicas: 2.0–4.0 oz Leafy brassicas, turnip greens: 2.5–5.3 oz	20 oz per year	12	Head and stem brassicas: 7 Leafy brassicas, turnip greens: 3	Turnip roots cannot be used for food/feed. Whiteflies have shown a tendency to develop resistance.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Belay Insecticide (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Do not use for seed production. Toxic to bees. Foliar applications at least 10 days apart. Exclude turnip.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7 Soil: apply at planting.	Foliar applications at least 10 days apart. Do not use an adjuvant. Includes turnip greens.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz Turnip: 1.7–4.01 oz	3.67 oz Turnip: 4.01 oz	12	30	Soil application.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–13 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Head and stem brassicas only. Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Head and stem brassicas: 1–4 oz (foliar) and 5–7.5 oz (soil) Leafy brassica, greens, turnip greens: 2–3 oz	Foliar: 6 fl oz Soil: 12 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method. Soil application for head and stem brassicas only.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application. No more than 1 application per season.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	Head and stem brassicas: 3 Leafy brassica greens: 7	Toxic to bees. Reapplications at least 7 days apart.
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz	4	1	No more than 3 crop seasons per year.
	7C	Knack (pyriproxyfen)	8–10 fl oz	20 fl oz per year	12	7	Immatures only. Apply when nymphs first appear. No more than 2 applications per year. Reapplications at least 14 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	Apply when aphids first appear. Reapplications at least 7 days apart. No more than 2 applications per crop.
	9B	PQZ (pyrifluquinazon)	Soil only: 2.4 to 3.2 fl oz	9.6 fl oz	12	7	Reapplications at least 7 days apart.
	15	Rimon 0.83 EC (novaluron)	12 fl oz	Head and stem brassicas: 24 fl oz per year Leafy brassicas, turnip greens: 36 fl oz per year	12	7	No more than 2 applications for thrips or whiteflies. Not for turnip root or for livestock.
	16	Courier SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz	12	1	Immatures only. No more than 2 applications per crop cycle or 4 applications per year.
	23	Movement (spirotetramat)	4-5 fl oz	10 fl oz	24	1	Only use a spreading-penetrating adjuvant known to be safe for the target crop. Reapplications at least 7 days apart.
	23	Oberon 2 SC (spiromesifen)	7.0-8.5 fl oz	25.5 fl oz	12	7	No more than 3 applications. Not for turnip greens.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i.	12	1	Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75-13.5 fl oz	0.4 lb a.i. of cyazypyr- or cyantraniliprole-containing products per year	4	Soil at planting: N/A Drip chemigation: 1	No more than 13.5 fl oz at planting. The pH should be 4-6. Drip chemigations at least 10 days apart.
	29	Beleaf 50 SG (flonicamid)	2.8 oz	8.4 oz per year	12	0	Suppression only. Reapplications at least 7 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Wireworms	1B	*Diazinon AG-500 *50 W (diazinon)	AG500 preplant: 3-4 qt 50W: 6-8 lb	AG500: 4 qt per year 50W: 8 lb per year	96	Preplant	No more than 1 soil application. Broccoli, cabbage, cauliflower, collard, kale, mustard greens. Preplant soil application and top 4-8 in. of soil.
	1B	Lorsban 75WG (chlorpyrifos)	Foliar: 0.67-1.33 lb Preplant soil: 2.66 lb for cauliflower, 3 lb for all others At plant or post planting: 0.8-2.15 oz/1000 row ft	See label for crop and application method specifics.	24 Cauliflower: 72	Foliar: 21 Pre- or at planting: 30	No more than 3 applications of products containing chlorpyrifos. Will not control organophosphate-resistant diamondback moth. Preplant: Incorporate preplant applications 2-4 in. deep.
	3A	*Brigade 2 EC (bifenthrin)	2.1-6.4 fl oz	Head and stem brassicas, turnip roots: 32 fl oz Leafy brassicas: 25.6 fl oz	12	7	Wireworm adults. Reapplications at least 7 days apart.
	3A	*Capture LFR (bifenthrin)	At planting: 3.4-6.8 fl oz	0.1 lb a.i. per year	12	At planting	For mixing directly with liquid fertilizer to control soil insect pests.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 10. Cole crop fungicides ordered by disease and FRAC group according to mode of action. Cole crops include head and stem crops (broccoli, brussels sprout, cauliflower, Chinese broccoli, and Chinese cabbage); leafy crops (collards, kale, mustard, and turnip); and watercress. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Nicholas S. Dufault, UF/IFAS Department of Plant Pathology, Gainesville.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria blight (<i>Alternaria</i> spp.)	3 + 11	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. No more than 2 applications per crop.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
Alternaria leaf spot (<i>Alternaria</i> spp.)	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champion++, Champ WG, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. Some reddening on older broccoli leaves at higher rates and flecking on wrapper leaves of cabbage may occur.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90 DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	See individual label	7	1-2	See individual labels for crop subgrouping.
	2	Iprodione 4L AG Rovral 4F Enclosure 4 Nevado 4F (iprodione)	1 pt	4 pt	10	-	Only labeled for Chinese mustard. No more than 4 applications for mustard.
	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	Procure 480 SC (triflumizole)	8 fl oz	18 fl oz	1	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection and repeat sprays at a 14-day interval.
	3	Rhyme 2.08SC (flutriafol)	7 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. No more than 2 applications per crop.
	7	Fontelis 1.67SC (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 11	Luna Sensation 500 SC (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications per year.
	9 + 3	Inspire Super 2.82 SC (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7- to 10-day interval. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential applications before rotating to a different mode of action for at least 2 applications; 30-day plant-back for off-label crops.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications per stem and head crop.
	11	Quadris Equation Satori (azoxystrobin)	15.5 fl oz	92.3 fl oz	0	4 hr	No more than 2 sequential applications. Different seasonal application limits for head and stem brassicas versus leafy green brassicas.
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	No more than 1 sequential application.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application. No more than 4 applications per season.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	–
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	29	Omega 500F (fluazinam)	15.25 fl oz	See label	See label	0.5	The REI is 2 days for workers conducting handset irrigation activities.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	40 fl oz	160 fl oz	7	0.5	No more than 2 sequential applications. No more than 4 applications per year.
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7- to 10-day interval. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications per stem and head crop.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	-
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.
	2	Iprodione 4L AG Rovral 4F Enclosure 4 Nevado 4F (iprodione)	2 pt	4 pt	0	-	Only labeled for broccoli. No more than 2 applications for broccoli.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0	4 hr	No more than 2 sequential applications per stem and head crop.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more than 3 applications in a season. Do not apply to turnip greens or roots.
Black rot (<i>Xanthomonas campestris</i>)	M1	(copper compounds) Many brands available.	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fixed copper compounds.
	P	Actigard 50 WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventatively. No more than 4 applications at 1 oz rate per year. Reapplications at least 7 days apart. Suppression only.
Cercospora leaf spot (<i>Cercospora brassicola</i>)	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	Rhyme 2.08SC (flutriafol)	7 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	-
	7 + 11	Luna Sensation 500 SC (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7- to 10- day interval. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants. Suppression only.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications per stem and head crop.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Labeled for leafy brassica. No more than 2 sequential applications.
	11	Reason 500SC (fenamidone)	8.2 oz	24.6 fl oz	2	0.5	No more than 1 sequential application. Suppression only.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	-
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Club root (<i>Plasmodiophora brassicae</i>)	21	Ranman (cyazofamid)	SEE LABEL	SEE LABEL	-	0.5	Applied as a transplant soil drench.
	29	Omega 500F (fluzazinam)	Soil: 41.6 fl oz Transplant drench: 6.45 fl oz/100 gal	3.85 pt	Leafy: 20 Head and stem: 50	2	Not labeled for watercress. Treated turnip roots are not fit for human or livestock consumption.
Downy mildew (<i>Peronospora parasitica</i>)	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champion++, Champ WG, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fix copper compounds.
	M3	(mancozeb) Many brands available: Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See individual label	See individual label	10	1	Not labeled for collards, mustard, turnip, or watercress. See labels for restrictions and details.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90 DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	See individual label	7	2	Not labeled for leafy cole crops or watercress.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4	Ridomil Gold SL (mefenoxam)	Foliar: 0.25 pt	Foliar: 1 pt	7	2	Not labeled for watercress. Use only in a tank mix with another effective fungicide (non-FRAC code 4).
	4 + M5	Ridomil Gold Bravo Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	1.5 lb	See label	7	2	Not labeled for leafy cole crops or watercress. No more than 4 applications per crop.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications per stem and head crop.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	92.3 fl oz	0	4 hr	Labeled for head and stem brassicas. No more than 2 sequential applications.
	11	Reason 500SC (fenamidone)	8.2 oz	24.6 oz	2	0.5	No more than 1 sequential application.
	21	Actigard 50 WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventatively. No more than 4 applications per crop on a 7-day schedule. Suppression only.
	21	Ranman (cyazofamid)	2.75 fl oz	39.5 fl oz	0	0.5	This product can be applied as a transplant soil drench. No more than 6 applications.
	29	Omega 500F (fluazinam)	15.25 fl oz	See label	See label	0.5	The REI is 2 days for workers conducting handset irrigation activities.
	33	Allette (aluminum tris)	5 lb	-	3	-	No more than 7 applications per season.
	40	Acrobat (dimethomorph)	6.4 oz	32 oz	0	0.5	Not labeled for head and stem cole crops. No more than 5 applications per season. See supplemental label for restrictions and details.
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Not labeled for turnip or watercress. No more than 5 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Not labeled for turnip or watercress. No more than 2 sequential applications or 4 total applications.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	0.5	Not labeled for watercress. No more than 2 sequential applications or 4 total applications per season.
	45 + 40	Zapro (ametoctradin + dimthomorph)	14 fl oz	42 fl oz	0	0.5	No more than 2 sequential applications.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	40 fl oz	160 fl oz	7	0.5	No more than 2 sequential applications. No more than 4 applications per year.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. No more than 4 applications per year.
Fusarium soilborne diseases (<i>Fusarium</i> spp.)	12	Maxim 4FS (fludioxonil)	0.08–0.16 fl oz/ 100 lb of seed	See label	-	0.5	Seed treatment only; not labeled for turnip or watercress.
Gray mold (<i>Botrytis cinerea</i>)	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. No more than 2 applications per crop.
	7	Fontelis 1.67 SC (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7+11	Luna Sensation 500 SC (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew (<i>Erysiphe cruciferarum</i> [syn. <i>Erysiphe polygoni</i>])	M2	(sulfur) Many brands available: Cosavet DF, Cosavet DF Edge, Crusade DF, Kumulus DF, Microfine Sulfure, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90W, Thiolux	See individual label	See individual label	0	-	Products are available for most cole crops; see labels for restrictions and details.
	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem (tebuconazole) cole crops. Apply prior to infection when environmental conditions are favorable.
	3	Procure 480 SC (triflumizole)	8 fl oz	18 fl oz	Leafy: 0	0.5	Not labeled for watercress or head and stem brassicas. See label for restrictions and details.
	3	Rhyme 2.08SC (flutriafol)	7 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	-
	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	No more than 2 applications per crop. Suppression only.
	7	Fontelis 1.67 SC (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 11	Luna Sensation 500 SC (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7- to 10-day interval. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential applications before rotating to a different mode of action for at least 2 applications; 30-day plant-back for off-label crops.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications per stem and head crop.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	-
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications per season.
	4	Apron XL (mefenoxam)	See label	See label	-	2	Seed treatment only; not labeled for watercress. See label for details.
Pythium and phytophthora diseases (soil)	4	Ridomil Gold SL (mefenoxam)	2 pt (soil)	2 pt (soil)	7	2	Not labeled for watercress; use only in a tank mix with another effective fungicide (non-FRAC code 4).

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4	Ultra Flourish (mefenoxam)	4 pt	4 pt	-	2	Soil applied as a preplant treatment or following transplanting.
Pythium damping-off (<i>Pythium</i> spp.)	4	Allegiance-FL (metalaxyl)	See label	See label	-	2	Seed treatment only. Primarily for commercial seed treatment.
	4	MetaStar 2E AG (metalaxyl)	See label	See label	-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/100 row ft	1.0 lb a.i.	-	-	No more than 1 application per season.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. No more than 2 sequential applications or 4 total applications per season.
Phytophthora spp.	4	MetaStar 2E AG (Metalaxyl)	See label	See label	-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. No more than 2 sequential applications or 4 total applications per season.
Rhizoctonia rot and blight (syn: Wirestem) (<i>Rhizoctonia solani</i>)	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/100 row ft	1.0 lb a.i.	-	-	Not labeled for leafy cole crops or watercress.
	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	No more than 2 applications per crop. Suppression only.
	7	Moncut SC (flutolanil)	26 fl oz	52 fl oz	45	0.5	No more than 2 applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	See label	4 hr	No more than 2 sequential applications per stem and head crop. Labeled only for suppression in leaf greens.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Quadris EquationsC Satori (azoxystrobin)	0.40–0.80 fl oz/ 100 row feet	46 fl oz	0	4 hr	Labeled only for soilborne control on leafy green brassicas. See label for details on soilborne applications. Dynasty seed treatment is also available; check label for more information.
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 1 application per season.
	12	Maxim (fludioxonil)	0.08–0.16 fl oz/ 100 lb of seed	-	-	0.5	Seed treatment only. Not labeled for turnip or watercress.
	14	Blocker 4F Terraclor 400 Terraclor 75WP Terraclor FL (PCNB)	See label	30 lb a.i.	-	0.5	Not labeled for leafy cole crops or watercress.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard, or watercress. No more than 2 sequential applications per stem and head crop.
Ring spot (<i>Mycosphaerella brassicicola</i>)	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	-
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.
	7	Endura (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. No more than 2 applications per crop.
Sclerotinia rot (<i>Sclerotinia</i> spp.)	7	Fontelis 1.67 SC (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 11	Luna Sensation 500 SC (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
White leaf spot (<i>Pseudocercospora capsellae</i>)	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard, or watercress. No more than 2 sequential applications per stem and head crop.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.
White rust (<i>Albugo candida</i>)	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 14	4 hr	No more than 2 sequential applications.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Not labeled for watercress. No more than 1 sequential application.
	11	Reason (fenamidone)	8.2 oz	24.6 oz	2	0.5	No more than 1 sequential application.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	-	7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications per season.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. P = host plant defense inducers. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 11. Nonfumigant nematicides for crucifer/cole crops in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Mocap 15G (a.i. ethoprop)	Apply 13 lb/A (36 in. row spacing) or 0.9 lb/1,000 linear row ft in a band of 15 in. wide on the row at-planting. Mix with the top 2–4 in. of soil with mechanical equipment right after application. If broadcast, apply 34 lb/A from 1 week before planting to at planting time and mix with 2–4 in. of soil. <i>Do not</i> use as a seed furrow treatment or allow granules to contact the seed. No more than 1 application per season.
Mocap EC (a.i. ethoprop)	Apply in 12 to 15 in. band on the row and incorporate 2–4 in. deep immediately following treatment. Do not use as a seed furrow treatment or allow spray to contact the seed because phytotoxicity may occur.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 30 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Soil reapplications at least 5 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Biological nematicides	See chapter 19.
Mocap is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water. Depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations). When nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 12. Fumigant nematicides for crucifer/cole crops in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new product label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 7. Cucurbit Production¹

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Botany and Planting

Angled or ridged luffa (silk squash, Chinese okra)—*Luffa acutangula*

Bittermelon (Chinese and Indian types)—*Momordica charantia*

Butternut squash—*Cucurbita moschata*

Cantaloupe—*Cucumis melo*

Chayote—*Sechium edule*

Chinese cucumber—*Trichosanthes kirilowii*

Cucumber—*Cucumis sativus*, Cucurbitaceae

Fuzzy melon (immature fruit) and **Winter melon**—*Benincasa hispida*

Long gourd (oopoh)—*Lagenaria siceraria*

Pumpkin (jack-o-lantern is *C. pepo*; some processing pumpkins are *C. maxima* and *C. moschata*)

Smooth luffa—*Luffa aegyptica* (cylindrical)

Snake gourd—*Trichosanthes cucumerina*

Summer squash (crookneck and straight-neck yellow squash)—*Cucurbita pepo*

Tropical pumpkin (calabaza)—*Cucurbita moschata*

Watermelon—*Citrullus lanatus*

Winter squash—*Cucurbita maxima*

Zucchini—*Cucurbita pepo*

Table 1. Planting dates for cucurbits.

Planting Region	Dates				
	Cucumber	Cantaloupe	Pumpkin	Squash	Watermelon
North Florida	Feb–Apr; July–Aug	Feb–Apr	Early July	Feb–Apr; Aug–Sept	Feb–Apr
Central Florida	Jan–Mar; Sept	Jan–Mar	Mid-July	Jan–Apr; Aug–Sept	Jan–Mar
South Florida	Sept–Feb	Dec–Mar	Early August	Aug–Mar	Dec–Mar

Table 2. Planting information for cucurbits.

Planting Parameters	Measurements					
	Cucumber	Cantaloupe	Pumpkin	Squash		Watermelon
				Bush	Vining	
Distance between rows (in)	48–60	60–72	60–108	36–48	60–108	60–108
Distance between plants (in)	6–12	20–36	36–60	12–24	36–60	24–48
Seeding depth (in)	0.5–0.75	0.5–1.0	1.5–2.0	1.0–1.5	1.5–2.0	1.5–2.0
Seed per acre (lb)	2–4	1–2	4–5	2–3	1–1.5	1–3
Days to maturity from seed	40–65	85–110	80–100	40–50	85–120	80–100
Days to maturity from transplant	NR	70–90	NR	NR	NR	60–90
Plant populations (acre)	21,780	4,356	2,904	11,616	2,904	1,815
NR = Not Recommended						

Cultivars

Table 3. Cultivars for cantaloupe.

Cantaloupe	Cultivars
Eastern Shipper	Accolade (H), Ariel (H), Athena (H), Atlantis (H), Avatar (H)
Harper Type	Caribbean Gold (H), Damaris (H), Infinite Gold (H), Timeless Gold (H)
Calabaza (Tropical Pumpkin)	Agriset 9001 (vining type), La Estrella (compact plant)
H=hybrid	

Table 4. Cultivars for cucumber.

Cucumber	Cultivars
Pickling	Calypso (H) (GY), Deli King, Deli Star, Excursion, Expedition (H), Jackson Classic (H) (GY), Jackson Supreme, Maxi Pack (H), Maxi Pick (H), Powerpak (H) (GY), Supremo (H)
Slicing	Bristol, Cobra (H) (GY), Diamondback (H), Dominator (H) (GY), Impact (H) (GY), Mamba (H) (GY), Mongoose (H) (GY), Python (H), Speedway (H) (GY), SV3462CS* (H) (GY), SV4719CS* (H) (GY)
H=hybrid; flower habit: GY=gynoecious *Improved downy mildew resistance	

Table 5. Cultivars for Halloween pumpkin (north Florida only).

Halloween Pumpkin (by size)	Cultivars
Miniature: <1 lb	Bumpkin (H), Gold Dust (H), Jill-Be-Little, Wee-Be-Little (PVP)
Small: 1–5 lb	Hybrid Pam (H), Pick-A-Pie (H), Small Sugar
Medium: 5–10 lb	Autumn Gold (H), Goose Bumps II (H), Jack of All Trades (H), Knucklehead (H), Merlin (H), October (H)
Large: 10–20 lb	Apogee (H), Connecticut Field, Early Giant (H), Early King (H), Magician (H), Magic Wand (H)
Giant: 25–80 lb	Dill's Atlantic Giant, Prizewinner (H)
PVP=Plant Variety Protection; H=hybrid	

Table 6. Cultivars for squash.

Squash	Cultivars
Summer (yellow)	Conqueror III (H) (SN)*, Enterprise (H) (SN), Fortune (H) (SN), Gentry (H) (CN), Goldprize (H) (SN), Gold Star (H) (CN), Grand Prize (H) (SN), Lazor (H) (SN), Lioness (H) (SN), Smooth Criminal (H) (SN)
Acorn	Mesa Queen (H), Royal Ace (H), Table Ace (H), TayBelle PM (H)
Butternut	Atlas (H), Avalon (H), Butternut (H), Canesi (H), Early Polaris (H), Quantam (H), Ultra (H), Waltham, Zenith (H)
Summer (zucchini)	Cash Machine, Everglades (H), Green Machine (H), Pascola (H), Paycheck (H), Payload (H), Payroll (H), Renegade (H), Respect (H), Senator (H), Spineless Beauty (H), Spineless King (H), Spineless Perfection (H)
Summer (yellow zucchini)	Golden Delight (H) (SN), Golden Glory (H) (SN), Goldrush (H) (SN)
H=hybrid; type: CN=crookneck, SN=straightneck *Biotech: Specific requirements and restrictions apply to these products.	

Table 7. Cultivars for watermelon.

Watermelon	Cultivars
Diploid	Estrella (H), Jamboree (H), Mardi Gras (H), Sangria (H), Sentinel (H), Starbrite (H), Stargazer (H), SSX 8585 (H), Summer Flavor 720, Summer Flavor 790 (H), Summer Flavor 800 (H), Summer Flavor 8490 (H), Summer Flavor 860, Top Gun (H)
Triploid (seedless, large)	ACX 6177 (H), Black Jack (H), Bottle Rocket (H), Captivation (H), Crisp N' Sweet (H), Crunchy Red (H), Embassy (H), Exclamation (H), Excursion (H), Fascination (H), Joy Ride (SV 8298) (H), Kingman (H), Melody (H), Red Amber (H), Red Garnet (H), Road Trip (H), Secretariat (H), SS 7167 (H), SS 7177 (H), SS 7187 (H), SS 7197 (H), Sugared (H), Sugar Heart (H), Sweet Gem (H), Sweet Polly (H), Talca (H), Traveler (H), Troubadour (H), Warrior (nun 1009) (H)
Non-harvestable Pollenizer	Ace Plus, Co-Pilot, Minipol, Polimax, Premium, SP-6, SP-7, Wildcard Plus, Wingman
Triploid (seedless, mini)	Ana (H), Belmont (H), Excite (H), Extazy (H), Leopard (H), Ocelot (H), Promesa (H), Sirius (H)
H=hybrid	

Asian Cucurbits

This group includes cucurbit fruits that can be eaten immature like several other vegetables with edible tender stems and leaves. Matured luffa are not edible, but after peeling off their skin and drying them, they can be used as durable scrubs for dishwashing or showering. All these Asian cucurbits can be grown on raised beds, with or without plastic mulch, and with drip, overhead, or subsurface irrigation. Most are well trellised to support the long vines and fruits, primarily to maximize space and receive sufficient sunlight, to minimize bud drop and fruit rot caused by overshadowing and exposure to soil moisture and pathogens, and to promote straight fruit. Winter melon is the exception because it is generally too heavy to trellis. Fertilizer recommendations for cucumbers are applicable

for fuzzy melon, long gourd, both luffas, Chinese cucumber, bittermelon, and snake gourd. There are two types of bittermelon: Indian and Chinese. The Indian type has smaller fruit with dark-green color and soft, prickled skin. The Chinese type has longer, larger fruit with light-green color and smooth skin. The Indian type tastes more bitter than the Chinese type. Chinese cucumber, though rarely commercially available, has fruit more than 1 foot long with dark-green color, very thin and rough skin, and crisp texture, similar to European cucumber but crunchier. Recommendations for watermelon should be followed for winter melon and chayote. With the exception of chayote, where the entire fruit is planted, these crops are started from seed and grown as transplants prior to being set in the field.

Table 8. Planting dates for Asian cucurbits.

Planting Region	Dates							
	Bittermelon	Long Gourd	Angled Luffa	Smooth Luffa	Fuzzy Melon	Snake Gourd	Chayote	Winter Melon
North Florida	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug	NR	Feb–Apr
Central Florida	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept	NR	Jan–Mar
South Florida	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb	Dec 15–Mar 1
NR = Not Recommended								

Table 9. Planting information for Asian cucurbits.

Planting Parameters	Measurements							
	Bittermelon	Long Gourd	Angled Luffa	Smooth Luffa	Fuzzy Melon	Snake Gourd	Chayote	Winter Melon
Distance between rows (in)	60–72	60–72	60–72	60–72	60–72	60–72	60–72	72–108
Distance between plants (in)	36–60	36–60	36–60	36–60	36–60	36–60	36–60	36–72
Days to maturity from seed	80–100	–	–	–	–	–	–	–
Plant populations (acre)	2904	2904	2904	2904	2904	2904	2904	1452–2420
Seeding depth (in)	–	–	–	–	1.5–2.0	1.5–2.0	Whole fruit is used: cover halfway	1.5–2.0
Seed per acre	–	–	–	–	–	–	2904—whole fruit	–

Table 10. Cultivars for Asian cucurbits.

Asian cucurbits	Cultivars
Bittermelon (Chinese)*	Hong Kong Green, Hybrid Bangkok Large, Japan Green Sprindle, Taiwan Large
Bittermelon (Indian)*	Hybrid India Star, India Green Long, India Green Queen, Palee
Winter Melon	Giant Wax, Hybrid Red Doll, Hybrid Small Round, Hybrid Wonder Wax, Round Tong Gwa
Snake Gourd*	Buag Ngu, Extra Long Dancer, Hybrid Snaky, Long EX, Polo
Angled Luffa*	Bonanza, Buam Liam Hybrid, Hybrid Green Glory, Lucky Boy, Summer Long
Smooth Luffa*	Dok Hybrid, Hybrid Smooth Beauty, Smooth Boy
Long Gourd*	Bitter Gourd Long, Hybrid Asia Short, Hybrid India Long
Fuzzy Melon*	Chiang Shin Joker, Mokwa, Mokwa Long, Seven Star Long
Chayote*	The seed is the viviparous fruit itself. There is some debate as to whether varieties remain true. Fruit purchased from grocery stores may not sprout.
*Should be trellised	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 11. Herbicides approved for managing weeds in cucurbit crops. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Nathan Boyd, UF/IFAS Gulf Coast Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	All cucurbits	Annual broadleaf and grass control. Incorporate or irrigate 1–2 in. within 36 hr of application. Non-labeled crops should not be planted within 120 days of application.
	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	All cucurbits	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Clomazone 0.15–0.38	(Command) 3 ME 0.4–1 pt	13	Cucumber	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Read label for additional restrictions. PHI 30 days.
	Clomazone 0.15–0.25	(Command) 3 ME 0.4–0.67 pt	13	Muskmelon, watermelon	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Read label for additional restrictions.
	Clomazone 0.25–0.50	(Command) 3 ME 0.67–1.33 pt	13	Summer squash	Annual broadleaf and grass weeds. Broadcast for bare-ground production; row middles only if growing on plastic. PHI 30 days.
	Clomazone 0.25–0.75	(Command) 3 ME 0.67–2 pt	13	Winter squash	Annual broadleaf and grass weeds. Broadcast for bare-ground production; row middles only if growing on plastic. Read labels for cultivar restrictions. PHI 45 days.
	Ethalfluralin + Clomazone 0.4–0.6 + 0.13–0.19	(Strategy) 2–3 pt	3 + 13	Cucumbers, melons, summer and winter squash, pumpkin, watermelon	Annual broadleaf and grass control. Must be applied no later than 2 days after seeding. Overhead irrigation or rainfall of 0.5 in. within 5 days. Do not apply under plastic mulch or over top of plants.
	Flumioxazin up to 0.125	(Chateau) EZ up to 4 fl oz	14	Cucumber, muskmelon, watermelon, pumpkins, summer and winter squash	Broadleaf and grass control. Row middles only. Do not apply after crops are transplanted/seeded. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Glufosinate up to 0.79	(Rely) 280 43 oz	10	Muskmelon, watermelon, cucumber, pumpkin, summer and winter squash, and others on label	Burndown of emerged broadleaves, grasses, and nutsedge. May be applied as a preplant burndown and preplant to plastic mulch covered beds. See label for planting intervals. 30-day PHI for melons. 14-day PHI for cucumbers, gourds, pumpkins, and squash. Note: Rely 280 label is still valid for use if the applicator has product on hand. Registration has since moved to the Liberty label through December 2026 for row middle weed management in cucurbits.
	Glyphosate	(various formulations) consult labels	9	All cucurbits	Controls emerged broadleaf, grass weeds, and nutsedge. Consult individual labels for restrictions.
	Halosulfuron 0.024	(Sandeia) 75 DG 0.5 oz	2	Cantaloupe, cucumber, crenshaw, honeydew	Yellow and purple nutsedge and broadleaf control. Apply after seeding but before soil cracking on bare ground or prior to laying the plastic mulch. Apply uniformly with ground equipment in a minimum of 15 gal of water per acre.
	Halosulfuron 0.024-0.036	(Sandeia) 75 DG 0.5-0.75 oz	2	Watermelon	Yellow and purple nutsedge and broadleaf control. May be applied preemergence to seeded watermelon on bare ground or preseeded to mulch-cultured watermelon. Transplanting should be no sooner than 7 days after application. Use lighter rates on sandy soils with low organic matter.
	Halosulfuron 0.024-0.036	(Sandeia) 75 DG 0.5-0.75 oz	2	Pumpkin, winter squash	Yellow and purple nutsedge and broadleaf control. Apply before soil cracking or pretransplant. Transplanting should not be made sooner than 7 days after application. May be applied POST over the top when plants reach the 4-5 true-leaf stage, but before first female flowers appear.
	Paraquat 0.63-0.94	(Gramoxone) 2 SL 2-4 pt (Firestorm) 3 SL 1.3-2.7 pt	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. Use a nonionic surfactant. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	All cucurbits	Controls emerged weeds. Apply before crop emergence. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity. May be tank-mixed with soil residual herbicides.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
POSTTRANSPLANT/ POSTEMERGENCE	Pendimethalin 1.0	(Prowl H2O) 2.1 pt	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. May be applied as a sequential application with 2.1 pt/A before and 2.1 pt/A after transplanting or seeding, with 21 days between applications. No more than 4.2 pt/A per season.
	S-metolachlor 0.95-1.26	(Brawl, Dual Magnum) 1.0-1.33 pt	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge control. Apply as inter-row or inter-hill application. Leave a 1-ft untreated area over the seeded row (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge.
	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	All cucurbits	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
	Clethodim 0.09-0.13 0.07-0.12	(Arrow) 2 EC 6-8 oz (Select Max) 1 EC 9-16 fl oz	1	Cucumber, squash, melons, and all commodities in crop group	Annual and perennial grass control. Use a crop oil concentrate at 1% v/v spray volume. Use nonionic surfactant in Select Max. PHI 14 days.
	Ethalfuralin + Clomazone	(Strategy) 2-3 pt	3 + 13	Cucumber, melon, summer and winter squash, pumpkin, watermelon	Annual broadleaf and grass control. After transplanting apply to row middles only. Does not control emerged weeds. PHI 45 days.
	Glufosinate up to 1.24	(Rely) 280 64 fl oz	10	Muskmelon, watermelon, cucumber, pumpkin, summer squash, winter squash, and others on label	Burndown of emerged broadleaves, grasses, and nutsedge. May be applied with a shielded applicator between rows of established cucurbits. 30-day PHI for melons. 14-day PHI for cucumbers, gourds, pumpkins, and squash. Note: Rely 280 label is still valid for use if the applicator has product on hand. Registration has since moved to the Liberty label through December 2026 for row middle weed management in cucurbits.
	Glyphosate	(various formulations) consult labels	9	All cucurbits	Control emerged broadleaf and grass weeds. Apply to row middles only. Use a hooded sprayer to reduce drift. Read individual labels for restrictions.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Halosulfuron 0.04–0.05	(Sandea) 75 DF 0.5–1 oz	2	Cucumber, cantaloupe, honeydew, crenshaw melon	Apply after the 3–5 true leaf stage (no sooner than 14 days after transplanting) but before the first female flower. Spot spray a POST application if a PRE application was made. Cucumber PHI 30 days. Cantaloupe, honeydew, crenshaw 57 days.
	Halosulfuron 0.02–0.05 0.02–0.04	(Sandea) 75 DF 0.5–1.0 oz 0.5–0.75 oz	2	Watermelon, summer squash, pumpkin, winter squash	Nutsedge and broadleaf weeds. Apply to the row middles only. Include a NIS in the spray solution. PHI 57 days for watermelon. PHI 30 days for summer/winter squash and pumpkin.
	Imazosulfuron 0.19–0.3	(League) 75 WG 4–6.4 oz	2	Muskmelon, watermelon	Nutsedge and broadleaf weeds. No more than 6.4 oz/A per year. No more than 1 application per year. Surfactant is needed if weeds have emerged. Row middles only. PHI 45 days.
	Paraquat 0.47–0.93	(Gramoxone) 2 SL 1.88–3.72	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. No more than 3 applications per year. Gramoxone SL is a supplemental label. Consult labels for other paraquat formulations. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Cucumber, gourd, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop.
	Pendimethalin 1.0	(Prowl H2O) 2.1 pt	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. Apply 2.1 pt/A after transplanting or seeding and before vines are off the bed and in the spray area. If a preplant application was applied, no more than 4.2 pt/A per season. PHI 35 days.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	All cucurbits	Growing grass weeds. Include a crop oil concentrate. Efficacy is decreased if weeds are under stress. Use 1 pt for seedling grasses and 1.5 pt on perennial grasses. PHI 14 days.
	S-metolachlor 0.95–1.26	(Brawl, Dual Magnum) 7.62 EC 1.0–1.33 pt	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge. Apply as inter-row or inter-hill application. Leave a 1 ft untreated area over the plant (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge. PHI 30 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Terbacil 0.1–0.2	(Sinbar) 80 WP 2–4 oz	5	Watermelon	Annual broadleaf weeds. Apply to row middles only. Do not allow contact with plant foliage. No more than 4 oz per year. PHI 70 days.
	Trifluralin	(Treflan) 4 EC 1.0 pt (Treflan) TR 10 5 lb	3	All cucurbits	Annual broadleaf and grass control. Apply after crop is 3–4 true leaf stage. Row middles only. PHI 30 days except for watermelon 60 days.
	POSTHARVEST				
	Diquat 0.25	(Reglone Dessicant) 1.0 pt	22	Cantaloupe	No more than 35 gal/A. Include an NIS. Thorough coverage is required.
	Diquat 0.38	(Reglone Dessicant) 1.5 pt	22	Cucumber, watermelon, squash (except acorn)	No more than 35 gal/A. Include an NIS. Thorough coverage is required.
	Diquat 0.5	(Reglone Dessicant) 2.0 pt	22	Squash (acorn)	No more than 35 gal/A. Include an NIS. Thorough coverage is required.

Table 12. Insecticides labeled for management of arthropod pests of cucurbit crops. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center—Quincy, or Jawwad Qureshi, UF/IFAS Southwest Florida Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1A	*Lannate LV (methomyl)	1.5-3 pt	18 pt	48	3	No more than 12 applications per year.
	1A	*Lannate SP (methomyl)	0.5-1 pt	6 pt	48	3	No more than 12 applications per year.
	1A	*Vydate L (oxamyl)	2-4 pt	16 pt	48	1	Reapplications at least 7 days apart.
	1B	Dimethoate 4 EC (dimethoate)	Melons: 1 pt Watermelons: 0.5-1 pt	2 pt per year	48	3	Highly toxic to bees. Not for squash or cucumber.
	1B	Malathion 5EC Malathion 8 (malathion)	5EC: 1.5-2.8 pt (cucumber), 2.0-2.8 pt (summer squash), 1.6 pt (winter squash), 1.5-2.5 pt (watermelon), or 1.6 pt (melon) 8: 1.75 pt (summer squash, winter squash, cucumber)	5EC: 5.6 pt (cucumbers), 8.4 pt (summer squash), 4.8 pt (winter squash), or 5 pt (watermelon) 8: 3.5 pt (cucumber) or 5.25 pt (summer squash, winter squash)	24	1	5EC: No more than 2 applications per year. 8: Squash and cucumbers only.
	3A	*Athena (bifenthrin)	7-17 fl oz	51 fl oz	12	7	No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Brigade 2 EC (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	12	3	No more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees. Can be tank-mixed with 3-4 oz of Belay insecticide.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4-10.3 oz	41.2 oz	12	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-15.61 oz	15.61 oz	12	0	OMRI-listed. ³ No more than 10 applications per season.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19 fl oz	24	1	Apply before pests reach damaging levels.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz	12	7	Reapplications at least 7 days apart.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	9 fl oz	31 fl oz	24	1	Reapplications at least 4 days apart.
	4A	Actara (thiamethoxam)	1.5-3.0 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	Admire Pro (imidacloprid) (see appropriate labels for other brands)	7-10.5 oz Planthouse: 0.44 fl oz/ 10,000 plants	10.5 fl oz	12	Soil: 21	Planthouse: 1 application to transplants. See label for use on mature greenhouse cucumbers.
	4A	Assail 30 SG (acetamiprid)	2.5-4 oz	20.0 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	Belay Insecticide (clothianidin)	Foliar: 3.0-4.0 fl oz Soil: 9.0-12.0 fl oz	12 fl oz	12	Foliar: Do not make application after 4th true leaf on main stem is unfolded. Soil: 21	Do not apply when plants are blooming.
	4A	Platinum 75SG (thiamethoxam)	5-11 fl oz 75SG: 1.66-3.67 oz	11 fl oz 75SG: 3.67 oz	12	30	A 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	Safari 20 SG (dinotefuran)	3.5-7.0 oz	1.34 lb	12	-	For transplants in greenhouse only.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4-7 oz	14 oz	12	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4C	Closer SC (sulfoxaflor)	1.5-2.0 fl oz	17 fl oz	12	1	Highly toxic against pollinators: Notify known beekeepers within 1 mile of the treatment area. Limit application to times when managed bees and native pollinators are least active.
	4D	Sivanto Prime (flupyradifurone)	Foliar: 7-14 fl oz Soil: 21-28 fl oz	Foliar: 28 fl oz Soil: 28 fl oz per crop season	4	Foliar: 1 Soil: 21	Foliar: Reapplications at least 7 days apart. Soil: No more than 3 crop seasons per year.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	24	7	Highly toxic to pollinators. Do not spray during bloom.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	0	Reapplications at least 7 days apart.
	9B	PQZ (pyrifluquinazon)	2.4-3.2 fl oz	9.6 fl oz	12	7	Reapplications at least 7 days apart.
	9D	Sefina Inscalis Insecticide (afidopyropen)	3.0 fl oz	28 fl oz	12	0	Reapplications at least 7 days apart. No more than 2 consecutive applications. Maintain a 10-ft vegetative filter strip of permanent vegetation between the field edge and aquatic habitat.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A of cyazypyr- or cyantraniliprole-containing products per season, either as foliar or soil applications.
	28	Verimark (cyantraniliprole)	At planting: 10-13.5 fl oz Drip chemigation: 10 fl oz	At planting: 13.5 fl oz Drip chemigation: 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at-plant and drip chemigation. No more than 2 drip chemigation applications (one if at-plant application used).
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels.
	1A	Lannate LV (methomyl)	1.5-3 pt	18 pt	48	3	No more than 12 applications per year.
Beetles (including cucumber beetle and flea beetle)	1A	Lannate SP (methomyl)	0.5-1 pt	12 pt	48	3	No more than 12 applications per year.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	1A	Sevin 4F, XLR (carbaryl)	0.5–1.0 qt	6 qt	12	3	Do not apply when plants are wet. Has been reported to flare mites. Do not apply to plants in bloom.
	1B	Malathion 5EC Malathion 8 (malathion)	5EC: 1.5–2.8 pt (cucumber), 2.0–2.8 pt (summer squash), 1.6 pt (winter squash), 1.5–2.5 pt (watermelon), or 1.6 pt (melon) 8: 1.75 pt (summer squash, winter squash, cucumber)	5EC: 5.6 pt (cucumber), 8.4 pt (summer squash), 4.8 pt (winter squash), or 5 pt (watermelon) 8: 3.5 pt (cucumber), 5.25 pt (summer squash), or 5.25 pt (winter squash)	24	1	5EC: No more than 2 applications per year 8: Squash and cucumbers only.
	3A	*Baythroid XL (beta-cyfluthrin)	2.4–2.8 fl oz	11.2 fl oz	12	0	Can be used on all cucurbits in crop group 9. Highly toxic to foraging bees.
	3A	*Brigade 2 EC (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	No more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	*Capture LFR (bifenthrin)	6.8–8.5 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Highly toxic to foraging bees.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19 oz	24	1	–
	3A + 6	*Gladiator (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	Reapplications at least 7 days apart.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	Reapplications at least 4 days apart.

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			Appl.	Season ²			
	4A	Actara (thiamethoxam)	1.5-3.0 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	Admire Pro (imidacloprid) (see appropriate labels for other brands)	7-10.5 oz	10.5 fl oz	12	21	Not for planthouse.
	4A	Assail 30 SG (acetamiprid)	2.5-5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Toxic to foraging bees.
	4A	Belay Insecticide (clothianidin)	Foliar: 3.0-4.0 fl oz Soil: 9.0-12.0 fl oz	12 fl oz	12	Foliar: Do not make application after 4th true leaf on main stem is unfolded. Soil: 21	Do not apply when plants are blooming.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2-7 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Highly toxic to foraging bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1-4 oz	6 oz	12	Foliar: 1	Highly toxic to foraging bees. Use only foliar application for beetles. Pests controlled differ depending on application method.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4-7 oz	14 oz	12	1	-
	15	Rimon 0.83EC (novaluron)	9-12 fl oz	36 fl oz	12	1	Reapplications at least 14 days apart.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A per season either as foliar or soil applications.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (incl. armyworms, cabbage looper, corn earworm, cutworm, melonworm, pickleworm)	1A	Lannate LV (methomyl)	1.5-3 pt	18 pt	48	3	No more than 12 applications per year.
	1A	Lannate SP (methomyl)	0.5-1 pt	12 pt	48	3	No more than 12 applications per year.
	1A	Sevin 4F, XLR (carbaryl)	0.5-1.0 qt	6 qt	12	3	Do not apply when plants are wet. Has been reported to flare mites. Do not apply to plants in bloom. Pickleworm and melonworm only.
	1B	Malathion 5EC Malathion 8 (malathion)	5EC: 1.5-2.8 pt (cucumber), 2.0-2.8 pt (summer squash), 1.6 pt (winter squash), 1.5-2.5 pt (watermelon), or 1.6 pt (melon) 8: 1.75 pt (summer squash, winter squash, cucumber)	5EC: 5.6 pt (cucumber), 8.4 pt (summer squash), 4.8 pt (winter squash), or 5 pt (watermelon) 8: 3.5 pt (cucumber) or 5.25 pt (summer squash, winter squash)	24	1	5EC: No more than 2 applications per year 8: Squash and cucumbers only.
	3A	*Ambush 25W (permethrin)	6.4-12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	No more than 8 applications per season. Highly toxic to bees.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	5.8-9.6 fl oz	48 fl oz	12	3	No more than 5 applications per season. Cucumber, melons, pumpkin, summer and winter squash only. Highly toxic to foraging bees.
	3A	*Athena (bifenthrin)	7-17 fl oz	51 fl oz	12	7	No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-2.8 fl oz	11.2 fl oz	12	0	Can be used on all cucurbits in crop group 9. Highly toxic to foraging bees.
	3A	*Brigade 2 EC (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	12	3	No more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	*Capture LFR (bifenthrin)	3.4-6.8 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.

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			Appl.	Season ²			
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4-10.3 oz	41.2 oz	12	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Mustang (zeta-cypermethrin)	3.0-4.3 oz	25.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4-12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Highly toxic to foraging bees.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-15.61 oz	15.61 oz	12	0	OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	1.28-1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4-4.5 fl oz	19 fl oz	24	1	-
	3A + 6	*Gladiator (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	Reapplications at least 7 days apart.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-9 fl oz	31 fl oz	24	1	No more than 4 applications per year. Reapplications at least 4 days apart.
	4A	Assail 30SG (acetamiprid)	2.5-5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4-7 oz	14 oz	12	1	-
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hr following application.
	6	*Proclaim (emamectin benzoate)	3.0-4.8 fl oz	14.4 fl oz	12	7	Apply this product diluted in a minimum volume of 10 gal/A. No more than 2 consecutive applications.

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			Appl.	Season ²			
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10 fl oz	20 fl oz	24	7	Restrictions exist for this product because of the risk to pollinators.
	11A	Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	-	4	0	Apply when larvae are small for best control. OMRI-listed. ³
	11A	Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	-	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed. ³
	11A	Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	-	4	0	Use high rate for armyworms. Treat when larvae are young. Genetically engineered strain of <i>Bt kurstaki</i> and <i>Bt aizawai</i> strains. Not for organic production.
	11A	Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25-1.5 lb	-	4	0	Use higher rates for armyworms. OMRI-listed. ³
	11A	DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	-	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed. ³
	11A	Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12-1.50 lb	-	4	0	Treat when larvae are young. Thorough coverage is essential. Use higher rates for armyworms. OMRI-listed. ³
	11A	Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	-	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. OMRI-listed. ³
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Reapplications at least 14 days apart.
	18	Intrepid 2F (methoxyfenozide)	4-10 fl oz	64 fl oz	4	3	No more than 4 applications per season.
	22	Avaunt (indoxacarb)	2.5-6.0 oz	24 oz	12	3	Highly toxic to foraging bees. Do not apply this product or allow it to drift to blooming crops or weeds while bees are foraging in the treatment area. Spray reapplications at least 5 days apart.

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			Appl.	Season ²			
	28	Coragen (chlorantraniliprole)	Drip: 2.0–7.5 fl oz Soil at planting: 3.5–7.5 fl oz Foliar: 2.0–7.0 fl oz	15.4 fl oz Combined at-plant and drip chemigation soil application: 10 fl oz	4	1	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	Exirel (cyantraniliprole)	7.0–13.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A per crop, either as foliar or soil applications.
	28	Verimark (cyantraniliprole)	At planting: 6.75–13.5 fl oz Drip chemigation: 5–10 fl oz	At planting: 13.5 fl oz Drip chemigation: 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at-plant and drip chemigation. No more than 2 drip chemigation applications (1 if an at-plant application is used).
Fire ants	6	Clinch (Abamectin)	1 lb in broadcast application or 5 tbsp per mount	4 lb	–	0	Do not apply if rainfall may occur in the next 6 hr. Ants need to be actively foraging.
	7A	Extinguish (S-methoprene)	0.75 lb	–	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. May be applied by ground equipment or aerially.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	2.0 lb	12	1	Apply when ants are actively foraging.
Leafminers	1A	Vydate L (oxamyl)	2–4 pt	12 pt	48	1	Reapplications at least 7 days apart.
	1B	Dimethoate 4 EC (dimethoate)	Melons: 1 pt Watermelons: 0.5–1 pt	2 pt per year	48	3	Highly toxic to bees. Not for squash or cucumber.
	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	No more than 8 applications per season. Highly toxic to bees.
	3A	*Athena (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A + 6	*Gladiator (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	Reapplications at least 7 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-9 fl oz	31 fl oz	24	1	No more than 4 applications per year. Reapplications at least 4 days apart.
	4A	Belay Insecticide (clothianidin)	Foliar: 3.0-4.0 fl oz Soil: 9.0-12.0 fl oz	12 fl oz	12	Foliar: Do not make application after 4th true leaf on main stem is unfolded. Soil: 21	Do not apply when plants are blooming.
	4A	Safari 20 SG (dinotefuran)	3.5-5.0 fl oz	1.34 lb	-	-	For transplants in greenhouse only.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2-7 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1-4 oz Soil: 5-7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Highly toxic to foraging bees. Use only 1 application method (soil or foliar). Pests controlled differ depending on application method.
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hr following application.
	6	*Agri-Mek SC (abamectin)	1.75-3.50 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications. Must be mixed with an adjuvant. Highly toxic to foraging bees.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10 fl oz	20 fl oz	24	7	Restrictions exist for this product due to the risk for pollinators. Apply as soon as leafminers are observed on the leaves.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Reapplications at least 14 days apart.
	17	Trigard (cyromazine)	2.66 oz	15.96 oz	12	0	No more than 6 applications.

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			Appl.	Season ²			
	28	Coragen (chlorantraniliprole)	Drip: 2.0–7.5 fl oz Soil at planting: 3.5–7.5 fl oz Foliar: 2.0–7.0 fl oz	15.4 fl oz Combined at-plant and drip chemigation soil application: 10 fl oz	4	1	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A per crop, either as foliar or soil applications.
	28	Verimark (cyantraniliprole)	At planting: 6.75–13.5 fl oz Drip chemigation: 5–10 fl oz	At planting: 13.5 fl oz Drip chemigation: 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at plant and drip chemigation more than 2 drip chemigation applications (1 if an at-plant application is used).
	1B	Malathion 5EC Malathion 8 (malathion)	5EC: 1.5–2.8 pt (cucumber), 2.0–2.8 pt (summer squash), 1.6 pt (winter squash), 1.5–2.5 pt (watermelon), or 1.6 pt (melon) 8: 1.75 pt (summer squash, winter squash, cucumber)	5EC: 5.6 pt (cucumber), 8.4 pt (summer squash), 4.8 pt (winter squash), or 5 pt (watermelon) 8: 3.5 pt (cucumber) or 5.25 pt (summer squash, winter squash)	24	1	5EC: No more than 2 applications per year. 8: Squash and cucumbers only.
	3A	*Athena (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	41.2 oz	12	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	No more than 10 applications per season. OMRI-listed. ³
	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications. Must be mixed with an adjuvant Highly toxic to foraging bees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Squash bug, leaf-footed bug	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10 fl oz	20 fl oz	24	7	Restrictions exist for this product because of the risk to pollinators. Apply as soon as mites are observed.
	10B	Zeal (etoxazole)	2.0-3.0 oz	3.0 oz Cucumbers: 6 oz	12	7	Apply when populations are low. No more than 1 application per season, except 2 for cucumbers (supplemental label).
	20B	Kanemite 15 SC (acequinocyl)	31 fl oz	62 fl oz	12	1	No more than 2 applications per season. Do not apply by air. Melons, watermelon, and cucumbers only.
	20D	Acramite-50WS (bifenazate)	0.75-1.0 lb	1.0 lb	12	3	No more than 1 application per season.
	21A	Magister (fenazaquin)	24-36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal XLO (fenpyroximate)	1.0-2.0 pt	4.0 pt	12	3 Cucumbers: 1	All melons, watermelon, and cucumbers. No more than 2 applications per season. Effective for broad mite control.
	23	Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	25.5 fl oz	12	7	No more than 3 applications.
	1A	Sevin 4F, XLR (carbaryl)	0.5-1.0 qt	6 qt	12	3	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom.
	3A	*Ambush 25W (permethrin)	6.4-12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	No more than 8 applications at the highest rate per season. Highly toxic to bees.
	3A	*Asana XL (0.66EC) (esfenvalerate)	5.8-9.6 fl oz	48 fl oz	12	7	-
	3A	*Athena (bifenthrin)	13.5-17 fl oz	51 fl oz	12	7	No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Brigade 2 EC (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	12	3	No more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	41.2 oz	12	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	No more than 10 applications per season. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19 fl oz	24	1	–
	3A + 6	*Gladiator (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	Reapplications at least 7 days apart.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	No more than 4 applications per year. Reapplications at least 4 days apart.
	4A	Assail 30SG (acetamiprid)	5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Applications for squash bug are most effective against newly laid eggs and nymphs. Toxic to foraging bees.
	4A	Belay Insecticide (clothianidin)	Foliar: 3.0–4.0 fl oz Soil: 9.0–12.0 fl oz	12 fl oz	12	Foliar: Do not make application after 4th true leaf on main stem is unfolded Soil: 21	Do not apply when plants are blooming.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for 38 hr after application.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips (check label for species controlled)	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Highly toxic to foraging bees. Use only 1 application method (soil or foliar). Note that pests controlled differ depending on application method.
	4D	Sivanto Prime (flupyradifurone)	Foliar: 10.5–14 fl oz	Foliar: 28 fl oz	4	Foliar: 1	Foliar: Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Reapplications at least 14 days apart.
	1A	Vydate L (oxamyl)	2–4 pt	12 pt	48	1	Reapplications at least 7 days apart.
	1B	Dimethoate 4 EC (dimethoate)	Melons: 1 pt Watermelons: 0.5–1 pt	2 pt per year	48	3	Highly toxic to bees. Not for squash or cucumber.
	4A	Admire Pro (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz	10.5 fl oz	12	Soil: 21	Do not use with other Group 4A insecticides. Not for planthouse. Only for foliage feeding thrips; will not control thrips feeding on flowers.
	4A	Platinum 75SG (thiamethoxam)	5–11 fl oz 75SG: 1.66–3.67 oz	11 fl oz 75SG: 3.67 oz	12	30	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	Safari 20 SG (dinotefuran)	3.5–5.5 fl oz	1.34 lb	12	-	For transplants in the greenhouse only.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Highly toxic to foraging bees. Use only 1 application method (soil or foliar). Pests controlled differ depending on application method.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	5	Entrust SC (spinosad)	6–8 fl oz	29 fl oz	1	4	No more than 5 applications per year. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6–10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hr following application.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A per crop, either as foliar or soil applications.
Whiteflies	1B	*Diazinon AG500 50W (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	AG500: 4 qt 50W: 8 lb	72	Preplant	Melons and watermelons only. Not for squash or cucumbers. No more than 1 application per year.
	3A	*Athena (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	Only for adults. No more than 2 consecutive applications. No more than 2 applications after bloom.
	3A	*Brigade 2 EC (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	No more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	*Capture LFR (bifenthrin)	3.4–8.5 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	41.2 oz	12	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	Reapplications at least 10 days apart. OMRI-listed. ³
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	9 fl oz	31 fl oz	24	1	Reapplications at least 4 days apart.
	4A	Actara (thiamethoxam)	1.5–5.5 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	Admire Pro (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz Planthouse: 0.44 fl oz/ 10,000 plants	10.5 fl oz	12	Soil: 21	Do not use with other Group 4A insecticides. Planthouse: 1 application to transplants. See label for use on mature greenhouse cucumbers.
	4A	Assail 30SG (acetamiprid)	2.5–5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Platinum 75SG (thiamethoxam)	5–11 fl oz 75SG: 1.66–3.67 oz	11 fl oz 75SG: 3.67 oz	12	30	A 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	Safari 20 SG (dinotefuran)	3.5–5.5 fl oz	1.34 lb	12	–	For transplants in the greenhouse only.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Highly toxic to foraging bees. Use only 1 application method (soil or foliar). Pests controlled differ depending on application method.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 oz	12	30	–
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	–
	4C	Closer SC (sulfoxaflor)	4.25–4.5 fl oz	17 fl oz	12	1	Highly toxic against pollinators: Notify known beekeepers within 1 mile of the treatment area. Limit application to times when managed bees and native pollinators are least active.
	4D	Sivanto Prime (flupyradifurone)	Foliar: 10.5–14 fl oz	Foliar: 28 fl oz	4	Foliar: 1	Foliar: Reapplications at least 7 days apart.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	24	7	Restrictions exist for this label because of the risks to pollinators.
	7C	Knack IGR (pyriproxyfen)	8–10 fl oz	20 fl oz	12	7	Immatures only. Apply when nymphs first appear. No more than 2 applications per growing season.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	0	Reapplications at least 7 days apart.
	9B	PQZ (pyrifluquinazon)	3.2 fl oz	9.6 fl oz	12	7	Reapplications at least 7 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	9D	Sefina Inscalis Insecticide (afidopyropen)	14 fl oz	28 fl oz	12	0	Reapplications at least 7 days apart. Maintain a 10-ft vegetative filter strip of permanent vegetation between the field edge and aquatic habitat.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Reapplications at least 14 days apart.
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	7	Immatures only. IGR. No more than 2 applications per season per crop or 4 per year.
	21A	Magister (fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	23	Oberon 2SC (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	12	7	No more than 3 applications.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	No more than 0.4 lb a.i./A per crop, either as foliar or soil applications.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	At planting: 13.5 fl oz Drip chemigation: 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at-plant and drip chemigation. No more than 2 drip chemigation applications (1 if at-plant application is used).
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 13. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. **Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Nicholas S. Dufault, UF/IFAS Department of Plant Pathology, Gainesville; or Pamela Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria leaf spot/blight	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Instill, Kalmor, Kantan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for specific guidelines.
	M1 + M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75 WDG, Koverall, Mancozeb 75 WDG, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for specific guidelines.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6 L, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, and other environmental conditions listed on the label.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	Apply preventatively when conditions are favorable for disease outbreak. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P4	Vacciplant (laminarin)	22 fl oz	See label	0	4 hr	Initiate as preventative application.
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz per year	0	0.5	Reapplications at least 7 days apart.
	3	Mettle 125 ME (tetraconazole)	8 fl oz	24 fl oz per year	1	0.5	No more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz per year	7	0.5	No more than 2 consecutive applications. Greenhouse use only for cucumber.
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	No more than 4 applications per crop.
	7	Endura (boscalid)	6.5 oz	26 oz per year	0	0.5	-
	7	Fontelis (penthiopyrad)	16 fl oz	67 fl oz per year	1	0.5	No more than 2 applications sequentially with any FRAC 7 containing fungicide. See label for rates for greenhouse use.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Experience (fluopyram + tebuconazole)	17 fl oz	34 fl oz per year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	8 fl oz	27.2 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	-
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	9	Vango WG (cyprodinil)	7 oz	28 oz per year	1	0.5	Alternate with fungicide in another FRAC group after 2 applications.
	9 + 12	Alterity 62.5 Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	1	0.5	No more than 2 consecutive applications.
	11	(azoxystrobin) Many brands available: Acadia 2 SC, Aframe, Arius 250, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxystrozone, AZteroid FC, AZteroid FC 3.3, Cadera, Dexter SC, Gold Rush, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Reason 500 SC (fenamidone)	5.5 fl oz	22 fl oz per year	14	0.5	Do not make more than 1 application of Reason 500 SC Fungicide before alternating with a fungicide from a different resistance management group.
	11 + M3	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Acadia ESQ Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	Emblem Spirato (fludioxonil)	7 fl oz	28 fl oz per year	1	0.5	-
	19	Affirm WDG PH-D (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	-
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb per year	5	2	No more than 8 applications per crop. Some cantaloupes are sensitive. See label.
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	See label	3	0.5	No more than 4 applications per crop. Must tank-mix with a contact fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	29	Lektivar 40 SC Omega 500 F Orbus 4 F Omavo Oxolid 4 F (fluazinam)	24 fl oz	See label	See label	0.5	See label for crop-specific guidelines.
	33	K-Phite Fungi-Phite Reliant (phosphorous acid and salts)	See label	See label	0	4 hr	Check label for guidelines on foliar and aerial applications, as well as preventative and control programs. Reapplications at least 3 days apart. Check label to see whether it is suppression of disease only.
	39	Magister SC (fenazaquin)	36 fl oz	36 fl oz	3	0.5	Also labeled as an acaricide. Note warning to bees and insect pollinators. No more than 1 application per year. Foliar suppression only.
	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Grotto, ET-F, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
Angular leaf spot	M1 + M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	P1	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz per year	0	0.5	Apply preventatively prior disease development. Suppression of disease.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Anthraco (<i>Colletotrichum</i> spp.)	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, Champion++, Champ WG, C-O-C-S WDG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Grotto, ET-F, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 50WP, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50 DF, Nu-Cop HB, Nu-Cop XLR, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncoze 75DF, Penncoze 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	M5 + 4	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	No more than 4 applications per crop.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	Spraying on mature watermelon may cause sun burn.
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85 WDG, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Talaris 4.5F, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label. Check label for additional guidelines.
	3 + 9	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz per year	7	0.5	No more than 2 consecutive applications. See label for greenhouse use only for cucumber.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	See label for guidelines.
	7 + 3	Luna Experience (fluopyram + tebuconazole)	17 fl oz	34 fl oz per year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Flex (fluopyram + difenoconazole)	8 fl oz	27.2 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	-
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	-
	11	(azoxystrobin) Many brands available: Acadia 2 SC, Aframe, A-Zox 25 SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxystrobin, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplant production. See label for details.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	19	Oso 5% SC (polyoxin D zinc salt)	13.0 fl oz	See label	0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Bacterial fruit blotch	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	See label	3	0.5	No more than 4 applications per crop. Must tank-mix with a contact fungicide. See label.
	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 30HB, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Suppression only. Check label for crop-specific guidelines.
Belly rot	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	P1	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz per year	0	0.5	Apply preventatively prior to disease development. Suppression of disease.
	27 + 11	Tanos (cymoxanil + famoxadone)	10 oz	See label	3	0.5	No more than 4 applications per crop. Must tank-mix with a contact fungicide. Bacterial fruit blotch disease suppression only.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Miramar, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7 + 3	Luna Experience (fluopyram + tebuconazole)	17 fl oz	34 fl oz per year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	11	(azoxystrobin) Many brands available: Acadia 2 SC, Aframe, A-Zox 25SC, Azoxy 2 SC, Azoxy 2SC Prime, AzoxyStar, Azoxzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Cercospora leaf spot	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	19	PH-D (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	-
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 4	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	No more than 4 applications per crop.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Mettle 125 ME (tetraconazole)	8 fl oz	24 fl oz per year	1	0.5	No more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3 + 9	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz per year	7	0.5	No more than 2 consecutive applications. See label for greenhouse use only for cucumber.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	8 fl oz	27.2 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	-
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	11	(azoxystrobin) Many brands available: Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb per year	5	2	No more than 8 applications per crop. Some cantaloupes are sensitive. See label.
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-
Downy mildew	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 30HB, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M2	Top Cop w Sulfur (copper + sulfur)	1 qt	See label	-	1	Do not apply if air temperatures greater than 90°F are expected.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P1	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz per year	0	0.5	Apply preventatively prior disease development. Suppression of disease.
	P4	Vacciplant (laminarin)	22 fl oz	See label	0	4 hr	Initiate as preventative application.
	3 + 33	Viathon (tebuconazole + potassium phosphite)	4 pt	12 pt	7	0.5	Watermelon only.
	4 + M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	5	2	No more than 4 applications per crop.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4 + M3	Ridomil Gold MZ WG (mancozeb + mefenoxam)	2.5 lb	10 lb	5	2	No more than 4 applications per crop. Rate is for downy mildew.
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	See label	0	2	No more than 4 applications per crop.
	7 + 11	Merivon (flupyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	-
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	-
	11	(azoxystrobin) Many brands available: Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Cabrio EG (pyraclostrobin)	12 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11	Flint Extra Flint (trifloxystrobin)	See label	See label	See label	0.5	For disease suppression. No more than 4 applications per crop and alternate chemistry.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 fl oz	14	0.5	See label.
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	19	Oso 5% SC (polyoxin D zinc salt)	13.0 fl oz	See label	0	4 hr	-
	21	Ranman Ranman 400 SC (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	No more than 6 applications per crop. Follow resistance management guidelines.
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz per year	1	0.5	Reapplications at least 14 days apart.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb per year	5	2	No more than 8 applications per crop. Some cantaloupes are sensitive. See label.
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-
	27	Curzate 60DF Cymbol (cymoxanil)	See label	See label	3	0.5	Use only with a labeled rate of protectant fungicide.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	See label	3	0.5	No more than 4 applications per crop. Must tank-mix with a contact fungicide.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	See label for instructions.
	29	Omega 500 F Lektivar 40 SC Omavo Orbus 4 F (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.
	33	Aliette 80WDG, Alude, Fosphite, Fungi-Phite, K-Phite 7 LP, Linebacker WDG, Prophyt, Reliant (fosetyl-Al, phosphorous acid and salts)	See label	See label	See label	See label	See label for specific product guidelines.
	40	Forum (dimethomorph)	6 oz	30 oz	See label	0.5	No more than 5 applications per crop. Apply with another fungicide that has a different mode of action and alternate.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	40	Orondis Ultra B Revus (mandipropamid)	8 fl oz	32 fl oz	0	4 hr	See label. For suppression only.
	43	Presidio (fluopicolide)	4 fl oz	8 fl oz per year	2	0.5	Tank-mix with another fungicide product with a different FRAC code.
	45 + 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz per year	0	0.5	No more than 2 sequential applications. Addition of a spreading/penetrating adjuvant is recommended.
	49	Orondis Opti A Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz per year	0	4 hr	Cucurbit vegetables, crop group 9. See label.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz per year	0	4 hr	No more than 2 sequential applications before rotating to a fungicide with a different mode of action. Check label for additional details.
	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
Gummy stem blight (<i>Diymella bryoniae</i>)	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Miramar, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz per year	0	0.5	Reapplications at least 7 days apart.
	3	Mettle 125 ME (tetraconazole)	8 fl oz	24 fl oz per year	1	0.5	No more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	Proline (prothioconazole)	5.7 fl oz	17.1 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz per year	0	0.5	No more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	(tebuconazole) Many brands available: Buzz Ultra DF, Incognito 4.5F, Monsoon, Onset 3.6L, Orius 3.6F, Teb 3.6 SC, Tebu-Crop 3.6F, Tebu 3.6F, Tebuconazole 3.6 F, Tebustar 3.6L, Tebuzol 3.6F, Toledo, Vibe	See label	See label	1	1	Follow resistance management guidelines indicated on the label. Check label for additional guidelines.
	3	Topguard (flutriafol)	14 fl oz	56 fl oz per year	0	0.5	-
	3 + M5	Muscle ADV (tebuconazole + chlorothalonil)	2.1 pt	6.4 pt	7	0.5	Watermelon, squash, pumpkin, and melon
	3 + 9	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz per year	7	0.5	No more than 2 consecutive applications. See label for greenhouse use only for cucumber.
	3 + 33	Viathon (tebuconazole + potassium phosphite)	4 pt	12 pt	7	0.5	-
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	See label	0	2	No more than 4 applications per crop.
	7	Endura (boscalid)	6.5 oz	26 oz per year	0	0.5	No more than 1 application before alternating to another labeled fungicide with a different mode of action for at least one application.
	7	Fontelis (penthioopyrad)	16 fl oz	67 fl oz per year	1	0.5	No more than 2 applications sequentially.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7 + 3	Luna Experience (fluopyram + tebuconazole)	17 fl oz	34 fl oz per year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7.
	7 + 3	Propulse (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	No more than 1 application before alternating to a non-FRAC 7, non-FRAC 11 group fungicide. In areas where gummy stem blight resistance to FRAC 7 or 11 fungicides have been reported, tank-mix with chlorothalonil at full rate.
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	No more than 4 applications per crop and alternate chemistry.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	9 + 12	Alterity 62.5 Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	1	0.5	No more than 2 consecutive applications before switching to fungicide with a different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 25C Prime, AzoxyStar, Azoxzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC (fluoaxystrobin)	See label	See label	See label	See label	-
	11	Narvos 50 WDG (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label.
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	Emblem (fludioxonil)	7 fl oz	28 fl oz per year	1	0.5	-
	19	Affirm WDG Oso 5% SC PH-D (polyoxin D zinc salt)	See label	See label	0	4 hr	-
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	29	Omavo Omega 500 F (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.
Phytophthora blight/fruit and root rot	4	Orondis Gold B Ridomil Gold SL (mefenoxam)	2 pt	See label	5	2	See label for application-specific guidelines (soil-injected or soil-incorporated, soil-directed and other foliar). Suppression only.
	4 + M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	5	2	No more than 4 applications per crop.
	21	Ranman Ranman 400 SC (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	No more than 6 applications per crop. Follow resistance management guidelines.
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz per year	2	0.5	Reapplications at least 14 days apart.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb per year	5	2	No more than 8 applications per crop. Some cantaloupes are sensitive. See label.
	27 + 11	Tanos (cymoxanil + famoxadone)	10 oz	See label	3	0.5	No more than 4 applications per crop. Must tank-mix with a contact fungicide. Phytophthora blight foliar and fruit phase only (disease suppression).
	29	Omavo Omega 500 F (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.
	33	Aliette 80WDG, Alude, Fosphite, K-Phite 7 LP, Linebacker WDG, ProPhyt, Reliant (fosetyl-Al, phosphorous acid and salts)	See label	See label	See label	See label	See label for specific product guidelines.
	40	Forum (dimethomorph)	6 oz	30 oz	See label	0.5	No more than 5 applications per crop. Apply with another fungicide that has a different mode of action and alternate.
	40	Orondis Ultra B Revus (mandipropamid)	8 fl oz	32 fl oz	0	4 hr	Phytophthora blight suppression only.
	43	Presidio (fluopicolide)	4 fl oz	8 fl oz per year	2	0.5	Tank-mix with another fungicide product with a different FRAC code.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	45 + 40	Zapro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz per year	0	0.5	No more than 2 sequential applications. Addition of a spreading/penetrating adjuvant is recommended.
	49	Orondis Gold 200 Orondis Opti A Orondis Ultra A (oxathiapiprolin)	See label	See label	0	4 hr	Cucurbit vegetables, crop group 9.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz per year	0	4 hr	No more than 2 sequential applications before rotating to a fungicide with a different mode of action. Check label for additional details.
	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCU, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
Powdery mildew	M1 + M2	Top Cop w Sulfur (copper + sulfur)	1 qt	See label	-	1	Do not apply if air temperatures greater than 90°F are expected.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M2	(sulfur) Many brands available: Acoidal, Cosavet DF, Cosavet DF Edge, Crusade DF, Defend DF, Micro Sulf, Micronized Wettable Sulfur, Suffa, Sulfur 6L, Sulfur 90W, Thiolux	See label	See label	See label	1	See individual label. Do not use when temperatures are greater than 90°F or on sulfur-sensitive varieties. Check label for use.
	M2 + 3	Unicorn (sulfur + tebuconazole)	3.75 lb	15 lb	14	0.5	Suppression only. Only available for use on some cucurbits. See label.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Praiz, Rialto 720F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P1	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventatively prior to disease development. Suppression of disease.
	P4	Vacciplant (laminarin)	22 fl oz	See label	0	4 hr	-
	U6	Torino (cyflufenamid)	3.4 oz	6.8 oz per year	0	4 hr	-
	50	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz per year	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label. This product is not recommended for powdery mildew based upon recent testing indicating that pathogen population in Florida was not sensitive to the active ingredient.
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz per year	0	0.5	Reapplications at least 7 days apart.
	3	Mettle 125 ME (tetraconazole)	8 fl oz	24 fl oz per year	1	0.5	No more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	Procure 480SC Trionic 4 SC (triflumizole)	8 fl oz	24 fl oz	0	0.5	Follow resistance management guidelines on label.
	3	(prothioconazole) Many brands available: Proline, Prothioconazole 4L, Prozio™ SC, Others	5.7 fl oz	17.1 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year.
	3	Rally 40WSP (myclobutanil)	5 oz	See label	0	1	-
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz per year	0	0.5	No more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	(tebuconazole) Many brands available: Buzz Ultra DF, Incognito 4.5F, Monsoon, Onset 3.6L, Orius 3.6F, Teb 3.6 SC, Tebu 3.6F, Tebuconazole 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo, Vibe	See label	See label	1	1	Follow resistance management guidelines indicated on the label. Check label for additional guidelines.
	3	Topguard (flutriafol)	14 fl oz	56 fl oz per year	0	0.5	-
	3 + M5	Muscle ADV (tebuconazole + chlorothalonil)	2.1 pt	6.4 pt	7	0.5	Watermelon, squash, pumpkin, and melon

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3 + 9	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz per year	7	0.5	No more than 2 consecutive applications. See label for greenhouse use only for cucumber.
	3 + 33	Viathon (tebuconazole + potassium phosphite)	3 pt	12 pt	7	0.5	-
	7	Endura (boscalid)	6.5 oz	26 oz per year	0	0.5	No more than 1 application before alternating to another labeled fungicide with a different mode of action for at least 1 application.
	7	Fontelis (penthioopyrad)	16 fl oz	67 fl oz per year	1	0.5	No more than 2 applications sequentially.
	7	Velum Prime (fluopyram)	6.84 fl oz	13.7 fl oz per year	0	0.5	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7 + 3	Luna Experience (fluopyram + tebuconazole)	17 fl oz	34 fl oz per year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	8 fl oz	27.2 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7.
	7 + 3	Propulse (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz per year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	No more than 1 application before alternating to a non-FRAC 7, non-FRAC 11 group fungicide. In areas where gummy stem blight resistance to FRAC 7 or 11 fungicides have been reported, tank-mix with chlorothalonil at full rate.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Pristine Empire (boscalid + pyraclostrobin)	18.5 oz	74 oz per year	0	0.5	No more than 4 applications per crop and alternate chemistry.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	9	Vango (cyprodinil)	7 oz	28 oz per year	1	0.5	Alternate to a different mode of action after 2 applications.
	9 + 12	Alterity 62.5 Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	1	0.5	No more than 2 consecutive applications.
	11	(azoxystrobin) Many brands available: Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 25C Prime, AzoxyStar, Azoxzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11	Flint Extra Flint (trifloxystrobin)	See label	See label	See label	0.5	(Disease suppression) No more than 4 applications per crop and alternate chemistry.
	11	Narvos 50 WDG Sovran (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label.
	11 + M5	Arius ADV Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	No more than 4 applications per crop for all QoI fungicides. No more than 1 consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz per year	1	0.5	Must be rotated with a non-QoI-containing fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	Mural (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	Emblem (fludioxonil)	7 fl oz	28 fl oz per year	1	0.5	-
	13	Quintec (quinoxifen)	6 fl oz	See label	3	0.5	No more than 4 applications. No more than 2 consecutive applications. Not labeled for all cucurbits; labeled for various melons, cantaloupe, winter squash, gourds, pumpkins, and watermelon.
	19	Affirm WDG Oso 5% SC PH-D (polyoxin D zinc salt)	13 fl oz	See label	0	4 hr	-
	39	Magister SC (fenazaquin)	36 fl oz	36 fl oz	3	0.5	Also labeled as an acaricide. Note warning to bees and insect pollinators. No more than 1 application per year.
	39	Torac (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	Reapplications at least 14 days apart.
	50	Prolivo 300 SC (pyriofenone)	5 fl oz	16 fl oz per year	0	-	No more than 2 sequential applications before rotating to another fungicide with a different mode of action.
	4	Apron XL Orondis Gold B Ridomil Gold SL Ultra Flourish (mefenoxam)	See label	See label	See label	See label	-
	4	(metalaxyl) Many brands available: Acquire, Allegiance FL, Metalaxyl 265 ST, Metalaxyl 318 FS, Metalaxyl 4.0 ST, Metastar 2E, Metastar 4S, MetXL, Sebring 318 FS, Sebring 480 FS	See label	See label	See label	See label	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Target spot (<i>Corynespora cassicola</i>)	4 + 11	Uniform (mefenoxam + azoxystrobin)	See label	See label	See label	0	Apply 0.34 fl oz/1000 row ft as in-furrow spray in a minimum of 5 gal of water/A at planting. No more than 1 application per season.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	Use a tank-mix partner. See label for directions using a contact fungicide and Pythium suppression.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B, Periapt, Praiz	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Mettle 125 ME (tetraconazole)	8 fl oz	24 fl oz per year	1	0.5	No more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz per year	0	0.5	No more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	Topguard (flutriafol)	14 fl oz	56 fl oz per year	0	0.5	Check label.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	See label for guidelines.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz per year	0	0.5	See label.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.
	11	(azoxystrobin) Many brands available: Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 25C Prime, AzoxyStar, Azoxzone, AZteroid FC, Azteroid FC 3.3, Equation, Equation SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	No more than 4 applications per crop and alternate chemistry. See label for tank-mixing restrictions.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	Evito 480 SC Tepera (fluoxastrobin)	See label	See label	See label	See label	-
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	19	Affirm WDG Oso 5% SC PH-D (polyoxin D zinc salt)	See label	See label	0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	-
Scab (<i>Cladosporium cucumerinum</i>)	M1	Cueva Camelot O Grotto (copper octanoate)	See label	See label	0	4	See label for crops listed.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	Dexter Max (mancozeb + azoxystrobin)	3.2 lb	12.8 lb per year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank-mixing. No more than 1 application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on the label.
	M5 + 27	Ariston Cymbol Advance (chlorothalonil + cymoxanil)	3 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications before rotating to a fungicide with different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	P1	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventatively prior to disease development. Suppression of disease.
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	No more than 4 applications per crop.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	No more than 2 applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	19	Affirm WDG Oso 5% SC PH-D (polyoxin D zinc salt)	See label	See label	0	4 hr	-
Fusarium wilt (watermelon)	3	(prothioconazole) Many brands available: Proline, Prothioconazole 4L, Prozio™ SC, others	5.7 fl oz	17.1 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year.
	7 + 3	Propulse (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz per year	7	0.5	No more than 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7+12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz per year	1	0.5	For suppression only. Follow specific guidelines in the label.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 14. Nonfumigant nematicides for cucurbit crops in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Mocap 15G (a.i. ethoprop) (only labeled on cucumber)	Apply 13 lb/A (7 ft row spacing) or 2.1 lb/1,000 linear row ft in a band 12–15 in. wide on the row at planting. Prepare bed and knock off top to provide a level area for treatment. Mix with the top 2–4 in. of soil with mechanical equipment right after application. DO NOT use as a seed furrow treatment or allow granules to contact the seed. No more than 1 application per season.
Vydate L (a.i. oxamyl)	Apply ½–1 gal/A at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. No more than 2 gal/A per season. Reapplications at least 7 days apart unless a longer interval is stated. If an at-plant application of more than ½ gal/A is made, do not make more than 2 additional applications.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Soil reapplications at least 5 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Salibro (a.i. fluazaindolizine)	Apply 15.3–23 fl oz/A (0.5–0.75 lb/A a.i.) as preplant incorporated, preplant drip, or at-plant drip. Apply 7.7 fl oz/A (0.25 lb a.i.) for in-season drip chemigations. No more than 23 fl oz/A per calendar year. No more than 2 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 28 days apart. Pre-harvest interval: Do not apply within 1 day of harvest.
Biological nematicides	See chapter 19.
Mocap and Vydate are insecticide/nematicides; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 15. Fumigant nematicides for cucurbit crops in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 8. Eggplant Production¹

Pamela D. Roberts, Craig Frey, Anna Mészáros, Nathan S. Boyd, Johan Desaegeer, and Jawwad Qureshi²

Botany and Planting

Eggplant, Oriental, Thai, and Indian eggplant—*Solanum melongena*

Table 1. Planting dates for eggplant.

Planting Region	Dates		
	Eggplant	Japanese/Chinese/Indian Eggplant	Thai Eggplant
North Florida	Aug; Feb–Mar	Feb–Mar	Feb–Mar
Central Florida	Aug–Sept; Jan–Feb	Aug–Sept; Jan–Feb	Aug–Sept; Jan–Feb
South Florida	Aug–Feb	Aug–Feb	Aug–Feb

Table 2. Planting information for eggplant.

Planting Parameters	Measurements		
	Eggplant	Japanese/Chinese/Indian Eggplant	Thai Eggplant
Distance between rows (in)	36–72	36–72	36–72
Distance between plants (in)	18–40	18–40	36–60
Seeding depth (in)	0.5–0.75	0.5–0.75	0.5–0.75
Seed per acre to seed (lb)	1	0.25–0.5	0.25–0.5
Seed per acre to transplant (lb)	0.25–0.50	–	–
Days to maturity from seed	90–115	–	–
Days to maturity from transplant	70–90	–	–
Plant population (acre)	9,680	9,680	9,680

Information on “Asian” solanums is included in this chapter. The Asian solanum group includes three types of eggplant and bird’s eye pepper (Thai pepper). Pea eggplant, which was discussed in previous editions of this handbook, is on the Federal Noxious Weed list, so it is not included in the current version. The harvestable products include fruits that are eaten at the immature or mature stage. All can be grown on raised beds with or without plastic mulch, using either drip or subsurface irrigation. As with most eggplants, these types tend to be short-lived

perennials, especially the Thai eggplant, which is a relatively compact, stocky plant. They can be severely pruned or ratooned and allowed to regrow if staking does not prohibit this operation. Fertilizer recommendations for eggplant should be used for the three types of eggplant, while those for peppers should be followed for bird’s eye peppers. These crops can be started from seed or transplants. All the indeterminate types of eggplant need some type of staking support.

Cultivars

Disease Key: CM = cucumber mosaic, ToM = tomato mosaic, R = resistant, IR = intermediate resistance, T = tolerant.

Traditional Types

Classic F1. Erect, vigorous plant; glossy deep-purple-black elongated-oval, green-calyxed fruit; medium-tall upright plant; fancy fruit appearance. Heavy yields of high-quality fruit. Does not perform well in cooler weather. R to ToM.

Nadia. Oval, long, vigorous plant with good fruit set under cool conditions. Very firm, attractive, purple-black fruit with long harvest period. Sets well under cool conditions.

Night Shadow. Elongate oval, widely adapted with high-yield potential. Strong plants produce firm fruit that maintain rich, dark glossy black color right through harvest. R to ToM.

Specialty Types

Birgah. A Sicilian-style eggplant with a round, heavy, firm fruit, deep-purple color, sweet taste, and white flesh.

Ghostbuster. Hybrid variety that produces oval-shaped white fruit 6–7 in. long.

Italian Pink. Open-pollinated cultivar; oval fruit; cream/rose color; mature fruit color is rose pink, purple calyx.

Megal. Italian cylindrical fruit; purple-black color, very uniform; excellent shelf life and flavor; few spines; early maturity. R to CM, ToM.

Millionaire. Slender, oriental type; dark-purple fruit color; purple calyx; early maturing.

Vittoria. Very long cylindrical, deep-purple Imperial type; green calyx; mild flavor. R to ToM.

Zebra. Elongated oval; purple with white stripes; very attractive with good flavor.

Table 3. Ethnic eggplant cultivars.

Eggplant	Cultivars
Oriental (Japanese) Eggplant	Black Shine, Hybrid Mangan, Money Maker 2
Oriental (Chinese) Eggplant	Bride Hybrid, Hybrid Purple Charm, Ma-Zu Purple
Thai Eggplant	Green: Green Beauty, Purple: Hybrid Violet Prince. Purple: Round Purple, Variegated: Hybrid Tiger, Variegated: Petch Slam, White: Hybrid White Ball
Indian Eggplant (Dark, Wine-Colored)	Hybrid Chu-Chu, Hybrid Bharata

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 4. Herbicides approved for managing weeds in eggplant. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PRETRANSPLANT/ PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Annual broadleaves and grasses. Incorporate 2–4 in. with mechanical cultivation or irrigation.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds up to 4 in. tall or rosettes less than 3 in. across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
	Flumioxazin up to 0.128	(Chateau) EZ up to 4 fl oz	14	Annual broadleaves. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middles and 24 in. bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds.
	Glufosinate up to 1.24	(Rely) 280 Up to 64 fl oz	10	Broadleaf, grass, and nutsedge burndown. Apply preplant to bare soil, preplant to plastic mulch beds, or preplant to areas between beds. Rate varies with use. PHI 30 days. Note: Rely 280 label is still valid for use if the applicator has product on hand. Registration has since moved to the Liberty label through December 2026 for row middle weed management in eggplant.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply preplant. Consult label for individual product directions.
	Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Do not exceed 2 oz/A per 12-month period. PHI 30 days.
	Lactofen 0.25–0.50	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Excessive injury occurs when product contacts green foliage or fruit. Drift of lactofen-treated soil particles onto plants can cause injury. Limit of 1 PRE and 1 POST application per growing season. PHI 30 days.
	Napropamide 1.0–2.0	(Devrinol) DF-XT 2.0–4.0 lb (Devrinol) 2-XT 2–4 qt	15	Annual broadleaves and grasses. Transplanted eggplant only. Use the lower rate on light soils (coarse-textured–sandy). No more than 4 lb/A per crop cycle.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
POSTTRANSPLANT	Pendimethalin 0.48-0.72	(Prowl H20) 3.8 1.0-1.5 pt	3	Broadleaves and grasses. Apply to row middles or under the plastic. No more than 3.0 pt/A per year. PHI 70 days.
	Pyraflufen 0.001-0.003	(ET Herbicide) 0.208 EC 0.5-2.0 fl oz	14	Emerged broadleaves less than 4 in. tall or rosettes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
	S-metolachlor 0.64-0.95	(Dual Magnum) 7.62 EC 0.67-1.0 pt	15	Annual broadleaves, grasses, and yellow/purple nutsedge suppression. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic or to row middles using a shielded applicator. No more than 1.68 pt/A of Dual Magnum per crop cycle. PHI 60 days.
	Sulfentrazone 0.09	(Willowood Sulfentrazone) 3 fl oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
	Trifluralin 0.5	(Treflan, Triflurex) 4 EC 1 pt	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 in. or less within 8 hr of application. Results in Florida are erratic on soils with low organic matter and clay contents. Do not apply after transplanting. Not all trifluralin herbicides are labeled in eggplant, so consult labels before application.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaves. Apply as a hooded application to row middles only. Do not exceed 6.1 fl oz/A per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. PHI 0 days.
	Clethodim 0.09-0.13 0.07-0.25	(Arrow) 2 EC (Select Max) 1 EC 9-16 fl oz	1	Perennial and annual grasses. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v or a nonionic surfactant with Select Max. PHI 20 days.
	Diquat 0.5	(Reglone Desiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. No more than 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. PHI 30 days.
	Glufosinate up to 1.24	(Rely) 280 Up to 64 oz	10	Broadleaf, grass, and nutsedge burndown. Apply post-emergence to weeds present between rows of established eggplant. Use shielded applicator. PHI 30 days. Note: Rely label still valid for use if the applicator has product on hand. Registration has since moved to Liberty label through December 2026 for row middle weed management in eggplant.
	Halosulfuron 0.024-0.05	(Sandea, Profine) 75 DF 0.5-1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Include a nonionic surfactant. No more than 2 oz/A per 12-month period. PHI 30 days.
	Lactofen 0.25-0.5	(Cobra) 2 EC 16-32 fl oz	14	Broadleaves. Apply to row middles only with shielded or hooded sprayers. Excessive injury can occur when lactofen contacts green foliage or fruit. Drift of lactofen-treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. Surfactant recommended. PHI 30 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Paraquat 0.5	(Gramoxone) 2 SL 2.0 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1–6 in. tall in row middles between mulched beds. Use low pressure and shields to control drift. No more than 3 applications per season. Nonionic surfactant recommended. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Pendimethalin 0.48–0.72	(Prowl H20) 3.8 1.0–1.5 pt	3	Broadleaves and grasses. May be applied posttransplant to row middles if previously untreated. No more than 3.0 pt/A per year. PHI 70 days.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Actively growing grasses. A total of 4.5 pt/A applied in 1 season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. PHI 20 days.
	S-metolachlor 0.95	(Dual Magnum) 7.62 EC 1.0 pt	15	Annual broadleaves and grasses. Yellow/purple nutsedge suppression. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only. No more than 1.68 pt/A of Dual Magnum per crop. PHI 60 days.
POSTHARVEST	Diquat 0.5	(Reglone Desiccant) 2.0 pt	22	No more than 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.

Table 5. Insecticides approved for management of arthropod pests of eggplant. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Craig Frey, UF/IFAS Extension Hendry County, or Jawwad Qureshi, UF/IFAS Southwest Florida Research and Education Center.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
Aphids (including green peach aphid, potato aphid, aphids transmitting viruses)	1A	*Lannate LV; *SP (methomyl)	LV: 0.75–3.0 pt SP: 0.25–1.0 lb	15 pt	5	48	No more than 10 applications per crop.
	1A	*Vydate L (oxamyl)	Foliar: 2–4 pt	16 pt	1	48	–
	1B	*Dibrom 8 EC (naled)	1 pt	1 pt	1	48	Do not apply when temperature is over 90°F.
	1B	Malathion 8F (malathion)	1.56 pt	6.24 pt	3	12	Reapplications at least 4 days apart.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. Reapplications at least 10 days apart. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	Toxic to bees and other insect pollinators.
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11 oz	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	Admire Pro (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	10.5 fl oz	21	12	Risk to bees and other insect pollinators. Most effective if applied to soil at transplanting.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	–	21	12	Planthouse: 1 application.
	4A	Assail 30 SG (acetamiprid)	1.5–4.0 oz	16.0 oz, including any pretransplant applications of acetamiprid	7	12	No more than 4 applications per season. Reapplications at least 7 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5.0–11.0 fl oz	11 fl oz	30	12	A 120-day plant-back interval must be observed.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	30	12	A 120-day plant-back interval must be observed.
	4A	Provado 1.6F (imidacloprid)	3.8–6.2 oz	19.2 fl oz	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	0	12	Apply before populations build to damaging levels. Reapplications at least 7 days apart. No more than 2 applications.
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz per crop cycle and 9.6 fl oz per year	1	12	Do not apply by air. No more than 2 applications per crop cycle. No more than 4 applications per year.
	9C	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	0	12	Begin applications before pests reach damaging levels.
	9D	Sefina Inscalis Insecticide (afidopyropen)	3.0 fl oz	28 fl oz	0	12	No more than 2 sequential applications of Sefina before using an effective insecticide with a different mode of action.
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	1	24	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	1	12	Risk to bees and other pollinators; follow application restriction. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i.	1	4	–
	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per year	3	12	Toxic to honeybees and other bees.
Beetles (including blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 times. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
	1A	*Vydate L (oxamyl)	Foliar: 2–4 pt	24 pt	1	48	–
	1B	*Dibrom 8 EC (naled)	1 pt	6 pt	1	48	No more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	2 lb a.i. (128 oz)	3	12	–
	3A	*Asana XL (0.66 EC) (esfenvalerate)	5.8–9.6 fl oz	0.35 lb a.i.	7	12	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Pounce 25 W (permethrin)	6.4–9.6 oz	0.6 lb a.i.	3	12	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz per year	5	24	-
	4A	Actara (thiamethoxam)	2.0–3.0 oz	11 oz	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	Admire Pro (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	10.5 fl oz	21	12	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	Assail 30 SG (acetamiprid)	1.5–4.0 oz	16.0 oz including any pretransplant applications of acetamiprid	7	12	No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5.0–11.0 fl oz	11 fl oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Provado 1.6F (imidacloprid)	3.8–6.2 oz	19.2 fl oz	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	5	Entrust SC (spinosad)	1.5–10 fl oz	29 oz	1	4	Do not apply to seedlings grown for transplant. OMRI-listed ² .
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	1	4	–
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	7	12	No more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	Do not use with an adjuvant.
	28	Coragen (rynaxypyr)	3.5–7.5 fl oz	15.4 fl oz	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/A when applied as a foliar spray.
	28	Exirel (cyantraniliprole)	7.0–13.5 fl oz	–	1	12	For control of Colorado potato beetle. This product has pollinator protection warning information on the label.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i.	1	4	Colorado potato beetle and flea beetles
	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per year	3	12	Toxic to honeybees and other bees.
	1A	*Lannate LV; *SP (methomyl)	LV: 0.75–3.0 pt SP: 0.25–1.0 lb	LV: 15 pt SP: 5 lb	5	48	No more than 10 applications per crop.
	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
Caterpillars (including cabbage looper; imported cabbageworm; corn earworm; garden webworm; hornworms; tobacco budworm; tomato fruitworm; beet, fall, and southern armyworm)	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	2 lb a.i. (128 oz)	3	12	–
	3A	*Asana XL (0.66 EC) (esfenvalerate)	5.8–9.6 fl oz	0.35 lb a.i.	7	12	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	42.67 fl oz	3	24	No more than 4 applications per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Pounce 25 W (permethrin)	6.4–9.6 oz	0.6 lb a.i.	3	12	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz	5	24	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–
	5	Entrust SC (spinosad)	1.5–10 fl oz	29 oz	1	4	Do not apply to seedlings grown for transplant. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	1	4	–
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	28.8 oz	7	12	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	7	24	This label contains pollinator warnings.
	11A	Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed. ³
	11A	Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	0	4	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25–1.5 lb	–	0	4	Use higher rates for armyworms. OMRI-listed. ³
	11A	DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	0	4	Treat when larvae are young. Good coverage is essential. Can be used in greenhouses. OMRI-listed. ³
	11A	Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12–1.50 lb	–	0	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed. ³
	11A	Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5–2.0 lb	–	0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	Do not use with an adjuvant.
	18	Confirm 2F (tebufenozide)	6–16 fl oz	64 oz	7	4	No more than 16 oz per application.
	18	Intrepid 2F (methoxyfenozide)	4–16 fl oz	64 oz	1	4	No more than 16 oz per application.
	28	Coragen (chlorantraniliprole/rynaxypyr)	3.5–7.5 fl oz	15.4 fl oz	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, use as little as 2.0 fl oz/A when applied as a foliar spray.
	28	Exirel (cyantraniliprole)	7–20.5 fl oz	0.4 lb a.i.	1	12	Application restrictions exist for this product because of the risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	28	Verimark (cyantraniliprole)	5–13.5 fl oz	0.4 lb a.i.	1	4	–
Fire ants	7A	Extinguish (S-methoprene)	1.0–1.5 lb	–	0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8–10 weeks. May be applied by ground equipment or aerially.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	–	1	12	Apply when ants are actively foraging.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
Grasshoppers	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz per year	5	24	–
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 at per year	3	12	Toxic to honeybees and other bees.
	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
Lace bugs	1B	Malathion 8F (malathion)	1.56 pt	6.24 pt	3	12	No more than 4 applications.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
Leafhoppers	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per year	3	12	Toxic to honeybees and other bees.
	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11 oz	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	Admire Pro (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	10.5 fl oz	21	12	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	4A	Platinum (thiamethoxam)	5.0–11.0 fl oz	11 fl oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related, pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	9B	PQZ (pyrifluquinazon)	3.2 fl oz	4.8 fl oz per crop cycle and 9.6 fl oz per year	1	12	Do not apply by air. No more than 2 applications per crop cycle. No more than 4 applications per year.
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	1	12	Immature insects only. No more than 2 applications per crop cycle.
	1A	*Vydate L (oxamyl)	Foliar: 2–4 pt	16 pt	1	48	–
	1B	*Dibrom 8 EC (naled)	1 pt	6 pt	1	48	No more than 1 pt/A in Florida. Do not apply when temperature is over 90°F.
	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	2 lb a.i. (128 oz)	3	12	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
Liriomyza leafminers	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	3A	*Pounce 25 W (permethrin)	6.4–9.6 oz	0.6 lb a.i.	3	12	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	5	Entrust SC (spinosad)	1.5–10 fl oz	29 oz per crop	1	4	Do not apply to seedlings grown for transplant. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	1	4	–
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	7	12	No more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	7	24	This label contains pollinator warnings.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	–
	28	Coragen (chlorantraniliprole/rynaxypyr)	5.0–7.5 fl oz	15.4 fl oz	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, use as little as 2.0 fl oz/A when applied as a foliar spray.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	1	12	Application restrictions exist for this product because of the risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	0.4 lb a.i.	1	4	–
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	1	12	Immature insects only. No more than 2 applications per crop cycle.
Mealybug							

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
Mites (including banks grass mite, broad mite, carmine spider mite, tomato russet mite, two spotted spider mite)	1A	*Vydate L (oxamyl)	Foliar: 2-4 pt	16 pt	1	48	-
	1B	*Dibrom 8 EC (naled)	1 pt	6 pt	1	48	No more than 1 pt/A in Florida. Do not apply when temperature is over 90°F.
	1B	Malathion 8F (malathion)	1.56 pt	6.24 pt	3	12	No more than 4 applications.
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	42.67 fl oz	3	24	No more than 4 applications (0.8 lb a.i./A) per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5-11.2 oz	43.26 fl oz	7	12	-
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92-3.84 fl oz	2.88 pt	5	24	-
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	0.36 lb a.i.	5	24	-
	6	*Agri-Mek SC (abamectin)	1.7-3.5 fl oz	0.25 fl oz	7	12	No more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10 fl oz	20 fl oz per year	7	24	This label contains pollinator warnings.
	10B	Zeal Miticide (etoxazole)	2-3 oz	3 oz	7	12	-
	12B	*Vendex 50 WP (fenbutatin-oxide)	2-3 lb	9 lb per year	3	48	Apply when mites first appear. No more than 3 applications per year.
	20B	Kanemite 15 SC (acequinocyl)	31 fl oz	62 fl oz	1	12	Reapplications at least 21 days apart. No more than 2 applications per year. Do not use an adjuvant.
	20D	Acramite 50WS (bifenazate)	0.75-1.0 lb	-	3	12	No more than 1 application per season.
	21A	Magister (fenazaquin)	24-36 fl oz	36 fl oz	12	3	No more than 1 application per year.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt	1	12	No more than 2 applications per season.
Plant bugs and tarnished plant bug	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz per year	5	24	–
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area.
Planthoppers	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	0	12	–
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	1	12	Immature insects only. No more than 2 applications per crop cycle.
Psyllids	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	23	Movement (spirotetramat)	4.0–5.0 fl oz	10 fl oz	1	24	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
Soil insects (garden symphylans) Stink bugs (including brown stink bug, green stink bug, southern green stink bug, squash bug)	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per year	3	12	Toxic to honeybees and other bees.
	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	42.67 fl oz	3	24	No more than 4 applications (0.8 lb a.i./A) per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11 oz	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	Do not use with an adjuvant.
Thrips (check label for species controlled) (eastern flower thrips, western flower thrips, Florida flower thrips, foliar feeding thrips, chili thrips, melon thrips)	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per year	3	12	Toxic to honeybees and other bees.
	1A	Sevin 80 S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	80S: 10 lb XLR, 4F: 8 qt	3	12	No more than 7 applications. Reapplications at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	7	12	Reapplications at least 7 days apart.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	4A	Admire Pro (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	10.5 fl oz	21	12	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	Assail 30 SG (acetamiprid)	1.5–4.0 oz	16.0 oz, including any pretransplant applications of acetamiprid	7	12	Begin applications for whiteflies when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5.0–11.0 fl oz	11 fl oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	Use only 1 application method.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil.
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	5	Entrust SC (spinosad)	1.5–10 fl oz	29 oz	1	4	Do not apply to seedlings grown for transplant. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	1	4	–
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	7	12	No more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	7	24	This label contains pollinator warnings.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	Do not use with an adjuvant.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	1	12	–
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 10.0–13.5 fl oz Drip: 10 fl oz	0.4 lb a.i.	1	4	–
Weevils	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	0.3 lb a.i.	1	12	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	5	24	This product can kill bees and other insect pollinators.
Whiteflies	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	7	12	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	43.26 fl oz	7	12	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	5	24	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–18.0 fl oz	11.25 pt	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	5	24	–
	4A	Platinum (thiamethoxam)	5.0–11.0 fl oz	11 fl oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	Platinum 75SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	30	12	–
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11 oz	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	Admire Pro (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	10.5 fl oz	21	12	Risk to bees and other insect pollinators; follow application restrictions. Most effective if applied to soil at transplanting.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	–	21	12	Planthouse: 1 application. See label.
	4A	Assail 30 SG (acetamiprid)	1.5–4.0 oz	16.0 oz, including any pretransplant applications of acetamiprid	7	12	Begin applications for whiteflies when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	1.6–3.2 oz	6.4 oz	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	Apply at planting	12	Do not release irrigation water from the treated area. Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	Scorpion 35SL Insecticide (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	Foliar: 1 Soil: 21	12	–
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–4 oz Soil: 5–6.0 oz	Foliar: 6 oz Soil: 12 oz	Foliar: 1 Soil: 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 oz	13 fl oz	30	12	May be applied to soil.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	1	12	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	1	4	Reapplications at least 7 days apart.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	7	24	This label contains pollinator warnings.
	7C	Knack IGR (pyriproxyfen)	8–10 fl oz	20 fl oz	1	12	Apply before populations build to damaging levels. Reapplications at least 7 days apart. No more than 2 applications.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	0	12	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz per crop cycle and 9.6 fl oz per year	1	12	Do not apply by air. No more than 2 applications per crop cycle. No more than 4 applications per year.
	9D	Sefina Inscalis Insecticide (afidopypyropen)	14 fl oz	28 fl oz of Sefina	0	12	No more than 2 sequential applications of Sefina before using an effective insecticide with a different mode of action.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	1	12	–
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	1	12	Immature insects only. No more than 2 applications per crop cycle.
	21A	Magister (fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt	1	12	No more than 2 applications per season.

Insect	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		Days to Harvest	REI (Hours)	Remarks ³
			Appl.	Season ²			
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	1	24	–
	23	Oberon 2SC (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	7	12	No more than 3 applications.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	1	12	Foliar application.
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 6.75–13.5 fl oz Drip: 6.75–10 fl oz	0.4 lb a.i.	1	4	Soil application.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 6. Eggplant fungicides sorted by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Pamela D. Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria blight/Early blight	M1	(copper compounds) Many brands available: AmeriCop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C-S WDG, COC DF, COC WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	See individual label	See individual label	Varies by product from 0–1 day	Varies by product from 4 hr to 2 days	-
	3	Tebuzol Toledo (tebuconazole)	See individual label	See individual label	-	-	-
	3	Provysoil (mefentrifluconazole)	5 oz	15 fl oz per year	0	0.5	See the label for specific guidelines.
	7	Endura (boscalid)	3.5 oz	21 oz	0	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	-
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-
	7 + 12	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz per year	0	0.5	-
	9	Vango WG (cyprodinil)	7 oz	28 oz	0	0.5	-
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9 + 12	Alerity 62.5 (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	-
	9 + 12	Alerity 62.5WG Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label.
	11	Aftershock Evito 480 EC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Do not use in greenhouse production; see label for additional instructions.
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	-
	11	Flint Extra Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	-
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	-
	12	Emblem (fludioxonil)	7 fl oz	28 fl oz per year	0	0.5	-
	19	Ph-D WDG Oso 5SC (polyoxin D zinc salt)	See label	See individual label	0	4 hr	-
	22 + M05	Zing! (zoxamide + chlorothalonil)	34 fl oz	See individual label	3	0.5	-
	M1	(copper compounds) Many brands available: AmeriCop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	See individual label	See individual label	Varies by product from 0–1 day	Varies by product from 4 hr to 2 days	-
	M1 + M2	Top Cop with Sulfur (copper sulfate + sulfur)	2 qt	-	-	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	See individual label	See individual label	See label	0.5	-
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	3	0.5	See label.
	3	Provysol (mefentrifluconazole)	5 oz	15 fl oz per year	0	0.5	See the label for specific guidelines.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant 0.125% v/v is recommended.
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	0.5	-
	3 + 7	Aprovia Top (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	See label	Disease suppression only.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	3 + 11	Affiance (tetraconazole + azoxystrobin)	12 oz	24 oz per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	-
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: Acadia LFC, Aframe, Azoxystar, Azoxystrobin, Azoxystrozone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy	15.5 fl oz	61.5 fl oz	0	4 hr	See individual label.
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	-
	11	Flint Extra Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	-
	11 + 3	Acadia ESQ Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-
	11 + 3	TopGuard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	-
	19	Ph-D (polyoxin D zinc salt)	6.2 oz	See individual label	0	4 hr	Disease suppression only.
	22 + M05	Zing! (Zoxamide + chlorothalonil)	34 fl oz	See individual label	3	0.5	-
	9	Alerity 62.5WG Vango WG (cyprodinil)	7 oz	See individual label	0	0.5	-
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	22 + M05	Zing! (Zoxamide + chlorothalonil)	34 fl oz	See individual label	3	0.5	-
Botrytis gray mold	M3	Signet 480FS 42-S Thiram (thiram)	6.5 fl oz/100 lb seed	-	-	1	-
	4	(mefenoxam) Many brands available: Apron XL, Ridomil Gold EC, Ridomil Gold SL, Ultra Flourish	See individual label	See individual label	-	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4	(metalaxyl) Many brands available: Acquire, Allegiance FL, Metastar 2E, Sebring 2.65 ST, Sebring 318 FS, Sebring 480 FS	See individual label	See individual label	-	-	-
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-
	11	(azoxystrobin) Many brands available: Acadia LFC, Aframe, Azoxystar, Azoxystrobin, Azoxystrozone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy	See label	-	0	4 hr	For Rhizoctonia seedling rot.
	11	Dynasty (azoxystrobin)	0.38 fl oz/100 lb seed	-	-	4 hr	-
	12	Maxim 4 FS Spirato 480 FS Dynashield (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	See individual label.
	3 + 4	Aprovia Top (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	3 + 9	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	7 + 12	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz per year	0	0.5	-
	11	Flint Extra Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	-
	11 + 3	Acadia ESQ Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-
Gray leaf spot (<i>Stemphylium</i>)	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	55 fl oz	-	-	-	At planting. See label. For Pythium only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Phomopsis blight	M1	(copper compounds) Many brands available: Americop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	See individual label	See individual label	Varies by product from 0–1 day	Varies by product from 4 hr to 2 days	-
	M1 + M2	Top Cop with Sulfur (copper sulfate + sulfur)	2 qt	-	-	1	-
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, C-O-C WDG, Cueva	See individual label	See individual label	Varies by product from 0–1 day	Varies by product from 4 hr to 2 days	-
Phytophthora blight and crown rot (<i>Phytophthora capsici</i>)	4	Many brands available: Ridomil Gold SL, Ultra Flourish (mefenoxam)	1 pt	1.5 lb a.i.	7	2	See label; disease suppression only.
	11-	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease suppression only.
	21-	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	-
	22-	Elumin (ethaboxam)	8 fl oz	16 fl oz	2	0.5	See label.
	29-	Omega 500F (fluazinam)	1.5 pt	9 pt	30	0.5	-
	33-	(phosphites) Many brands available: Confine Extra, Fosphite, Fungi-Phite, K-Phite, Rampart	See individual label	See individual label	-	-	-
	40-	Forum (dimethomorph)	6 oz	30 oz	0	0.5	-
	40-	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Disease suppression only.
	40 + 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4	-	See label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	43-	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	-
	49-	Orondis Gold 200 (oxathiapiprolin)	9.6 fl oz	19.2 fl oz	0	4 hr	Apply at transplant; see label.
	49 + 4-	Orondis Gold (oxathiapiprolin + mefenoxam)	55 fl oz	-	-	-	At planting. See label.
	49 + 40-	Orondis Ultra (oxathiapiprolin + manipropamid)	8 fl oz	32 fl oz per year	1	4 hr	See label.
Powdery mildew	M2	(sulfur) Many brands available: Cosavet DF, Kumulus DF Fungicide-Acaricide, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90 W/ Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	See individual label	See individual label	-	0.5	-
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt per year	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	3	0.5	See label.
	3	Mettle 125ME (tetraconazole)	8 fl oz	16 fl oz per year	0	0.5	-
	3	Rally 40WSP Sonoma 40WSP (myclobutanil)	See individual label	See individual label	0	1	-
	3	Provysol (mefentrifluconazole)	5 oz	15 fl oz per year	0	0.5	See the label for specific guidelines.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant 0.125% v/v is recommended.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	0.5	-
	3 + 7	Aprovia Top (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per year	0	0.5	-
	3 + 11	Affiance (tetraconazole + azoxystrobin)	12 oz	24 oz per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	-
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-
	7 + 12	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz per year	0	0.5	-
	9	Vango WG (cyprodinil)	7 oz	28 oz	0	0.5	-
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	-
	9 + 12	Switch Alerity 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label.
	11	(azoxystrobin) Many brands available: Acadia LFC, Aframe, Azoxystar, Azoxystrobin, Azoxzone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy	-	-	-	-	See individual label.
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	-
	11 + 3	Acadia ESQ Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	TopGuard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	-
	12	Emblem (fludioxonil)	7 fl oz	28 fl oz per year	0	0.5	-
	13	Quintec (quinoxifen)	6 fl oz	24 fl oz	3	0.5	See label.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	-
	50	Prolivo 300SC (pyriofenone)	5 fl oz	16 fl oz per year	0	4	Follow resistance management on label.
	50	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	Apply prior to symptoms of powdery mildew.
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-
	M1	Cueva (copper octanoate)	See individual label	See individual label	-	-	-
	3 + 11	Affiance (tetraconazole + azoxystrobin)	12 oz	24 oz per year	0	0.5	Check label for additional guidelines. No more than 2 sequential applications.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	-
Sclerotinia	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-
	7 + 12	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz per year	0	0.5	-
	9 + 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	-
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	-
	11	Flint Extra Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	Disease suppression only. See individual label.
Septoria leaf spot							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease suppression only.
White mold	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	Disease suppression only.
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	0	0.5	-

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 7. Nonfumigant nematicides for eggplants in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½–1 gal/A at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. No more than 3 gal/A per season. Reapplications at least 7 days apart unless a longer interval is stated. No more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Soil reapplications at least 5 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Salibro (a.i. fluazaindolizine)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated, via preplant drip, or via at-plant drip. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year. No more than 4 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 14 days apart. Preharvest interval is 1 day.
Biological nematicides	See chapter 19.
Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 8. Fumigant nematicides for eggplants in Florida.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine ^{2,3}	13–20.5	–	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60 ^{2,3}	19.5–31.5	57–90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC ^{2,3}	19.5–31.5	–	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 9. Leafy Vegetable Production¹

Germán Sandoya-Miranda, Ramdas Kanissery, Nicholas S. Dufault, Johan Desaeger, Anna Mészáros, Julien Beuzelin, Katia Viana Xavier, and D. Calvin Otero²

Lettuce, Endive, and Escarole

Botany and Planting

Lettuce—*Lactuca sativa*, Asteraceae (Compositae)

Endive—*Cichorium endivia*

Escarole—*Cichorium endivia*

Table 1. Planting dates for lettuce, endive, and escarole.

Planting Region	Dates				
	Crisphead	Butterhead	Romaine	Endive	Escarole
North Florida	Sept–Oct; Jan–Feb	Sept–Oct; Jan–Feb	Aug–Oct; Jan–Feb	Aug–Oct; Jan–Feb	Aug–Oct; Jan–Feb
Central Florida	Sept–Feb	Sept–Feb	Aug–Feb	Aug–Feb	Aug–Feb
South Florida	Sept–Feb	Sept–Feb	Sept–Mar	Sept–Mar	Sept–Mar

Table 2. Planting information for lettuce, endive, and escarole.

Planting Parameters	Measurements				
	Crisphead	Butterhead	Romaine	Endive	Escarole
Distance between rows (in)	18–30	18–30	18–30	18–30	18–30
Distance between plants (in)	8–12	9	12	14–16	14–16
Seeding depth (in)	0.25	0.25	0.25	0.25	0.25
Seed per acre (lb)	1–3	1–3	2–4	3–4	3–4
Days to maturity from seed	70–95	60–80	60–80	60–80	60–80
Plant populations (acre)	43,560	38,720	29,040	24,891	24,891

Cultivars

Table 3. Lettuce, endive, and escarole cultivars.

Lettuce, Endive, and Escarole	Cultivars
Green Salad bowl	Green Star, Tropicana, Two Star
Romaine (Green)	Concept, Fusion, Kalura, Medallion, Snappy, Solid King, Terrapin
Red Leaf	Galactic, New Red Fire, Red Saladbowl, Vulcan
Crisphead	Gator, Gulfstream, Raleigh, Summer Crisp (red)
Endive	Markant, Salad King
Escarole	Full Heart NR 65, Twinkle
Boston	Ermosa, Florida Butter Crisp, Margarita
Romaine (Red)	Outredgeous, Rosalita
Oakleaf (Green)	Ferrari, Royal Oak
Bibb	Cherokee, Floribibb

Table 4. Lettuce and escarole planted in south Florida.

Type	Cultivar	Planting
Iceberg	Belle Glade	Intermediate ¹
	Chosen	Early ²
	Cooper	Intermediate/Late ³
	Flagler	Throughout ⁴
	Lantana	Early
Romaine	1505	Intermediate/Late
	Desert Gold	Intermediate
	Hialeah	Throughout
	Homestead	Intermediate
	Manatee	Throughout
	Okeechobee	Intermediate
	Sawgrass	Intermediate/Late
	Solid King	Intermediate
	Tammy	Intermediate
Leaf	3SX739	Intermediate
	Big Star	Intermediate
	Cherokee	Throughout
	RSX743	Throughout
Boston	Odyssey	Throughout
	Palmetto	Throughout
Escarole	38100	Throughout
	39019	Throughout
	Forbes	Throughout
	Olmos	Throughout
	Siena	Throughout
¹ Planting starts in December ² Planting starts in October ³ Planting starts in January ⁴ Planting all season (October to March)		

Spinach

Botany and Planting

Spinach—*Spinacia oleracea*

Table 5. Planting dates for spinach.

Planting Region	Dates
North and central Florida	Sept–Mar
South Florida	Oct–Feb

Table 6. Planting information for spinach.

Parameter	Measurements
Distance between rows (in)	12–36
Distance between plants (in)	2–6
Seeding depth (in)	0.5
Seed per acre (lb)	10–15
Days to maturity from seed	45–60

Cultivars

Table 7. Spinach cultivars.

Spinach	Cultivars
Smooth Leaf	A+C #30 (H) Space (H)
Semi-savoy Leaf	Ashley (H) Chinook II (H) Gladiator (H) Melody (H) Seaside Skookum (H) Tyee (H)
Savoy Leaf	Ambassador (H) Hybrid 612 (H)
H = hybrid	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 8. Herbicides approved for managing weeds in lettuce. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE	Benefin 1.2	(Balan) DF 2 lb	3	Lettuce	Annual broadleaf and grass weeds. Apply before seeding or transplanting. Incorporate with cultivation or irrigation into the top 2–3 in. of the final bed.
	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Leafy vegetables	Annual broadleaf and grass weeds. Incorporate with cultivation or irrigation. Do not use on spinach or Swiss chard.
	Carfentrazone up to 0.031	(Aim) 2EC up to 2 fl oz	14	Leafy vegetables	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult label	9	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
	Imazethapyr 0.016–0.031	(Pursuit) 2 EC 1–2 fl oz	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. No more than 2 applications per crop. No more than 4 oz/A per crop season. Should be applied in 2 or more gallons of water per acre. Potential for rotational crop injury is highly variable. Label is a Third-Party Registration (TPR, Inc.). Use without having a signed authorization and waiver of liability agreement is a misuse of the product. PHI 30 days.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2–4 pt (Gramoxone) 3 SL 1.3–2.7 pt	22	Lettuce, endive, escarole	Emerged broadleaf and grass weeds. Apply as a preplant burndown. No more than 3 applications per year. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
	Pronamide 1.0–2.0	(Kerb) 50 W 2.0–4.0 lb	3	Head lettuce, endive, escarole	Certain annual broadleaf and grass weeds. Overhead irrigate with 1–2 in. following applications. Observe rotational restrictions to other crops. Not recommended for soils with high organic matter. PHI 55 days.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Leafy vegetables	Emerged broadleaf weeds. Apply as a preplant burndown 1 day prior to planting. Include an NIS at 0.25% or COC at 1.0% to the spray solution.
	Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1.0 pt (Trifluralin) 10 G 5 lb	3	Endive, escarole, radicchio	Annual broadleaf and grass weeds. Apply as preplant incorporated to mineral soils only.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
POSTEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Leafy vegetables	Emerg broadleaf weeds. Apply as a preplant burndown for emerg broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides.
	Clethodim 0.09-0.13 0.07-0.12	(Arrow) 2 EC 6-8 fl oz (Select Max) 1 EC 9-16 fl oz	1	Leafy vegetables	Emerg annual and perennial grass weeds. Reapplications at least 14 days apart. PHI 14 days.
	Imazethapyr 0.016-0.031	(Pursuit) 2 EC 1-2 fl oz	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. Apply postemergence after 3-4 true leaf stage. No more than 2 applications per crop. No more than 4 oz/A per crop season. Potential for rotational crop damage is highly variable. Label is a Third-Party Registration (TPR, Inc.). Use without having a signed authorization and waiver for liability agreement is a misuse of the product. PHI 30 days.
	Paraquat 0.3-0.5	(Gramoxone) 2 SL 1.2-2.0 pt (Gramoxone) 3 SL 0.8-1.3 pt	22	Lettuce	Emerg broadleaf and grass weeds. Row middles only. Consult individual labels; not all formulations are labeled for this use pattern. Include a NIS at 0.25% v/v. PHI 24 hr. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Leafy vegetables	Emerg broadleaf and grass weeds. Apply as a directed or shielded spray to row middles.
	Sethoxydim 0.19-0.28	(Poast) 1.5 EC 1.0-1.5 pt	1	Head/leaf lettuce, endive, radicchio	Emerg grass weeds. No more than 3.0 pt/A per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 days.

Table 9. Herbicides approved for managing weeds in spinach. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kaniserry, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
REPLANT/ PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with soil residual compounds.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with soil residual compounds.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
POSTEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides. PHI 0 days.
	Clethodim 0.09–0.13 0.07–0.25	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. Use higher rates under heavy grass pressure or larger grass weeds. Read the label for required surfactant. PHI 14 days.
	Clopyralid 0.06–0.12	(Clopyr Ag) 3 EC 0.17–0.33 pt	4	Certain broadleaf weeds. No more than 0.5 pt/A per growing season. Apply in the 2-to 5-leaf stage of crop growth. PHI 21 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Controls emerged grass weeds. No more than 3.0 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 15 days.

Table 10. Insecticides labeled for management of arthropod pests of lettuce and other leafy vegetables (non-brassica, including escarole and endive). **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1A	*Lannate LV *Lannate SP (methomyl)	LV: 1.5–3 pt SP: 0.5–1.0 lb	Head varieties: 24 pt (LV) or 8 lb (SP) Leaf varieties and endive (escarole), dandelions, Swiss chard: 12 pt (LV) or 4 lb (SP)	48	10, or 7 for lowest rates for lettuce only	–
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 0.5–1 pt 50W: 0.5–1 lb	–	72	14	No more than 1 application. Head and leaf lettuce only.
	1B	Dimethoate 4 EC (dimethoate)	0.5 pt	1.5 pt per year	48	14	Leaf lettuce only; not for head lettuce. Also for endive (escarole) and Swiss chard.
	1B	Malathion 5EC Malathion 8F (malathion)	Endive: 1.5–2.0 pt (5EC) or 1.25 pt (8F) Lettuce: 2–3 pt (5EC) Head and leaf lettuce: 1.88 pt (8F)	–	24	Endive: 7 Head and leaf lettuce: 14	No more than 2 applications per year.
	1B	Orthene 97 (acephate)	0.5–1.0 lb	2.125 lb	24	21	Crisphead head lettuce only. Other brands available with same active ingredient.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	51.2 oz per year	12	1	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 21	Other brands available with same active ingredient.
	4A	Assail 30SG Assail 70WP (acetamiprid)	30SG : 2.0–4.0 oz 70WP : 0.8–1.7 oz	30SG : 20.0 oz per year 70WP : 8.5 oz per year	12	7	Other brands available with same active ingredient.
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz	4	1	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz per year	12	7	–
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz	12	1	–
	9D	Versys (afidopyropen)	1.5 fl oz	14 fl oz	12	0	–
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until at least 14 days after emergence.
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	3	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Beetles (includes cucumber beetles, flea beetles) and weevils	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	
	28	Harvanta 50SL (cyclaniliprole)	10.9-16.4 fl oz	49.2 fl oz per year	4	1	-
	28	Verimark (cyantraniliprole)	6.75-13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	at planting	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz	12	0	-
	1A	Sevin 4F (carbaryl)	0.5-1.0 qt	6 qt per year	12	14	-
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2-3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
	3A	*Warrior II (lambda-cyhalothrin)	1.28-1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-9 fl oz	31 fl oz per year	24	1	Head and leaf lettuce only.
	4A	Actara (thiamethoxam)	1.5-3.0 oz	11 oz	12	7	Flea beetles only.
	4A	Admire Pro (imidacloprid)	1.3 fl oz	6.5 fl oz per year	12	7	Flea beetles only. Other brands available with same active ingredient.
	4A	Belay (clothianidin)	Foliar: 3-4 fl oz Soil: 9-12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Flea beetles only.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6-2.1 oz Soil: 4.8-6.4 oz	6.4 oz	12	7	Flea beetles only.
	4A	Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	3.67 oz	12	30	Flea beetles only.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (includes armyworms, corn earworm, green cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworms)	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until at least 14 days after emergence. Flea beetles only.
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	Flea beetles only. No more than 2 applications per year.
	1A	*Lannate LV *Lannate SP (methomyl)	LV: 1.5–3 pt SP: 0.5–1.0 lb	Head varieties: 24 pt (LV) or 8 lb (SP) Leaf varieties and endive (escarole), dandelions, Swiss chard: 12 pt (LV) or 4 lb (SP)	48	10, or 7 for lowest rates for lettuce only	–
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	6 qt per year	12	14	–
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	Lettuce: 2 qt (AG500) or 4 lb (50W) Endive (escarole): 1 qt (AG500) or 1–2 lb (50W)	Lettuce: 4 qt per year (AG500) or 8 lb per year (50 W) Endive (escarole): 1 qt per year (AG500) or 2 lb per year (50W)	Lettuce: 72 Endive (escarole): 96	Preplant	Head and leaf lettuce, endive (escarole) only.
	1B	Orthene 97 (acephate)	1.0 lb	2.125 lb	24	21	Crisphead head lettuce only. Other brands available with same active ingredient.
	3A	*Asana XL (esfenvalerate)	4.8–9.6 fl oz	67.2 fl oz	12	7	Head lettuce only.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A	*Pounce 25 WP (permethrin)	3.2–12.8 oz	51.2 oz per year	12	1	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	31 fl oz per year	24	1	Head and leaf lettuce only.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	Turnip greens and other leaves of root, tuber, legume vegetables: 3
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz per year	12	7	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10.0 fl oz	20 fl oz per year	12	7	–
	18	Confirm 2F (tebufenozide)	6–8 fl oz	40 fl oz	4	7	–
	18	Intrepid 2F (methoxyfenozide)	4–10 fl oz	64 fl oz	4	1	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Grasshoppers, mole crickets	22	Avaunt Avaunt eVo (indoxacarb)	2.5–6.0 oz	Avaunt: 24 oz Avaunt eVo: 18 oz	12	3	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	7–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Harvanta 50SL (cyclaniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	–
	28	Verimark (cyantraniliprole)	5.0–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	32	Spear-Lep (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	10 gal per year	4	0	Must be tank-mixed with a <i>Bacillus thuringiensis</i> (Bt) product.
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 1 qt (lettuce, endive or escarole) 50W: 2 lb (lettuce, endive or escarole)	Lettuce: 4 qt per year (AG500) or 8 lb per year (50W) Endive (escarole): 1 qt per year (AG500) or 2 lb per year (50W)	AG500: 72 (lettuce) 50W: 96 (endive or escarole)	Preplant	Head and leaf lettuce, endive (escarole) only.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafhoppers	1A	*Lannate LV *Lannate SP (methomyl)	LV: 1.5–3 pt SP: 0.5–1.0 lb	Head varieties: 24 pt (LV) or 8 lb (SP) Leaf varieties and endive (escarole), dandelions, Swiss chard: 12 pt (LV) or 4 lb (SP)	48	10, or 7 for lowest rates for lettuce only	–
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	14	–
	1B	Dimethoate 4 EC (dimethoate)	0.5 pt	1.5 pt per year	48	14	Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.
	1B	Malathion 5EC Malathion 8F (malathion)	Endive: 1.25 pt (8F) Lettuce: 2–3 pt (5EC) Head and leaf lettuce: 1.88 pt (8F)	–	24	Head and leaf lettuce: 14	No more than 2 applications per year.
	1B	Orthene 97 (acephate)	0.5–1.0 lb	2.125 lb	24	21	Crisphead head lettuce only. Other brands available with same active ingredient.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	Foliar: 7 Soil: 21	Other brands available with same active ingredient.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafminers	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz	4	1	–
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	7	–
	21A	Torac (tolfenpyrad)	14–21 fl oz	42 fl oz	12	1	Do not apply until at least 14 days after emergence.
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 0.5–1 pt 50W: 0.5–1 lb	–	72	14	No more than 1 application. Head and leaf lettuce only.
	1B	Dimethoate 4 EC (dimethoate)	0.5 pt	1.5 pt per year	48	14	Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1 Turnip greens and other leaves of root, tuber, legume vegetables: 3	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	10.25 fl oz per year	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Other brands available with same active ingredient.
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz per year	12	7	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10.0 fl oz	20 fl oz per year	12	7	–
	17	Trigard (cyromazine)	2.66 oz	–	12	7	No more than 6 applications for head lettuce and 5 applications for other leafy vegetables.
	28	Coragen (chlorantraniliprole)	5.0–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Harvanta 50SL (cyclaniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	1B	Malathion 5EC Malathion 8F (malathion)	Endive: 1.5–2.0 pt (5EC) or 1.25 pt (8F) Lettuce: 2–3 pt (5EC) Head and leaf lettuce: 1.88 pt (8F)	–	24	Endive: 7 Head and leaf lettuce: 14	No more than 2 applications per year.
	3A	*Brigade 2EC (bifenthrin)	5.1–6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.
Mites (includes carmine spider mite, two-spotted spider mite)							

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Stink bugs, plant bugs, meadow spittlebug	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	10.25 fl oz per year	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Other brands available with same active ingredient.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10.0 fl oz	20 fl oz per year	12	7	–
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	Head lettuce only. Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	19.2 fl oz	24	1	Head and leaf lettuce only. Other brands available with same active ingredient.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz per year	24	1	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
Thrips (check labels for species control)	1A	*Lannate LV *Lannate SP (methomyl)	LV: 1.5–3 pt SP: 0.5–1.0 lb	Head varieties: 24 pt (LV) or 8 lb (SP) Leaf varieties and endive (escarole), dandelions, Swiss chard: 12 pt (LV) or 4 lb (SP)	48	10, or 7 for lowest rates for lettuce only	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz per year	4	1 Turnip greens and other leaves of root, tuber, legume vegetables: 3	-
	21A	Torac (tolfenpyrad)	21 fl oz	42 fl oz	12	1	Do not apply until at least 14 days after emergence.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	-
	30	Incipio (isocycloseram)	3.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned *Restricted use insecticide.							

Table 11. Insecticides labeled for management of arthropod pests of spinach. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC Malathion 8F (malathion)	5EC: 1.6 pt 8F: 1.0 pt	-	12	7	No more than 2 applications per year.
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	-
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	38.4 oz per year	12	1	-
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	-
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	Foliar: 7 Soil: 21	Other brands available with same active ingredient.
	4A	Assail 30SG Assail 70WP (acetamiprid)	30SG: 2.0–4.0 oz 70WP: 0.8–1.7 oz	30SG: 20.0 oz per year 70WP: 8.5 oz per year	12	7	Other brands available with same active ingredient.
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	-
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7	-
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	-

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz per year	4	1	–
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz	12	1	–
	9D	Versys (afidopyropen)	1.5 fl oz	14 fl oz	12	0	–
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	3	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Harvanta 50SL (cyclaniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	0	–
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	14	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	25.6 fl oz	12	7	Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
Beetles (includes cucumber beetle, flea beetles, darking beetles) and weevils	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	Flea beetles only.
	4A	Admire Pro (imidacloprid)	1.3 fl oz	6.5 fl oz per year	12	7	Flea beetles only. Other brands available with same active ingredient.
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	Flea beetles only.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7	Flea beetles only.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	Flea beetles only.
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	Flea beetles only.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	Soil application.
	4A + 28	Voliame Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
Caterpillars (including armyworms, corn earworm, green cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworms)	1A	*Lannate LV *Lannate SP (methomyl)	LV: 1.5–3 pt SP: 0.5–1.0 lb	LV: 12 pt SP: 4 lb	48	7	Do not apply to seedlings less than 3 in. diameter.
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	6 qt per year	12	14	–
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 2.0–4.0 qt 50W: 4.0–8.0 lb	AG500: 4 qt per year 50W: 8 lb per year	72	preplant	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	25.6 fl oz	12	7	Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A	*Pounce 25 WP (permethrin)	3.2–12.8 oz	38.4 oz per year	12	1	–
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	–
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz	12	7	–
	18	Confirm 2F (tebufenozide)	6–8 fl oz	40 fl oz	4	7	–

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Grasshoppers, mole crickets	18	Intrepid 2F (methoxyfenozide)	4-10 fl oz	64 fl oz per year	4	1	-
	28	Coragen (chlorantraniliprole)	3.5-7.5 fl oz	15.4 fl oz	4	1	-
	28	Exirel (cyantraniliprole)	7-20.5 fl oz	0.4 lb a.i. per year	12	1	Do not use an adjuvant.
	28	Harvanta 50SL (cyclaniliprole)	10.9-16.4 fl oz	49.2 fl oz per year	4	1	-
	28	Verimark (cyantraniliprole)	5.0-13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	-
	30	Incipio (isocycloseram)	2.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	32	Spear-Lep (GS-omega/kappa-Hxtx-HV1a)	1-2 pt	10 gal per year	4	0	Must be tank-mixed with a <i>Bacillus thuringiensis</i> (Bt) product.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Fastac CS (alpha-cypermethrin)	3.2-3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
Leafhopper	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5.25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	0.5-1.0 qt	6 qt per year	12	14	-
	1B	Malathion 8F (malathion)	1.6 pt	-	12	7	No more than 2 applications per year.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Fastac CS (alpha-cypermethrin)	3.2-3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
	3A	*Pounce 25 W (permethrin)	3.2-12.8 oz	38.4 oz per year	12	1	-
	4A	Actara (thiamethoxam)	1.5-3.0 oz	11 oz	12	7	-

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	Foliar: 7 Soil: 21	Other brands available with same active ingredient.
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	-
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz Soil: 4.8–6.4 oz	6.4 oz	12	7	-
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	-
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz per year	4	1	-
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	7	
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	4	1	-
	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	10.25 fl oz per year	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Other brands available with same active ingredient.
Leafminers	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz	12	7	-
	17	Trigard (cyromazine)	2.66 oz	13.3 oz	12	7	-
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	-

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Harvanta 50SL (cyantraniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	3A	*Brigade 2EC (bifenthrin)	5.1–6.4 fl oz	25.6 fl oz	12	7	Other brands available with same active ingredient.
	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	10.25 fl oz per year	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Other brands available with same active ingredient.
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	6 qt per year	12	14	–
	3A	*Brigade 2EC (bifenthrin)	5.1–6.4 fl oz	25.6 fl oz	12	7	Other brands available with same active ingredient.
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	0	–
Mites (includes carmine spider mite, two-spotted spider mite)							
Stink bugs, plant bugs, meadow spittlebug							

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips (check label for species controlled)	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	30	Incipio (isocycloseram)	3.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 12. Escarole and endive fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to Reentry		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria leaf spot	3	Procur 480SC (triflumizole)	8 fl oz	16 fl oz	0	0.5	-
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	Trionic 4SC (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	-
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop D, Nu-Cop HB	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
Bacterial blight	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Botrytis rot	12	Cannonball WG (fludioxonil)	7 oz	28 oz	0	0.5	-
	14	Botran 5F (dichloran)	5.33 lb	5.33 lb	14	0.5	-
	19	OSO 5% SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	-
	7	Endura (boscalid)	9.0 oz	18 oz	14	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	-
Cercospora leaf spot, septoria leaf spot	14	Botran 5F (dichloran)	5.33 lb	5.33 lb	14	0.5	-
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for restrictions.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Damping off	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	M3	Defiant 75 WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.
Downy mildew	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB	See individual label	See individual label	1	Varies by product from 4 hrs to 2 days	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M2	(sulfur) Many brands available: Crusade DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	11	(azoxystrobin) Various brands available: Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides with dissimilar modes of action.
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	-
	33	Aliette WDG Legion 80WDG Linebacker WDG (fosetyl-Al)	5 lb	Aliette: 35 lb Legion, Linebacker: 20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	3 qt	-	0	4 hr	-
	40	Forum (dimethomorph)	6.0 fl oz	30 fl oz	0	0.5	Do not apply sequentially.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. See label for soil applications.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. No more than 2 sequential applications.
	45 + 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	19.2 fl oz	38.4 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if applied using soil applications. Be aware of plant-back restrictions.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	0.5	No more than 4 applications per crop. No more than 2 sequential applications. Do not exceed more than 33% of total foliar applications.
	M2	(sulfur) Many brands available: Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sufsa, Sulfur 90W	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	Procure 480SC (triflumizole)	8 fl oz	18 fl oz	0	0.5	-
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	Trionic 4SC (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for restrictions.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications. See label for details.
	11	(azoxystrobin) Various brands available: Equation, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Pythium damping off	4	Sebring (metalaxyl)	0.7 fl oz/100 lb of seed	-	-	2	Seed treatment only.
Pythium seedling blight	4	Acquire Allegiance FL (metalaxyl)	0.7 fl oz/100 lb of seed	-	-	1	Seed treatment only.
	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb of seed	-	-	2	-
	4	Metastar 2E (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in.
Pythium seedling disease	4	Ridomil Gold GR Ridomil Gold SL Ultra Flourish (mefenoxam)	GR: 40 lb SL: 2 pt Ultra Flourish: 4 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Rhizoctonia bottom rot	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Sclerotinia diseases	7	Endura (boscalid)	10.0 oz	18 oz	14	0.5	-
	9 + 12	Switch 62.5 WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
Various seedling diseases	11	Quadris (azoxystrobin)	15.2 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	4 + 11	Uniform (azoxystrobin + mefenoxam)	0.34 fl oz/1000 row ft	-	-	0	Soil incorporated. No more than 1 application per season.
	12	Maxim 4FSS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

13. Table Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
<i>Alternaria</i> spp.	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	Trionic (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	–
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Bacterial blight	M1	(copper compounds) Many brands available: Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, C-O-C-S WDG, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Stretch, Tenn Cop, Top Cop w/Sulfur	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
Botrytis rot	12	Cannonball WG (fludioxonil)	7 oz	28 oz	0	0.5	-
	7	Endura (boscalid)	11 oz	22 oz	14	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	12	Cannonball WG (fludioxonil)	7 oz	28 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
Cercospora leaf spot	14	Botran 5F (dichloran)	5.33 lb	5.33 lb	14	0.5	-
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) Various brands available: Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	12	Cannonball WG (fludioxonil)	0.5 oz	1.5 lb	14	0.5	-
	M3	Defiant 75WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.
Damping off	M1	(copper compounds) Many brands available: Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, C-O-C-S WDG, Cueva, Kocide 3000, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Stretch, Tenn Cop, Top Cop w/Sulfur (sulfur)	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
Downy mildew	M2	Many brands available: Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, That Flowable, Thiolux, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M3	(mancozeb) Many brands available: Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mankocide, Manzate Max, Manzate Pro-stick, Penncozeb 75 DF, Penncozeb 80 WP, Roper DF Rainshield	See individual label	See individual label	10	1	-
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	1.0 pt	7	2	Must be applied in a tank mixture with full rate of another downy-mildew-registered product.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Various brands available: Quadris, Satori, Tetraban, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides of dissimilar modes of action.
	21	Actigard 50 WG (acibenzolar)	1 oz	4 oz	7	0.5	Apply preventatively. See label for details.
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	21A	Toran (tolfenpyrad)	21 fl oz	42 fl oz	14	0.5	Also an insecticide. Suppression only.
	27	Curzate (cymoxanil)	5 oz	30 oz	3	0.5	Must be applied as a tank mix with a fungicide of dissimilar mode of action.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	–
	28	Previcur Flex (propamocarb)	2 pt	8 pt	2	0.5	–
	28	Promess (propamocarb)	2 pt	8 pt	2	0.5	–
	33	Aliette WDG (fosetyl-AI)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	Legion 80WDG (fosetyl-AI)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	Linebacker WDG (fosetyl-AI)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart	3 qt	-	0	4 hr	See label for details.
	40	Forum (dimethomorph)	6 fl oz	30 fl oz	0	0.5	Do not apply alone in sequential applications.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	0.5	No more than 2 sequential applications. See label for soil applications.
	43	Presidio (fluopicolide)	3-4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. No more than 2 sequential applications. See label for soil applications.
	45 + 40	Zapro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	4 hr	-
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications. No more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Gray mold	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	Cannonball WG (fludioxonil)	7 oz	28 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew	M2	(sulfur) Many brands available: Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, That Flowable, Thiolux, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M3	(mancozeb) Many brands available: Dithane F45 Rainshield, Dithane M-45, Fortuna 75WDG, Koverall, Mankocide, Manzate Flowable, Manzate Pro-stick, Penncozeb 75 DF, Penncozeb 80 WP, Roper DF Rainshield	See individual label	See individual label	10	1	-
	3	Procure 480SC (fludioxinil)	8 fl oz	18 fl oz	0	0.5	-
	3	Rally 40WSP (myclobutanil)	5 oz	20 oz	3	1	Supplemental label.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	Sonoma 40WSP (myclobutanil)	5 oz	20 oz	3	1	-
	3	Trionic (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pythium damping off	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate. Alternate with fungicide with dissimilar modes of action after 2 applications.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Various brands available: Equation SC, Quadris, Satori, Tetra, Willowood Azoxystrobin	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	13	Quintec (quinoxifen)	6 fl oz	24 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	4	Ridomil Gold SL (mefenoxam)	2 pt	1 lb a.i.	7	2	-
	4	Sebring 318FS Sebring 480FS (metalaxyl)	0.75 fl oz/100 lb of seed	-	-	1	Seed treatment only.
	4	Acquire Allegiance FL (metalaxyl)	0.75 fl oz/100 lb of seed	-	-	1	Seed treatment only.
	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb seed	-	-	-	-
	4	Metastar 2E (metalaxyl)	8 pt	-	-	-	Apply as a broadcast soil application and incorporate into top 2 in.
	4	Ridomil Gold Ridomil Gold GR Ultra Flourish (mefenoxam)	Gold: 2 pt GR: 40 lb Ultra Flourish: 4 pt	-	2	-	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	Uniform (fludioxonil)	0.34 fl oz/1000 row ft	-	0	-	Soil incorporated. No more than 1 application.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Rhizoctonia bottom rot	2	(iprodione) Many brands available: Enclosure 4F, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4F	2 pt	6 pt	14	1	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Apply at critical timing for disease suppression. See Extension guidelines for best application.
Rhizoctonia	7	Endura (boscalid)	11 oz	22 oz	14	0.5	-
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	-
Sclerotinia drop	2	(iprodione) Many brands available: Enclosure 4F, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4F	2 pt	6 pt	14	1	-
	7	Endura (boscalid)	11 oz	22 oz	14	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7	Kenja 400 SC (isofetamid)	12.3 fl oz	24.6 fl oz	14	0.5	Make first application after emergence and second at thinning.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	Cannonball (fludioxonil)	7 oz	28 oz	0	0.5	Apply after emergence and after thinning.
	14	Botran 5F (dichloran)	5.33 lb	5.33 lb	14	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	-
Septoria	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of actions.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	13.4 fl oz	14	0.5	No more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	Various brands available: Equation SC, Quadris, Satori, TetraBan, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of actions.
	11	Cabrio EG (pyraclostrobin)	16 oz	16 oz	0	0.5	Alternate with fungicides with dissimilar modes of actions.
Various seedling diseases	4 + 11	Uniform	0.34 fl oz/1000 lb of seed	-	-	0	Soil incorporated. No more than 1 application.
	12	Maxim 4FS Spirato 480 FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	-	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 14. Spinach fungicides ordered by disease and then FRAC group according to their mode of action. Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to Reentry		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
<i>Alternaria</i> spp.	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action. May cause leaf cupping.
	9 + 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	11	Quadris (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Anthrachnose	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Previsto, Top Cop w/Sulfur	See individual label	See individual label	-	Varies by product from 4 hr to 2 days	-
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	11	Quadris (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Damping off	M3	Defiant 75WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Downy mildew	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4 + 11	Uniform (azoxystrobin + mefenoxam)	0.34 fl oz/1000 ft row	-	-	0	Make only 1 application per season at planting.
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	See individual label	See individual label	-	Varies by product from 4 hr to 2 days	-
	M2	(sulfur) Many brands available: Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur, Sulfur 90W, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. No more than 2 applications.
	4 + M1	Ridomil Gold/Copper (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. No more than 2 foliar applications.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.
	11	(azoxystrobin) Various brands available: Equation SC, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	0.5	No more than 3 applications per crop and alternate chemistry.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	21	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.
	21A	Torac (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	No more than 2 applications per crop cycle. Insecticide also controls aphids, thrips, etc. Suppression only.
	27	Curzate 60DF (cymoxanil)	5 oz	30 oz	1	0.5	Use only in combination with a broad-spectrum protectant such as copper fungicides.
	27 + 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with another FRAC group 11 fungicide.
	33	Aliette 80WDG Legion 80WDG Linebacker 80WDG (fosetyl-Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	3 qt	-	0	4 hr	See label for details.
	40	Forum (dimethomorph)	6 fl oz	18 fl oz	0	0.5	Must be tank-mixed with another fungicide when used against downy mildew. No more than 2 sequential applications.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. See label for soil applications.
	40 + 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	No more than 2 sequential applications.
	43	Presidio (fluopicolide)	4 oz	1 pt	2	0.5	Must be tank-mixed with a fungicide of a different mode of action. See label for rotational restrictions.
	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	19.2 fl oz	38.4 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if applied using soil applications. Be aware of plant-back restrictions.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Powdery mildew	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	No more than 2 sequential applications.
	9 + 12	Switch 62.5WDG (fludioxonil)	14 oz	56 oz	7	0.5	See label for details.
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	21A	Torac (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	No more than 2 applications per crop cycle. Insecticide also controls aphids, thrips, etc.
Pythium seedling blight	4	Acquire Allegiance FL (metalaxyl)	0.75 fl oz/100 lb of seed	-	-	1	Seed treatment only.
	4	Apron XL LS (mefenoxam)	0.64 fl oz/100 lb of seed	-	-	2	Seed treatment only.
	4	Metastar (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
	4	Sebring 2.65ST (metalaxyl)	0.75 fl oz/100 lb of seed	-	-	1	Seed treatment only.
Pythium seedling diseases	4	Ridomil Gold GR (mefenoxam)	40 lb	-	-	2	-
	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ultra Flourish (mefenoxam)	4 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row	-	-	0	Make only 1 application per season at planting.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Stemphylium leaf spot	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	11	(azoxystrobin) Various brands available: Equation SC, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Various leaf spots	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kantan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	See individual label	See individual label	-	Varies by product from 4 hr to 2 days	-
	M2	(sulfur) Many brands available: Microfine Sulfur, Micro Sulf, Microthiol Dispers, Sulfur 90W, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	No more than 2 sequential applications.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Various brands available: Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Quadris (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Reason (fenamidone)	8.2 oz	24.6 fl oz	2	0.5	Alternate with fungicides of dissimilar modes of action.
	12	Cannonball (fludioxonil)	7 fl oz	-	7	0.5	No more than 2 sequential applications before rotating with dissimilar modes of action.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	21	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	Do not apply to young seedlings.
White rust	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	See individual label	See individual label	-	Varies by product from 4 hr to 2 days	-
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. No more than 2 applications.
	4 + M1	Ridomil Gold/Copper WP (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. No more than 2 foliar applications.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Various brands available: Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Quadris (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	21	Ranman (cyazofamid)	2.75 fl oz	13.75 fl oz	0	0.5	No more than 3 sequential applications.
	33	Aliette 80WDG Legion 80WDG Linebacker 80WDG (fosetyl-Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.
	P	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. P = host plant defense inducers. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 15. Nonfumigant nematicides for leafy vegetables in Florida. Contact: Johan Desaeager, UF/IFAS Gulf Coast Research and Education Center.

Application Directions	
Product	
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Biological nematicides	See chapter 19.

Table 16. Fumigant nematicides for leafy vegetables in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/Chisel-Spaced 12" Apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory Good Agricultural Practices (GAPs), product and applicator training certification, and other uses and rate recommendations.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 10. Minor Vegetable Crop Production¹

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Celery, Okra, and Parsley Botany and Planting

Celery—*Apium graveolens*, Apiaceae (Umbelliferae)

Okra—*Abelmoschus esculentus*, Malvaceae

Parsley—*Petroselinum crispum*, Apiaceae (Umbelliferae)

Table 1. Planting dates for celery, okra, and parsley.

Planting Region	Dates		
	Celery	Okra	Parsley
North Florida	Aug–Feb	Mar–Jun	Sept–Mar
Central Florida	Sept–Mar	Feb–Aug	Sept–Mar
South Florida	Sept–Mar	Jan–Mar/Aug–Oct	All year

Table 2. Planting information for celery, okra, and parsley.

Planting Parameters	Measurements		
	Celery	Okra	Parsley
Distance between rows (in)	18–40	36–60	6–12
Distance between plants (in)	6–12	4–10	Drilled
Seeding depth (in)	On surface	0.5–1.0	0.25
Seed per acre (lb)	1–2	6–81	6–8
Days to maturity from seed	75–90	60–70	70–80
Plant population (acre)	58,080	43,560	1 million+

Cultivars

Table 3. Common cultivars of celery, okra, and parsley.

Crop	Cultivars
Celery	Tall Utah 52-70R Improved*
Okra	Annie Oakley II (H), Cajun Delight (H), Clemson Spineless, Clemson Spineless 80, Millionaire (H), North and South (H), Spike (H)
Parsley	Dark Green Italian (PL), Forest Green (CL), Improved Market Gardeners (CL), Jade (CL, H)
*Note the vast majority of celery production in Florida uses proprietary varieties H=hybrid, CL=curly leaf, PL=plain leaf	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 4. Herbicides approved for managing weeds in celery. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kaniserry, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREPLANT/ PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Broadleaf and grass weeds. Incorporate mechanically 1–2 in. deep or with irrigation 2–4 in. deep.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and postemergence herbicide that does not have residual effects. It can be mixed with residual or preemergence herbicides to extend its control.
	Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. No more than 1 application. Consult label for rotational crop restrictions.
	Pyraflufen ethyl 0.0008–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Broadleaf and grass weeds. Preplant burndown application. Allow 1 day before planting. Include a nonionic surfactant or crop oil concentrate in the spray solution.
	S-metolachlor 0.95–1.26	(Dual Magnum) 1.0–1.33 pt	15	Broadleaf, grass weeds, and nutsedge. Label is a Third-Party Registration (TPR, Inc.), and authorization and waiver agreements must be obtained prior to use. Rates are based on soil organic matter.
	Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan, Trifluralin) 10 G 5 lb	3	Annual broadleaf and grass weeds. Do not apply to muck soil. For mineral soils with 2%–5% organic material, apply 0.75 lb a.i./A. Incorporate 4 in. or less within 8 hr of application.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded sprays to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. PHI 0 days.
	Clethodim 0.09–0.13 0.07–0.12	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Use a nonionic surfactant with Select Max. PHI 30 days.
POSTTRANSPLANT/ POSTEMERGENCE	Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	Broadleaf and grass weeds. Apply after transplanting but before celery is 8 in. tall. Do not apply when temperatures exceed 85°F nor as a tank mix with surfactants, nitrogen, or fertilizer solution. PHI 45 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles with hooded or shielded sprayer. Product is a contact, nonselective herbicide with no residual control. May be tank-mixed with several soil residual compounds.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Prometryn 0.8–1.6	(Caparol) 4 L 1.6–3.2 pt	5	Broadleaf weeds. Apply 1 application during the 2-to-6-week period after transplanting. Weeds should not exceed 2 in.
	Sethoxydim 0.28	(Poast) 1.5 EC 1.5 pt	1	Emerged grass weeds. No more than 3 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.
	S-metolachlor 0.95–1.26	(Dual Magnum) 1.0–1.33 pt	15	Broadleaf, grass weeds, and nutsedge. Label is a Third-Party Registration (TPR, Inc.), and authorization and waiver agreements must be obtained prior to use. Rates are based on soil organic matter.
CELERY SEEDBEDS	Prometryn 0.6–0.8	(Caparol) 4 L 1.2–1.6 pt	5	Broadleaf weeds. Apply once per year to seedbeds. Apply after celery has 2–5 true leaves. Apply after seedbed covers have been removed for at least 1 week.

Table 5. Herbicides approved for managing weeds in okra. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Flumioxazin up to 0.128	(Chateau EZ) up to 4 fl oz	14	Annual broadleaf weeds. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization is a waiver of liability and is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weed control. Apply as a preplant burndown for emerged weeds. Read label for individual product directions.
	Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 fl oz/A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control of emerged weeds. Registration is through Third-Party Registration (TPR, Inc.), and a copy of the label must be on-hand at time of application. PHI 30 days.
	Mesotrione 0.19	(Callisto) 4 L 6 fl oz	28	Broadleaf and grass weeds. Apply to row middles only. Leave 1 ft of untreated area or 6 in. on either side of the plant row. Injury risk is greatest on coarse-textured soils (sand, sandy loam, or loamy sand). Apply as one preemergence application OR one postemergence application. Callisto will cause whitening of the okra leaves.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt	22	Emerged broadleaf and grass weed control. Apply 1 application before crop emergence. No more than 8 pt/A per season. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broadleaf and grass weeds. Scythe is a contact, nonselective herbicide with no residual activity. May be tank-mixed with trifluralin for soil residual activity. Consult label for rates and other information.
	Prometryn 0.75–1.5	(Caparol) 4 L 1.5–3.0 pt	5	Apply after planting, but before crop emergence. Apply as 1 preemergence application at 3 pt OR 1 preemergence application at 1.5 pt followed by 1 POST directed application at 1.5 pt. No more than 3 pt/A per crop cycle.
	Sulfentrazone 0.07–0.09	(Willowood sulfentrazone) 4SC 2.25–3.0 fl oz	14	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. No more than 12 fl oz/A within a 12-month period. Should be trialed on a small area to find suitable rate for the soil type in your area.
	Trifluralin 0.5–0.75	(Treflan, Trifluralin) 4 EC 0.5–1.5 pt (Treflan, Trifluralin) 10 G 5.0–7.5 lb	3	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents. Note precautions against planting nonregistered crops within 5 months.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
POSTEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply to row middles only with a hooded sprayer. No more than 0.096 lb a.i./A per season. Rates apply to mineral and muck soils. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply to row middles only with a hooded sprayer. PHI 14 days.
	Halosulfuron 0.024–0.05	(Sande) 75 WG 0.5–1.0 oz	2	Broadleaf and purple/yellow nutsedge weeds. Apply to row middles of direct-seeded or transplanted okra. If plastic is used, prevent herbicide contact with the plastic. No more than 2 oz/A per 12-month period. PHI 30 days.
	Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 fl oz/A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control of emerged weeds. One POST application may be made per growing season at 18 days after transplanting. Cobra contacting green foliage or fruit can cause excessive injury. Registration is through Third-Party Registration (TPR, Inc.), and a copy of the label must be on hand at time of application. PHI 30 days.
	Mesotrione 0.09	(Callisto) 4 L 3 fl oz	28	Broadleaf and grass weeds. Direct spray with hooded sprayer to minimize contact with okra plants. Okra must be at least 3 in. tall. Use of a nonionic surfactant is required. Injury risk is greatest on coarse-textured soils. Apply as 1 preemergence or 1 postemergence application. PHI 28 days.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0 pt	22	Emerged broadleaf and grass weeds. Apply to row middles only and do not allow contact with okra plants. No more than 2 applications after crop emergence. No more than 8 pt/A per season. PHI 60 days. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broadleaf and grass weeds. Apply to row middles only with a shielded sprayer.
	Prometryn 0.75	(Caparol) 4 L 1.5 pt	5	Apply 1 postemergence application directed to the base of the crop. If a preemergence application was made, do not exceed 3 pt/A. PHI 14 days.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Emerged grass weeds. Efficacy will decrease if grass weeds are under stress. Include a crop oil concentrate or methylated seed oil in the spray. PHI 14 days.

Table 6. Herbicides approved for managing weeds in parsley. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kaniserry, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Parsley	Annual broadleaf and grass weeds. Incorporate or irrigate 1–2 in. deep within 36 hr of application. Consult label for rotation restrictions.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Parsley, cilantro	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Parsley, cilantro	Control emerged broadleaf and grass weeds. Consult individual labels for restrictions.
	Linuron 0.5–1.5	(Lorox DF) 50 DF 1–3 lb	7	Parsley, cilantro	Mineral and muck soils. Apply after planting and before crop emergence. Use lower rates on coarse soils.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Parsley, cilantro	Controls emerged weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity.
POSTEMERGENCE	Prometryn 1.0–1.6	(Caparol) 4 L 1.0 pt	5	Parsley, cilantro	A single preemergence application can be applied up to 14 days after planting. A 2nd application can be made up to 30 days prior to harvest. Do not apply on sand or loamy sand. Read label for rotation restrictions.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Parsley	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Plant 1 day after application.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Parsley, cilantro	Emerged broadleaf control. Post-direct hooded application to row middles. Read the label for adjuvant requirements. PHI 0 days.
	Clethodim 0.09–0.13 0.07–0.12	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Parsley, cilantro	Annual and perennial grass control. Read the label for required adjuvants.
	Linuron 0.5	(Lorox DF) 50 DF 1 lb	7	Parsley, cilantro	Apply after the crop has a minimum of 3 true leaves or crop injury may result. Apply when weeds are in the 1–3 true leaf stage. No more than 3 lb/A of Lorox per season. PHI 30 days.
	Prometryn 0.5	(Caparol) 4 L 1.0 pt	5	Parsley, cilantro	An application can be made up to 30 days prior to harvest. Another application can be applied after harvest to the new regrowth. Do not use on sand or loamy sands. Read label for rotation restrictions.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Parsley, cilantro	Emerged grass weeds. Decreased efficacy if weeds are under stress. No more than 3.0 pt/A per season. Include a crop oil concentrate in the spray solution. PHI 15 days.

Table 7. Insecticides approved for management of arthropod pests of celery. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC, 8F (malathion)	5EC: 2.4 pt 8F: 1–1.5 pt	-	24	7	No more than 2 applications per year.
	1B	Orthene 97 (acephate)	0.5–1.0 lb	2.125 lb	24	21	-
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	-
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	-
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	51.2 oz per year	12	1	-
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	-
	4A	Admire Pro (imidacloprid)	Soil: 4.4–10.5 fl oz	10.5 fl oz per year	12	45	-
	4A	Assail 30SG, 70WP (acetamiprid)	30SG: 2.0–4.0 oz 70WP: 0.8–1.7 oz	30SG: 20.0 oz or per year 70WP: 8.5 oz per year	12	7	-
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	-
	4A	Platinum 75 SG (thiamethoxam)	Soil: 1.66–3.67 oz	3.67 oz	12	30	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	-
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	1	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz per year	12	7	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	-
	9B	PQZ (pyrifluquinazon)	2.4-3.2 fl oz	4.8 fl oz	12	1	-
	9D	Versys (afidopyropen)	1.5 fl oz	14 fl oz	12	0	-
	21A	Torac (tolfenpyrad)	14-21 fl oz	42 fl oz	12	1	-
	23	Movento (spirotetramat)	4.0-5.0 fl oz	10 fl oz	24	3	-
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	-
	28	Verimark (cyantraniliprole)	6.75-13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz	12	0	-
	1A	*Lannate LV, *SP (methomyl)	LV: 0.75-3 pt SP: 0.25-1.0 lb	LV: 21 pt SP: 7 lb	48	7	-
	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year	12	14	-
	1B	Orthene 97 (acephate)	1.0 lb	2.125 lb	24	21	-
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	32 fl oz	12	7	-
	3A	*Fastac CS (alpha-cypermethrin)	2.2-3.8 fl oz	11.4 fl oz	12	1	-
Caterpillars (includes beet armyworm, cabbage looper, celery leaf-tier, corn earworm, cutworms, fall armyworm)	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
	3A	*Pounce 25 WP (permethrin)	3.2-12.8 oz	51.2 oz per year	12	1	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10.0-13.0 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0-7.0 oz	14 oz	12	7	-
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz per year	4	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz per year	12	7	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10.0 fl oz	20 fl oz per year	12	7	–
	18	Confirm 2F (tebufenozide)	6–8 fl oz	40 fl oz	4	7	–
	18	Intrepid 2F (methoxyfenozide)	4–10 fl oz	64 fl oz per year	4	1	–
	22	Avaunt, Avaunt eVo (indoxacarb)	Avaunt: 3.5 oz eVo: 3.5–6.0 oz	Avaunt: 14 oz eVo: 18 oz	12	3	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	7.0–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Verimark (cyantraniliprole)	5.0–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	32	Spear-Lep (GS-omega/kappa-Htxt-Hv1a)	1–2 pt	10 gal per year	4	0	
	1A	Sevin 4F, XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	14	–
Flea beetles	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	–
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	13 fl oz	12	30	–
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	21A	Torac (tolfenpyrad)	14–21 fl oz	42 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
Grasshoppers	4A	Belay (clothianidin)	Soil: 9–12 fl oz	12 fl oz	12	21	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	1A	Sevin 4F, XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	14	–
Leafhoppers	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz	12	7	–
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Admire Pro (imidacloprid)	4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	45	–
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	13 fl oz	12	30	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafminers	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz	4	1	–
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	7	–
	21A	Torac (tolfenpyrad)	14–21 fl oz	42 fl oz	12	1	–
	1A	*Vydate L (oxamyl)	2–4 pt	24 pt	48	21	–
	1B	Dimethoate 4EC (dimethoate)	1 pt	3 pt per year	48	7	–
	4A	Belay (clothianidin)	Soil: 9–12 fl oz	12 fl oz	12	21	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	–
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl per year	12	7	–
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	14.4 oz per year	12	7	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10.0 fl oz	20 fl oz per year	12	7	–
	17	Trigard (cyromazine)	2.66 oz	16 oz per year	12	7	–
	28	Coragen (chlorantraniliprole)	5.0–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre			REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²				
Plant bugs	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year		12	14	-
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	32 fl oz		12	7	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz		12	0	-
Planthoppers	16	Courier 40SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz		12	7	-
Stink bugs	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year		12	14	-
	3A	*Fastac CS (alpha-cypermethrin)	3.2-3.8 fl oz	11.4 fl oz		12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2-4.0 fl oz	24 fl oz		12	1	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5.25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz		12	Foliar: 7 Soil: 21	-
Twospotted spider mite	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz		12	Foliar: 7 Soil: 21	-
	1B	Malathion 5EC, 8F (malathion)	5EC: 2.4 pt 8F: 1-1.5 pt	-		24	7	No more than 2 applications per year.
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	32 fl oz		12	7	-
	6	*Agri-Mek SC (abamectin)	1.75-3.5 fl oz	10.25 fl per year		12	7	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10.0 fl oz	20 fl oz per year		12	7	-

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions.

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

*Restricted use insecticide.

Table 8. Insecticides approved for managing arthropod pests of okra crops. Contact: Dakshina Seal, UF/IFAS Tropical Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	*Malathion 5EC Malathion 8F (malathion)	5EC: 1.5 pt 8F: 1.2 pt	5EC: 9.5 pt per year 8F: 6.0 pt per year	12	1	-
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	-
	4A	Admire Pro (imidacloprid)	Soil: 7–14 fl oz Foliar: 1.3–2.2 fl oz	Soil: 14 fl oz Foliar: 6.7 fl oz	12	Soil: 21 Foliar: 0	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	Assail 30SG (acetamiprid)	2.0–4.0 oz	16 oz	12	7	-
	4D	Sivanto Prime (flupyradifurone)	Foliar: 7.0–14 fl oz Soil: 21–28 fl oz	28 fl oz per year	4	Foliar: 1 Soil: 45	-
	9D	Sefina Inscalis (afidopyropen)	3.0 fl oz	28 fl oz	12	0	-
	23	Movento (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	-
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.; see label	12	1	-
	29	Beleaf 50 SG (flonicamid)	2.8–4.28 oz	8.4 oz	12	0	-
	1B	*Malathion 5EC Malathion 8F (malathion)	5EC: 1.9 pt 8F: 1.2 pt	5EC: 9.5 pt per year 8F: 6.0 pt per year	12	1	Do not graze or feed forage to livestock.
Beetles (including cucumber beetles, flea beetles)	3A	*Capture LFR (bifenthrin)	3.4–6.8 fl oz	0.2 lb a.i.	12	At planting	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	-
	3A + 28	Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	-
	4A	Admire Pro (imidacloprid)	Soil: 7–14 fl oz Foliar: 1.3–2.2 fl oz	Soil: 14 fl oz Foliar: 6.7 fl oz	12	Soil: 21 Foliar: 0	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	Assail 30SG (acetamiprid)	1.5–2.5 oz	16 oz	12	7	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	15	Rimon 0.83 EC (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
Caterpillars (including armyworms, loopers, tomato fruitworm — also known as corn earworm, caterpillars, cutworms)	1A	Sevin 4F, XLR Plus (carbaryl)	4F: 1–1.5 qt XLR: 1–1.5 qt	6 qt per year	12	3	–
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	1	Do not feed or graze livestock on treated vines.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	–
	3A	*Capture LFR (bifenthrin)	3.4–6.8 fl oz	0.2 lb a.i.	12	At planting	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	3A + 28	Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	–
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz	4	1	–
	6 + 28	Minecto Pro (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	7	–
	11A	Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	No limit	4	0	Use high rate for armyworms. Treat when larvae are young.
	15	Rimon 0.83 EC (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	18	Intrepid (methoxyfenozide)	4–16 fl oz	64 fl oz	4	1	–
	22	Avaunt (indoxacarb)	2.5–3.5 oz	14 oz	12	3	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz of chlorantraniliprole products	4	1	–
	28	Exirel (cyantraniliprole)	7.0–13.5 fl oz	0.4 lb a.i. of cyantraniliprole or cyazapyr products	12	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Fire ants	7A	Extinguish (S-methoprene)	1–1.5 lb broadcast	As needed	4	0	IGR (insect growth regulator). Colonies will get reduced after 3 weeks and eliminated after 8–10 weeks.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	0.134 lb a.i.	12	1	IGR. Apply at first sign of ant activity.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	7	–
Leafminers	5	Radiant SC (spinetoram)	6–10 fl oz	34 oz per year	4	1	Use adjuvant for leafminer.
	6 + 28	Minecto Pro (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	7	–
	15	Rimon 0.83 EC (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.; see label	12	1	–
	28	VeriMark (cyantraniliprole)	6.75–13.5 fl oz	13.5 oz of cyantraniliprole or cyazapyr products	4	1	Apply at planting or in drip.
Mites	6 + 28	Minecto Pro (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	7	–
	10B	Zeal (etoxazole)	2.0–3.0 oz	3.0 oz	12	7	–
	20B	Kanemite 15 SC (acequinocyl)	31 fl oz	62 oz	12	1	–
	20D	Acramite-50WS (bifentzate)	0.50–1.0 lb	1.0 lb	12	3	–
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt	12	1	–
	23	Movento (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	–
	1A	Sevin 4F, XLR Plus (carbaryl)	4F: 1–1.5 qt XLR: 1–1.5 qt	6 qt per year	12	3	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	12.8 oz	7	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	–
	15	Rimon 0.83 EC (novaluron)	12 fl oz	36.0 fl oz	12	1	
	4A	Admire Pro (imidacloprid)	Soil: 7–14 fl oz	Soil: 10.5 fl oz	12	Soil: 21	Soil application only for thrips.
Thrips	6 + 28	Minecto Pro (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.	12	7	–
	15	Rimon 0.83 EC (novaluron)	12 fl oz	24.0 fl oz	12	1	
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	7	–
	4A	Admire Pro (imidacloprid)	Soil: 7–14 fl oz Foliar: 1.3–2.2 fl oz	Soil: 14 fl oz Foliar: 6.7 fl oz	12	Soil: 21 Foliar: 0	Do not apply to both soil and foliage.
Whiteflies	4A	Assail 30SG (acetamiprid)	2.5–4.0 fl oz	16 oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	Foliar: 10.5–14 fl oz Soil: 21–28 fl oz	28 fl oz per year	4	Foliar: 1 Soil: 45	–
	6 + 28	Minecto Pro (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	7	–
	7C	Knack IGR (pyriproxyfen)	8–10 fl oz	20 fl oz	12	1	IGR
	9D	Sefina Inscalis (afidopyropen)	14 fl oz	28 fl oz	12	0	–
	15	Rimon 0.83 EC (novaluron)	12.0 fl oz	24.0 oz	12	1	–
	16	Courier 40 SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	1	–
	23	Movento (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.; see label	12	1	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz of cyantraniliprole or cyazapyr products	4	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	U	Requiem EC (extract of <i>Chenopodium ambrosioides</i>)	2-4 qt	as needed	4	0	-
Wireworm	3A	*Capture LFR (bifenthrin)	3.4-6.8 fl oz	0.2 lb a.i.	12	At planting	Extremely toxic to bees, fish, and aquatic invertebrates.

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet.

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in the table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

*Restricted use insecticide

Table 9. Insecticides labeled for management of arthropod pests of parsley. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.4 pt 8F: 1.5 pt	–	24	7	No more than 2 applications per year.
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	–
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	51.2 oz per year	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4–10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Assail 30SG Assail 70WP (acetamiprid)	30SG: 2.0–4.0 oz 70WP: 0.8–1.7 oz	30SG: 20.0 oz or per year 70WP: 8.5 oz per year	12	7	–
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	13 fl oz	12	30	–
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	1	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	12	7	–
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	7	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz	12	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	9D	Versys (afidopyropen)	1.5 fl oz	14 fl oz	12	0	-
	23	Movento (spirotetramat)	4.0-5.0 fl oz	10 fl oz	24	3	-
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	-
	28	Verimark (cyantraniliprole)	6.75-13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz	12	0	-
	1A	*Lannate LV, *SP (methomyl)	LV: 1.5-3 pt SP: 0.5-1.0 lb	LV: 12 pt SP: 4 lb	48	10	-
	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year	12	14	-
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Fastac CS (alpha-cypermethrin)	2.2-3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
Caterpillars (includes beet armyworm, cabbage looper, celery leaf-tier, corn earworm, cutworms, fall armyworm)	3A	*Pounce 25 WP (permethrin)	3.2-12.8 oz	51.2 oz per year	12	1	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13 fl oz	12	30	-
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0-7.0 oz	14 oz	12	7	-
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz per year	4	1	-
	6	*Proclaim (emamectin benzoate)	2.4-4.8 oz	14.4 oz per year	12	7	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10.0 fl oz Cabbage looper: 7.5-10.0 fl oz	20 fl oz per year	12	7	-
	18	Confirm 2F (tebufenozide)	6-8 fl oz	40 fl oz	4	7	-
	18	Intrepid 2F (methoxyfenozide)	4-10 fl oz	64 fl oz per year	4	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Flea beetles	22	Avaunt Avaunt eVo (indoxacarb)	Avaunt: 2.5–3.5 oz eVo: 2.5–6.0 oz	Avaunt: 24 oz Avaunt eVo: 18 oz	12	3	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	7.0–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Verimark (cyantraniliprole)	5.0–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	30	Incipio (isocycloseram)	2.1–4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications per year.
	32	Spear-Lep (GS-omega/kappa-Hctx-Hv1a)	1–2 pt	10 gal per year	4	0	–
	1A	Sevin 4F, XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	14	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–3.2 fl oz	12.8 fl oz	12	0	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	11 oz	12	7	–
	4A	Admire Pro (imidacloprid)	1.3 fl oz	6.5 fl oz per year	12	7	–
	4A	Belay (clothianidin)	Foliar: 3–4 fl oz Soil: 9–12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2–5.25 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Venom (dinotefuran)	Foliar: 1.0–3.0 oz Soil: 5.0–6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	–
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	7	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	30	Incipio (isocycloseram)	2.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
Grasshoppers	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	4A	Belay (clothianidin)	Soil: 9-12 fl oz	12 fl oz	12	21	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5.25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
Leafhoppers	1A	Sevin 4F, XLR Plus (carbaryl)	0.5-1.0 qt	6 qt per year	12	14	-
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-3.2 fl oz	12.8 fl oz	12	0	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	1	-
	3A	*Pounce 25 WP (permethrin)	3.2-12.8 oz	51.2 oz per year	12	1	-
	4A	Actara (thiamethoxam)	1.5-3.0 oz	11 fl oz	12	7	-
	4A	Admire Pro (imidacloprid)	Foliar: 1.3 fl oz Soil: 4.4-10.5 fl oz	Foliar: 6.5 fl oz Soil: 10.5 fl oz per year	12	Foliar: 7 Soil: 21	-
	4A	Belay (clothianidin)	Foliar: 3-4 fl oz Soil: 9-12 fl oz	12 fl oz per year	12	Foliar: 7 Soil: 21	-
	4A	Platinum 75SG (thiamethoxam)	1.66-3.67 oz	3.67 oz	12	30	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5.25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13 fl oz	12	30	-
	4D	Sivanto Prime (flupyradifurone)	7-14 fl oz	28 fl oz	4	1	-
	16	Courier 40SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz	12	7	-
	30	Incipio (isocycloseram)	2.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafminers	3A	*Pounce 25 WP (permethrin)	3.2-12.8 oz	51.2 oz per year	12	1	-
	4A	Belay (clothianidin)	Soil: 9-12 fl oz	12 fl oz	12	21	-
	4A	Platinum 75SG (thiamethoxam)	1.66-3.67 oz	3.67 oz	12	30	-
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5.25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz per year	4	1	-
	6	*Agri-Mek SC (abamectin)	1.75-3.5 fl oz	10.25 fl per year	12	7	-
	6	*Proclaim (emamectin benzoate)	2.4-4.8 oz	14.4 oz per year	12	7	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10.0 fl oz	20 fl oz per year	12	7	-
	17	Trigard (cyromazine)	2.66 oz	13.3 oz	12	7	-
Plant bugs	28	Coragen (chlorantraniliprole)	5.0-7.5 fl oz	15.4 fl oz	4	1	-
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	-
	28	Verimark (cyantraniliprole)	6.75-13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	-
	30	Incipio (isocycloseram)	2.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year	12	14	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz	12	0	-
Planthoppers	16	Courier 40SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz	12	7	-
Stink bugs	1A	Sevin 4F, XLR Plus (carbaryl)	1-2 qt	6 qt per year	12	14	-
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2-4.0 fl oz	24 fl oz	12	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2-5,25 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Venom (dinotefuran)	Foliar: 1.0-3.0 oz Soil: 5.0-6.0 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 7 Soil: 21	-
	6	*Agri-Mek SC (abamectin)	1.75-3.5 fl oz	10.25 fl per year	12	7	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10.0 fl oz	20 fl oz per year	12	7	-
	30	Incipio (isocycloseram)	2.1-4.1 fl oz	8.2 fl oz per year	12	1	No more than 2 applications.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 10. Celery fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
<i>Alternaria</i> spp.	7	Endura (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
	9 + 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	(azoxystrobin) Many brands available: Azoxystrobin SC, Equaton SC, Quadris SC, Satori, Willowood Azoxystrobin	15.4 fl oz	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Bacterial blight	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, Champion++, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Previs-to, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur	See individual label	See individual label	1	Varies by product from 4 hr to 2 days.	-
	25	Agri-mycin 17 AG Streptomycin Bac-Master Firewall 17 WP (streptomycin)	200 ppm	-	-	0.5	See label for details. For transplant production.
Early blight (<i>Cercospora apii</i>)	M2	(sulfur) Many brands available: Cosavet, Dusting Sulfur - IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	18 lb a.i.; see individual label	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5 + 33	Catamaran (chlorothalonil + potassium phosphite)	4 pt	60 pt	7	0.5	-
	3	(propiconazole) Many brands available: Amcide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	No more than 4 applications.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Pristine (boscalid + pyraclostrobin)	25 oz	50 oz	0	0.5	No more than 1 application before rotating to a fungicide of dissimilar mode of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	Aftershock (fluofoxastrobilin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	(azoxystrobin) Many brands available: Azoxystrobin, Azteroid SC, Equation SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint Extra (trifloxystrobin)	2.9 oz	11.6 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti or rotate with non-Qol fungicides.
	11 + 3	Quilt Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with another FRAC group 11 fungicide.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
Leaf Curl (Colletotrichum)	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Late blight (Septoria)	7 + 11	Pristine (boscalid + pyraclostrobin)	25 oz	50 oz	0	0.5	No more than 1 application before rotating to a fungicide of dissimilar mode of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	No more than 1 sequential application of Qol fungicides. See label for soil application.
	M2	(sulfur) Many brands available: Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	See individual label	7	0.5	–
	M5 + 33	Catamaran (chlorothalonil + potassium phosphite)	4 pt	60 pt	7	0.5	–
	3	(propiconazole) Many brands available: Amcide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Pristine (boscalid + pyraclostrobin)	15 oz	50 oz	0	0.5	No more than 1 application before rotating to a fungicide of dissimilar mode of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	(azoxystrobin) Many brands available: Azoxystrobin, Azteroid SC, Equaton SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint Extra (trifloxystrobin)	2.9 oz	11.6 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti or rotate with non-QoI fungicides.
	11 + 3	Quilt Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with another FRAC group 11 fungicide.
	7	Endura (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
Botrytis	9 + 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	40	Forum (dimethomorph)	6 fl oz	18 fl oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
Downy mildew	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	40 + 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	52 fl oz	0	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	43	Presidio (Fluopicolide)	4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with another fungicide active against the pathogen but of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pink rot (Sclerotinia)	14	Botran 75W (dichloran)	2 lb	5.33 lb	7	0.5	Direct spray to base of plant.
Powdery mildew	M2	(sulfur) Many brands available: Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/ Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
Pythium	33	Aliette WDG Legion 80WDG Linebacker WDG (fosetyl-Al)	5 lb	20 lb	-	0.5	-
Pythium seedling blight	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb seed	-	-	2	Seed treatment only.
	4	Metastar 2E (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
Pythium seedling diseases	4	Ridomil Gold GR (mefenoxam)	40 lb	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ultra Flourish (mefenoxam)	4 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row	-	-	2	No more than 1 application. Soil incorporated.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Sclerotinia	7	Endura (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	See individual label	7	0.5	-
	3	(propiconazole) Many brands available: Amcide Propiconazole, Bumper 41.8EC, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt 3.6E	4 fl oz	16 fl oz	14	0.5	No more than 4 total applications.
	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint Extra (trifloxystrobin)	2.9 oz	11.6 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti or rotate with non-Qol fungicides.
Various	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	11	(azoxystrobin) Many brands available: Azoxystrobin, Azteroid SC, Equaton SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	96 fl oz	0	0.5	No more than 1 sequential application of Qol fungicides. See label for soil application.
	19	OSO 5% SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt	-	0	4 hr	See label for details.
Various seedling diseases	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 row ft	-	-	0	No more than 1 application per season. Soil incorporated.
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 11. Okra fungicides ordered by disease and then FRAC group according to their mode of action. Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides including materials labeled for certified organic production. Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Anthracnose	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	No more than 2 consecutive applications.
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	13.1 lb	0	Field: 2 GH: 1	OMRI listed. ³
	M1	Champion++ (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	Cueva (copper octanoate)	2 gal	6.7 gal	0	4 hr	-
	M1	Kalmor (copper hydroxide)	1.75 lb	17.5 lb	0	2	OMRI listed. ³
	M1	Kocide 2000 (copper hydroxide)	3 lb	15 lb	0	2	-
	M1	Kocide 3000 (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	Kop-5 (copper sulfate pentahydrate)	32 fl oz	10.6 gal	-	Field: 2 GH: 1	-
	M1	MasterCop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	-
	M1	Nu-Cop 50 DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	-
	M1	Nu-Cop 30 HB (copper hydroxide)	1.75 lb	17.5 lb	-	2	-
	M1	Previsto (copper hydroxide)	3 qt	69 qt	-	2	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	Field: 2 GH: 1	OMRI listed. ³
	M5	Bravo Ultrex (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	-
	M5	Bravo Weather Stik (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Chlorothalonil 720 (chlorothalonil)	1.5 pt	12 pt	3	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	Echo 720 (chlorothalonil)	1.5 pt	9.0 lb a.i.	3	0.5	-
	M5	Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Reapplications at least 7 days apart.
	M5	Initiate 720 (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Oranil 6L (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz NG (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Rialto 720F (chlorothalonil)	1.5 pt	16 pt	14	0.5	-
	M5 + 22	Zing! (chlorothalonil + zoxamide)	34 fl oz	272 fl oz	3	0.5	-
	M5 + 27	Cymbol Advance (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.7 pt	10.8 pt	3	0.5	-
	3	Cevya (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	-
	3	Mettle 125ME (tetraconazole)	8 fl oz	16 fl oz	0	0.5	-
	3	Provyosol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	-
	3	Rhyme Fungicide (flutriafol)	7 fl oz	28 fl oz	7	0.5	-
	3	Topguard Fungicide (flutriafol)	14 fl oz	56 fl oz	0	0.5	-
	3+11	Affiance (tetraconazole + azoxystrobin)	12 fl oz	24 fl oz	0	0.5	-
	3 + 11	Acadia ESQ Fungicide (difenoconazole + azoxystrobin)	14 fl oz	55.3 fl oz	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3 + 11	Veltyma Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	0	0.5	Reapplications at least 14-21 days apart.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	-
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	No more than 2 sequential applications.
	3 + 9	Vango ESQ (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Only suppression; no more than 2 sequential applications.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	No more than 2 sequential applications of Luna Sensation or any Group 7 or Group 11 containing fungicide before rotating with a fungicide of a different group.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	77.5 fl oz	0	4 hr	-
	11	Aframe (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Arius 250 (azoxystrobin)	15.5 fl oz	62 fl oz	0	4 hr	-
	11	Atticus Acadia 2 SC (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	A-Zox 255C (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Azoxystar (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Azoxystrobin SC (azoxystrobin)	15.3 fl oz	61.5 fl oz	0	4 hr	-
	11	AZteroid FC 3:3 (azoxystrobin)	9.7 fl oz	38.8 fl oz	0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Flint Extra (trifloxystrobin)	3.8 fl oz	16 fl oz	3	0.5	-
	11	GCS Azoxy 25C (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Quadris Flowable (azoxystrobin)	15.5 fl oz	60 fl oz	0	4 hr	-
	11	Satori Fungicide (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	No more than 1 application.
	11	Tetran Fungicide (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Trevo (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11 + 3	Quadris Top (azoxystrobin; difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 2 consecutive applications.
	11 + 3	Trevo DCZ (azoxystrobin; difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-
	BM01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	No more than 2 consecutive applications.
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	13.1 lb	0	Field: 2 GH: 1	OMRI listed. ³
Bacterial leaf spot	M1	ChampION++ (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	Cueva (copper octanoate)	2 gal	6.7 gal	0	4 hr	-
	M1	Kalmor (copper hydroxide)	1.75 lb	17.5 lb	0	2	OMRI listed. ³
	M1	Kocide 2000 (copper hydroxide)	3 lb	15 lb	0	2	-
	M1	Kocide 3000 (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	KOP-5 (copper sulfate pentahydrate)	32 fl oz	10.6 gal	-	Field: 2 GH: 1	-
	M1	MasterCop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	-
	M1	Nu-Cop 30 HB (copper hydroxide)	1.75 lb	17.5 lb	1	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Cercospora leaf spot	M1	Nu-Cop 50 DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	-
	M1	Previsto (copper hydroxide)	3 qt	69 qt	-	2	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	Field: 2 GH: 1	OMRI listed. ³
	M5	Bravo Ultrex (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	-
	M5	Bravo Weather Stik (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Chlorothalonil 720 (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Echo 720 (chlorothalonil)	1.5 pt	9.0 lb a.i.	3	0.5	-
	M5	Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Reapplications at least 7 days apart.
	M5	Initiate 720 (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Oranil 6L (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz NG (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Rialto 720 F (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5 + 22	Zing! (chlorothalonil + zoaxamide)	34 fl oz	272 fl oz	3	0.5	-
	M5 + 27	Cymbol Advance (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.7 pt	10.8 pt	3	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Monsoon (tebuconazole)	6 fl oz	24 fl oz	3	2	-
	3	Onset 3.6L (tebuconazole)	6 fl oz	24 fl oz	7	0.5	-
	3	Rhyme Fungicide (flutriafol)	7 fl oz	28 fl oz	0	0.5	-
	3	TebuCon 3.6F Fungicide (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3	Tebu-Crop 3.6F (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3	TebuStar 3.6L (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3	TebuZol 3.6F (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3	Toledo (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	0.5	-
	3	Willowood Teb 3.6SC (tebuconazole)	6 fl oz	24 fl oz	3	0.5	-
	3 + 11	Acadia ESQ (difenoconazole + azoxystrobin)	14 fl oz	55.3 fl oz	0	0.5	-
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	-
	7 + 3	Aprovia Top Fungicide (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 3	Luna Experience (fluopyram + tebuconazole)	12.8 fl oz	34 fl oz	3	0.5	No more than 2 sequential applications of Luna or any fungicide containing Group 7 or Group 3 before rotation with a fungicide of a different Group.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	-
	7 + 11	Pageant Intrinsic (boscalid + pyraclostrobin)	18 oz	54 oz	0	0.5	-
	7 + 11	Pompa (boscalid + pyraclostrobin)	12 oz	54 oz	0	0.5	Use preventively.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 2 sequential applications.
	11 + 3	Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-
Phytophthora	4	Acquire Fungicide Seed Treatment (metalaxyl)	0.75 fl oz/100 lb seed	-	-	1	Seed treatment for control of early season <i>Phytophthora</i> spp.
	4	Allegiance-FL Seed Treatment (metalaxyl)	1.5 fl oz/100 lb seed	-	-	1	Seed dressing for control of <i>Phytophthora</i> spp.
	4	Metalaxyl 4.0 ST (metalaxyl)	0.50 fl oz/100 lb seed	-	-	1	Seed treatment for control of early season <i>Phytophthora</i> spp.
	4	Ridomil Gold SL (mefenoxam)	1.0 pt	-	7	2	Preplant or at planting.
	4 + 12	Spirato M 185 FS (metalaxyl + fludioxonil)	3.0 fl oz/ 100 lb seed	-	-	2	Protection against early season soil and seedborne fungi.
	4 + 49	Orondis Gold (Premix) (mefenoxam + oxathiapiprolin)	55 fl oz	55 fl oz	5	2	At-planting soil application.
	7 + 11	Pageant Intrinsic (boscalid + pyraclostrobin)	18 oz/100 gal	-	-	0.5	See label.
	7 + 11	Pompa (boscalid + pyraclostrobin)	18 oz	54 oz	0	0.5	Use preventively in 100 gal of water.
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Ground application only.
	21	Ranman 400 SC (cyazofamid)	2.75 fl oz	16.75 fl oz	7	0.5	No more than 6 applications per season. Rotate with dissimilar modes of action.
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz	2	0.5	Reapplications at least 14 days apart.
	29	Omavo (fluazinam)	24 fl oz	144 fl oz	30	0.5	-
	29	Omega 500F (fluazinam)	24 fl oz	144 fl oz	30	0.5	-
	29	Orbus 4F (fluazinam)	24 fl oz	144 fl oz	30	0.5	-
	29	Vantana (fluazinam)	24 fl oz	144 fl oz	30	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	40	Micora (mandipropamid)	8 fl oz	16 fl oz	1	4 hr	For suppression
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	For suppression
	43	Presidio (fluopicolide)	4 fl oz		2	0.5	Must be tank mixed with a labeled fungicide of different FRAC.
	49	Orondis Gold 200 (oxathiapiprolin)	9.6 fl oz	19.2 fl oz	0	4 hr	Soil application at planting. No more than 2 applications per year.
	49 + 40	Orondis Ultra (Premix) (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	0.5	No more than 2 sequential applications before alternating to a different MOA. No more than 4 total applications. Do not exceed 33% of all applications with oxathiapiprolin.
Pod spot	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	13.1 lb	0	Field: 2 GH: 1	Reapplications at least 5 days apart.
	M1	Champion++ (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	Cueva Fungicide Concentrate (copper octanoate)	33 gal; 98 fl oz/1000 ft ²	-	-	-	-
	M1	Kalmor (copper hydroxide)	1.75 lb	17.5 lb	0	2	OMRI listed. ³
	M1	Kocide 2000 (copper hydroxide)	3 lb	15 lb	0	2	-
	M1	Kocide 3000 (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	KOP-5 (copper sulfate pentahydrate)	32 fl oz	10.6 gal	-	Field: 2 GH: 1	-
	M1	MasterCop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	-
	M1	Nu-Cop 30 HB (copper hydroxide)	1.75 lb	17.5 lb	1	2	-
	M1	Nu-Cop 50 DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI listed. ³
	M1	Previsto (copper hydroxide)	3 qt	69 qt	-	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	Field: 2 GH: 1	OMRI listed. ³
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	No more than 2 consecutive applications.
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	13.1 lb	0	Field: 2 GH: 1	OMRI listed. ³
	M1	ChampION++ (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	Cueva Fungicide Concentrate (copper octanoate)	6.7 gal in 30–100 gal of water	33.7 gal or 98 fl oz/1000 ft ²	0	4 hr	Consult the label for any seasonal restrictions.
	M1	Kalmor (copper hydroxide)	1.75 lb	17.5 lb	0	2	OMRI listed. ³
	M1	Kocide 2000 (copper hydroxide)	3 lb	15 lb	0	2	-
	M1	Kocide 3000 (copper hydroxide)	1.75 lb	17.5 lb	0	2	-
	M1	KOP-5 (copper sulfate pentahydrate)	32 fl oz	10.6 gal	-	Field: 2 GH: 1	-
	M1	MasterCop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	-
	M1	Nu-Cop 30 HB (copper hydroxide)	1.75 lb	17.5 lb	1	2	-
	M1	Nu-Cop 50 DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	-
	M1	Previsto (copper hydroxide)	3 qt	69 qt	-	2	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	Field: 2 GH: 1	OMRI listed. ³
M2		Microthiol-Disperss (sulfur)	10 lb	-	-	1	-
	M2	Suffa (sulfur)	0.5 gal	-	-	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M2	Sulfur 80 WDG (sulfur)	10 lb	-	-	1	OMPI listed. ³
	M2	Sulfur 90W (sulfur)	20 lb	-	-	1	-
	M2	THAT Flowable Sulfur (sulfur)	8 pt	-	-	1	-
	M2	Thiolux (sulfur)	10 lb	-	-	1	-
	M5	Bravo Ultrex (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	-
	M5	Bravo Weather Stik (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Chlorothalonil 720 (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Echo 720 (chlorothalonil)	1.5 pt	9.0 lb a.i.	3	0.5	-
	M5	Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Reapplications at least 7 days apart.
	M5	Initiate 720 Flowable Fungicide (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Oranil 6L (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Praiz NG (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5	Rialto 720 F (chlorothalonil)	1.5 pt	12 pt	3	0.5	-
	M5 + 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	M5 + 27	Cymbol Advance (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	-
	U6	Torino (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	-
	U8	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	-
	3	Cevya (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Mettie 125 ME (tetraconazole)	8 fl oz	16 fl oz	0	0.5	-
	3	Provyso (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	-
	3	Rally 40WSP (myclobutanil)	5 oz	1.25 lb	0	1	No more than 4 applications per season.
	3	Relix 40 WSP (myclobutanil)	5 oz	1.25 lb	0	1	Reapply on a 10- to 14-day protectant schedule.
	3	Rhyme Fungicide (flutriafol)	7 fl oz	28 fl oz	0	0.5	-
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	0.5	-
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	No more than 2 sequential applications.
	3 + 9	Vango ESQ (difenoconazole +cyprodinil)	20 fl oz	80 fl oz	0	0.5	-
	3 + 11	Acadia ESQ (difenoconazole + azoxystrobin)	14 fl oz	55.3 fl oz	0	0.5	-
	3 + 11	Affiance (tetraconazole + azoxystrobin)	12 fl oz	24 fl oz	0	0.5	-
	3 + 11	TopGuard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	-
	3 + 11	Veltyma Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	0	0.5	Reapplications at least 14-21 days apart.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	-
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	-
	7	Velum Prime (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	-
	7 + 11	Pageant Intrinsic (boscalid + pyraclostrobin)	18 oz/100 gal	-	-	0.5	-
	7 + 11	Pompa (boscalid + pyraclostrobin)	18 oz	54 oz	-	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications.
	9	Vango WG (cyprodinil)	7 oz	28 oz	0	0.5	-
	9 + 12	Alterity 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	After 2 applications, alternate with another fungicide with a different mode of action for 2 applications.
	9 + 12	Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	-
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	After 2 applications, alternate with another fungicide with a different mode of action for 2 applications.
	9 + 12	Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	No more than 2 sequential applications.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	77.5 fl oz	0	4 hr	-
	11	Aframe (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Arius 250 (azoxystrobin)	15.5 fl oz	62 fl oz	0	4 hr	-
	11	Atticus Acadia 2 SC (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	A-Zox 25SC (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Azoxystar (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	No more than 1 application of Azoxystar or other Group 11 fungicides before alternation with a non-Group 11 fungicide.
	11	Azoxystrobin SC (azoxystrobin)	15.3 fl oz	61.5 fl oz	0	-	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	AZteroid FC 3.3 (azoxystrobin)	19.5 fl oz	77.5 fl oz	0	4 hr	-
	11	GCS Azoxy 25C (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Quadris Flowable (azoxystrobin)	15.5 fl oz	60 fl oz	0	4 hr	-
	11	Satori Fungicide (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	No more than 1 application.
	11	Tetranan (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11	Trevo (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	-
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Do not make 2 consecutive applications.
	11 + 3	Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	-
	12	Spirato GHN (fludioxonil)	7 fl oz	28 fl oz	0	0.5	-
	13	Quintec Fungicide (quinoxifen)	6 fl oz	24 fl oz	3	0.5	Reapplications at least 10 days apart.
Pythium damping-off	50	Prolivo 300SC (pyriofenone)	5 fl oz	16 fl oz	0	4 hr	-
	4	Acquire Fungicide Seed Treatment (metalaxyl)	0.75 fl oz/100 lb seed	-	-	1	-
	4	Allegiance-FL Seed Treatment (metalaxyl)	1.5 fl oz/100 lb seed	-	-	1	-
	4	Metalaxyl 4.0 ST (metalaxyl)	0.50 fl oz/100 lb seed	-	-	1	-
	4	Ridomil Gold SL (mefenoxam)	1.0 pt	-	7	2	Preplant or at planting.
	4	STartUp™ MEFEN (mefenoxam)	0.47 fl oz/100 lb seed	1.5 lb a.i.	-	0.5	No pre-plant or at-plant application of mefenoxam or metalaxyl products to seed treated with STartUp™ MEFEN.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Rhizoctonia damping-off, seedling rot	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Can be applied to the lower portions of the plants and surrounding soil, or via drip irrigation, transplant/setting water, or by sprinklers.
	4 + 12	Spirato M 185 FS (metalaxyl + fludioxonil)	3.0 fl oz/100 lb seed	-	-	2	-
	4 + 49	Orondis Gold (Premix) (mefenoxam + oxathiapiprolin)	55 fl oz	55 fl oz	5	2	At-planting soil application.
	7 + 11	Pompa (boscalid + pyraclostrobin)	18 oz	54 oz	0	0.5	Use preventively.
	11	Acadia LFC (azoxystrobin)	1.0 fl oz/1000 row ft	77.5 fl oz	0	4 hr	-
	11	Aframe (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	-
	11	Arius 250 (azoxystrobin)	0.8 fl oz/1000 row ft	62 fl oz	0	4 hr	In-furrow and banded applications.
	11	Atticus Acadia 2 SC (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	In-furrow and banded applications over the row, either shortly after plant emergence or during herbicide applications or cultivation.
	11	A-Zox 25SC (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	In-furrow and banded applications.
	11	Azoxystar (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	-
	11	Azoxystrobin SC (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	0	-
	11 + P5	AZterknot (azoxystrobin + extract of <i>Reynoutria sachalinensis</i>)	0.9 fl oz/1000 row ft	73.6 fl oz	0	4 hr	Apply in-furrow as a spray or a banded spray targeting plant base and surrounding soil.
	11	AZteroid FC 3.3 (azoxystrobin)	0.48 fl oz/1000 row ft	38.8 fl oz	0	4 hr	May be applied by ground, air or chemigation.
	11	GCS Azoxystrobin 2SC (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	In-furrow and banded applications.
	11	Quadris Flowable (azoxystrobin)	0.8 fl oz/1000 row ft	60 fl oz	0	4 hr	-
	11	Satori (azoxystrobin)	0.8 fl oz/1000 row ft	60 fl oz	0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Tetraban (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	-
	11	Trevo (azoxystrobin)	0.8 fl oz/1000 row ft	61.5 fl oz	0	4 hr	-
	7 + 3	Aprovia Top Fungicide (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	Apply by ground or by chemigation.
	3 + 11	Veltyma Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	0.5	-	-
	7 + 11	Pompa (boscalid + pyraclostrobin)	18 oz	118 oz	0	0.5	Use preventively. No more than 2 sequential applications.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: listed by Organic Materials Review Institute for use in organic production.

Table 12. Parsley fungicides ordered by disease and then FRAC group according to their mode of action. Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria leaf blight	3	Procure 480SC (triflumizole)	8 fl oz	18 fl oz	0	0.5	Reapplications at least 14 days apart.
	3	(propiconazole) Many brands available: Bumper 41.8EC, Propi-star, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications and 4 total applications.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7	Endura (boscalid)	9 oz	18 oz	14	0.5	No more than 2 applications before rotating to a fungicide of dissimilar mode of action.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	–
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications before moving to dissimilar mode of action.
	9 + 12	Switch 62.5 WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	–
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Stretch	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	–

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Basal rot and Botrytis	12	Cannonball WP (fludioxonil)	7 oz	28 oz	0	0.5	-
	3	Bumper 41.8EC (propiconazole)	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications before alternating to different mode of action.
Damping-off	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	33	Aliette WDG Legion 80WDG Linebacker WDG (fosetyl-Al)	5 lb	35 lb	-	0.5	-
Downy mildew	11 + 27	Tanos (cymoxanil + famoxadone)	10 oz	48 oz	1	0.5	Must be tank-mixed with appropriate contact fungicide with different modes of action. No more than 1 application before rotating to a fungicide of dissimilar mode of action.
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Fosphite, Fungi-phite, K-phite, Phiticide, Phostrol, Rampart, Reveille	See individual label	See individual label	0	0.5	See label for details.
	40	Forum (dimethomorph)	6 fl oz	18 fl oz	0	0.5	See label for details.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. See label for soil applications.
	40 + 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	1	4 hr	No more than 2 sequential applications.
	43	Presidio (fluopicolide)	3-4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. No more than 2 sequential applications. See label for soil applications.
	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	9.6 fl oz	19.2 fl oz	0	4 hr	Soil application only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications. No more than 2 sequential applications. Do not exceed more than 33% of all fungicide applications with Orondis.
Powdery mildew	M2	(sulfur) Many brands available: Sulfur 90W, Super Six, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	Bumper 41.8EC (propiconazole)	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications before alternating to different mode of action.
	3	Procure 4805C (triflumizole)	8 fl oz	18 fl oz	0	0.5	Reapplications at least 14 days apart.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
	3	Tilt (propiconazole)	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications and 4 total applications.
	3	Trionic (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications. Reapplications at least 14 days apart.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7	Endura (boscalid)	9 oz	18 oz	14	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications before moving to dissimilar mode of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pythium damping-off; Pythium seedling blight; Pythium seedling diseases	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb seed	-	-	2	Seed treatment only.
	4	(metalaxyl) Various brands available: Acquire, Allegiance, Sebring 2.65ST	0.75 fl oz/100 lb seed	-	-	2	Seed treatment only.
	4	Ridomil Gold EC (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ridomil Gold GR (mefenoxam)	40 lb	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	Ultra-Flourish (mefenoxam)	4 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per year.
Septoria	3	Tilt (propiconazole)	4 fl oz	16 fl oz	14	0.5	No more than 2 sequential applications and 4 total applications.
	3 + 11	Topguard EQ (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	-	No more than 3 applications per season. No more than 2 sequential applications before alternating to a different mode of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications before moving to dissimilar mode of action.
	11	(azoxystrobin) Many brands available: Azoxystrobin, Equaton, Quadris, Satori, Willowood	15.4 fl oz or 0.8 fl oz/1000 row ft	92.3 fl oz	0	4 hr	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Various seedling diseases	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 row ft	-	-	0	No more than 1 application per season. Soil incorporated.
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 13. Nonfumigant nematicides for celery crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop, and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (re-cropping) intervals for a variety of crops.
Vydate L (a.i. oxamyl)	Apply ½–2 gal/A at planting, preferably via drip application or soil spray. Make additional applications on a 10-to-14-day interval. No more than 3 gal/A per season. Minimum retreatment interval is 5 days unless a longer interval is stated. Last application at least 21 days to harvest. Consult label for more details on application.

Table 14. Nonfumigant nematicides for okra in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Velum (a.i. fluopyram)	Apply 6.5–6.8 fl oz/A by chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Soil reapplications at least 7 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation or method of application (soil or foliar).
Vydate L (a.i. oxamyl)	Apply ½ –1 gal/A at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. No more than 2 gal/A per season. Reapplications at least 7 days apart unless a longer interval is stated. If an at plant application of more than ½ gal/A is made, do not make more than 2 additional applications.
Salibro (a.i. fluazaindolizine)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated, via preplant drip, or via at-plant drip. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year. No more than 4 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 14 days apart. Pre-harvest interval is 1 day.
Biological nematicides	See chapter 19.

Table 15. Fumigant nematicides for celery crops in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 11. Legume Production¹

Craig Frey, Peter J. Dittmar, Anna Mészáros, Dakshina R. Seal, Jawwad Qureshi, Shouan Zhang, Johan Desaegeer, and Qingren Wang²

Botany and Planting

Cluster bean/Guar—*Cyamopsis tetragonolobus*, Fabaceae (Leguminosae)

Edamame—*Glycine max*, Fabaceae (Leguminosae)

Fenugreek/Methi—*Trigonella foenum-gracum*, Fabaceae (Leguminosae)

Hyacinth bean/Lablab bean—*Lablab purpureus*, Fabaceae (Leguminosae)

Lima bean—*Phaseolus lunatus*, Fabaceae (Leguminosae)

Pigeon pea—*Cajanus cajan*, Fabaceae (Leguminosae)

Snapbean—*Phaseolus vulgaris*, Fabaceae (Leguminosae)

Snowpea—*Pisum sativum*, Fabaceae (Leguminosae)

Southernpea/Yard-long bean—*Vigna unguiculata*, Fabaceae (Leguminosae)

Winged bean—*Psophocarpus tetragonolobus*, Fabaceae (Leguminosae)

Table 1. Planting dates for legumes.

Planting Region	Dates					
	Snapbean Bush	Snapbean Pole	Lima Bean Bush	Lima Bean Pole	Southern Pea	Snowpea
North Florida	Mar–Apr Aug–Sept	Mar–Apr Aug–Sept	Mar–Apr Aug	Mar–Apr Aug	Mar–July	Jan–Mar
Central Florida	Feb–Apr Aug–Sept	Feb–Apr Aug–Sept	Feb–Mar Aug–Sept	Feb–Mar Aug–Sept	Feb–Aug	Nov–Feb
South Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr	Nov–Feb

Table 2. Planting information for legumes.

Planting Parameters	Measurements					
	Snapbean Bush	Snapbean Pole	Lima Bean Bush	Lima Bean Pole	Southern Pea	Snowpea
Distance between rows (in)	18–40	36–48	18–36	36–48	20–42	36 (2-row beds)
Number of rows/bed	1–2	–	–	–	–	–
Distance between rows/bed (in)	10–12	–	–	–	–	–
Distance between plants (in)	2–4	3–5	3–6	8–12	2–6	2–6
Seeding depth (in)	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5
Seed per acre (lb)	45–80	30–45	40–60	20–40	15–30	25–50
Days to maturity from seed	45–60	50–70	60–80	80–100	75–90	60–80
Plant populations	52,272–172,240	58,000	116,160	21,780	104,544	87,120

Cultivars

Table 3. Commercial legume cultivars.

Legume	Cultivars
Snapbean—Green Bush	Affirmed, BA 0958, Caprice, Coyote, Desoto, Greencrop, Jackson, LaSalle, Momentum, PV 575, PV 857, PV 959, Sybaris (BA 1007), Valentino
Snapbean—Yellow Bush	Carson, Golden Rod, Gold Strike, SV1003GF
Snapbean—Green Pole	Dade, McCaslan 42
Lima	Bridgeton, Fordhook 242, Jackson Wonder, Thorogreen
Southern Pea	CA Blackeye No. 5, Cream 8, Cream 12, Coronet Pinkeye, Knuckle Purplehull, Pinkeye Purplehull, Quickpick, Texas Cream 40, Top Pick Cream, Top Pick Crowder, Top Pick Pinkeye, White Acre, Zipper Cream
Snowpea	Oregon Sugarpod II

Asian Legumes

The Asian legume group includes fruits (usually known as pods), which are eaten at the immature stage with edible immature seeds (green shell) and some young leaves and stem tips. For instance, the winged bean has edible leaves and roots, though the latter are rarely cultivated commercially in the continental United States. Pole bean, long (or yard long) bean (both dark and light green colors), broad bean, and lablab bean are commercially grown in south Florida. All pole or indeterminate types can be grown on raised beds with or without plastic mulch using drip, overhead, or subsurface irrigation. Fenugreek does not grow well in rocky soils, such as those found in Miami-Dade County. Pigeon pea is a semi-perennial shrub in

warmer areas. Many pigeon pea and winged bean varieties are short-day and only flower during the fall. Some day-neutral varieties are available for both crops. Many edamame varieties are sensitive to daytime length, so care must be taken to select varieties for one's growing area. Japanese varieties are classified as "summer" or "fall" types, indicating when they flower. Fertilizer recommendations for pole, long, or broad beans are generally applicable to this group. All of these crops start from seed, though winged beans require scarification prior to planting. All the indeterminate types need some kind of support, ranging from individual bamboo stakes to trellises. However, some bush-type broad beans (Indian type) do not need trellises.

Table 4. Planting dates for Asian legumes.

Planting Region	Dates							
	Cluster Bean/ Guar	Edamame	Fenugreek	Hyacinth Bean	Pigeon Pea	Snowpea	Winged Bean	Yard-long Bean
North Florida	Mar–Apr; Aug	Mar–Apr; Aug	Mar–Apr; Aug	Mar–Apr; Aug	Not recommended	Jan–Mar	Not recommended	Mar–July
Central Florida	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept	Not recommended	Nov–Feb	Not recommended	Feb–Aug
South Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr	Nov–Feb	Nov–Feb	Mar–Apr	Sept–Apr

Table 5. Planting information for Asian legumes.

Planting Parameter	Measurements							
	Cluster Bean/ Guar	Edamame	Fenugreek	Hyacinth Bean	Pigeon Pea	Snowpea	Winged Bean	Yard-long Bean
Distance between rows (in)	24	20–30	9	20	24–36	36 (2-row beds)	36	20–42
Distance between plants (in)	6	2–6	2–3	4–6	2–6	2–6	8	2–6
Seeding depth (in)	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5
Days to maturity from seed	90–120	80–120	90–120	90–120	180 (early); 270–365 (late)	60–80	90 (day-neutral varieties)	75–90
Plant populations	43,560	87,120	348,480	78,409	10,890	87,120	21,780	104,544

Table 6. Cultivars for Asian legumes.

Crop	Life Cycle	Cultivars	Trellising
Broad bean	Annual	–	Yes
Bush-type broad bean	Annual	Indian type	No
Cluster bean, guar	Annual	–	Yes
Edamame	Annual	Lucky Lion, Tohya, Triple Play, Chiba Green	No
Fenugreek, methi	Annual	–	No
Hyacinth bean, lablab bean	Annual	Akahana Fugimame	No
Long bean (dark- and light-green color)	Annual	–	Yes
Pigeon pea (a short-lived perennial)	Short-lived perennial	–	No
Snow/snap (edible podded) pea	Annual	Oregon Sugarpod II	Yes
Winged bean, goa bean	Annual	Winged Bean, Youdou	Yes
Yard-long bean	Annual	Orient Wonder, Stickless Wonder	Yes

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 7. Herbicides approved for managing weeds in beans and peas. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Bean (all), pea (all)	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	EPTC 2.0-4.0	(Eptam) 7E 2.25-4.5 pt	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Incorporate in the same operation to reduce volatilization. No more than 9 pt/A per crop.
	Fomesafen 0.25-0.38	(Reflex) 2 EC 1.0-1.5 pt	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade County. No more than 1.5 pt/A per year.
	Glyphosate	(various formulations) consult labels	9	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Consult individual labels for restrictions.
	Halosulfuron 0.02	(Sandeal) 75 DF 0.5 oz	2	Bean (black-eyed, cowpea, southern pea)	Broadleaf weeds and nutsedge. Apply after planting but before crop emergence. May cause significant, temporary stunting and delayed maturity of peas, resulting in delayed harvest.
	Imazethapyr 0.02	(Pursuit) 2 L 1.5 fl oz	2	Bean (snap)	Only 1 application a year. Preplant incorporate within 1 week of planting, preemergence application within 1 week of planting, or preemergence application within 1 day after planting. PHI 3 days.
	Imazethapyr 0.05	(Pursuit) 2 L 3.0 fl oz	2	Bean (dry, lima, southern pea, cowpea), pea (dry, English), chickpea	Only 1 application a year. Preplant incorporate within 1 week of planting or preemergence application within 1 day after planting. Can apply up to 4 oz/A to southern pea only. Consult label for preharvest interval.
	Paraquat 0.5-1.0	(Gramoxone) 2 SL 2-4 pt (Firestorm) 3 SL 1.3-2.7 pt.	22	Bean (lima, snap), pea (all)	Emerged weeds. Apply prior, during, or after planting, but before crop emergence. No more than 3 applications per season. Use a nonionic surfactant.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Bean (all), pea (all)	Emerged weeds. Apply before crop emergence. Product is a contact, nonselective, foliar-applied herbicide.
	Pendimethalin 0.50-0.75	(Prowl) 3.3 EC 1.2-1.8 pt (Prowl H2O) 3.8 1.0-1.5 pt	3	Bean (dry, lima, snap, garbanzo), Bean (southern pea, cowpea), chickpea	Annual broadleaf and grass weeds. Incorporate 1-2 in. deep within 7 days of application.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Pyraflufen ethyl 0.0008–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl. oz	14	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Plant 1 day after application. Apply as a preplant burndown treatment.
	Saflufenacil 0.027	(Sharpen) 3.42 SL 1.0 fl oz	14	Bean (garbanzo), bean (dry, chickpea)	Broadleaf weeds. Apply as a preplant/preemergence burndown. Sequential application can be applied within 14 days between timings. No more than 2 fl oz/A per season.
	S-metolachlor 0.95–1.27	(Brawl, Dual Magnum) 7.62 EC 1.0–1.33 pt	15	Bean (lima, mung, pinto, snap), bean (southern pea), pea (English)	Annual broadleaf and grass weeds and yellow nutsedge. Consult label for rate based on soil type and specific tank mix directions.
	Sulfentrazone 0.07–0.09	(Willowood sulfentrazone) 4 SC 2.25–3.0 fl oz	14	Bean and pea (dry shelled)	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. No more than 8 fl oz/A within a 12-month period. Trial on a small area.
	Sulfentrazone 0.07–0.12	(Willowood sulfentrazone) 4 SC 2.25–3.75 fl oz	14	Succulent pea	Broadleaf and grass weed. Nutsedge suppression. Do not apply on sands with less than 1% organic matter. No more than 6 fl oz/A within a 12-month period. Trial on a small area.
	Trifluralin 0.50–0.75	(Treflan, Trust) 4 EC 1.0–1.5 pt (Treflan, Trifluralin) 10 G 5.0–7.5 lb	3	Bean (lima, mung, guar, snap), bean (southern pea), pea (dry, English)	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay content. Consult label for rotation restrictions.
	Bentazon 0.5–1.0	(Basagran) 4 L 1.0–2.0 pt	6	Bean (dry, succulent), bean (southern pea), pea (garden, English)	Broadleaf weeds. Apply after the first trifoliolate leaf is fully expanded in bean and 3 pairs of leaves in pea. Yellowing, bronzing, speckling, or leaf burning may occur under certain conditions. This injury is generally outgrown without delaying pod set or maturity. PHI 30 days.
	Carfentrazone Up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Bean (all), pea (all)	Emerged broadleaf control. Direct application to row middles. Include crop oil concentrate or nonionic surfactant in recommended rates. PHI 0 days.
	Clethodim 0.094–0.25 0.07–0.25	(Arrow) 2 EC 6–16 fl oz (Select Max) 1 EC 9–32 fl oz	1	Bean (succulent), pea (succulent)	Annual and perennial grass control. Consult label for bean types. PHI 21 days.
	EPTC 3.1–4.0	(Eptam) 7 E 3.5–4.5 pt	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Apply as layby treatment during the last cultivation of the season. Direct spray solution to the base of the crop. No more than 9 pt/A per crop.
POSTEMERGENCE					

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
	Fluazifop 0.19-0.38	(Fusilade DX) 2 EC 12-24 fl oz	1	Bean (dry)	Annual and perennial grass weeds. Do not apply to cowpea. No more than 48 fl oz/A per season. Include a COC or NIS in the spray solution. PHI 60 days.
	Fomesafen 0.25-0.38	(Reflex) 2 EC 1.0-1.5 pt	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade County. Consult label for rate based on size of specific weed species. No more than 1.5 pt/A per year.
	Halosulfuron 0.02-0.03	(Sandeal) 75 DF 0.5-0.66 oz	2	Bean (dry)	Broadleaf weeds and nutsedge. Row middles only. Avoid contact with planted crop. No more than 1 oz/A per crop.
	Halosulfuron 0.02-0.03	(Sandeal) 75 DF 0.5-0.66 oz	2	Bean (snap, lima)	Broadleaf weeds and nutsedge. Directed sprays. Apply after the 2-4 trifoliate leaf stage, but before flowering.
	Imazethapyr 0.14	(Pursuit) 2 L 3.0 oz	2	Bean (dry), bean (southern pea), pea (dry, English)	Do not apply before bean has at least 1 trifoliate leaf. Apply to peas at least 3 inches in height but prior to the fifth node and before flowering. Consult label for preharvest intervals.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Bean (all), pea (all)	Emerged weeds, row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop.
	Quizalofop 0.04-0.08	(Assure II) 6-12 fl oz	1	Bean (dry, snap, chickpea), pea (succulent, dry)	Annual and perennial grass weeds. Allow 7 days between sequential applications to allow for regrowth. Include a COC or NIS in the spray solution. PHI 30 days for succulent pea and dry bean. PHI 60 days for dry pea.
	Sethoxydim 0.19-0.47	(Poast) 1.5 EC 1.0-2.5 pt	1	Bean (dry, succulent), pea (dry, succulent)	Growing grass weeds. No more than 4.0 pt/A per season. Include a COC in the spray solution. PHI 30 days for dry bean and dry pea. PHI days for succulent bean and succulent pea.

Table 8. Insecticides approved for managing arthropod pests of beans and peas. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Anna Meszaros, UF/IFAS Extension Palm Beach County.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1A	*Lannate LV; *SP (methomyl)	LV: 1.50–3 pt SP: 0.5–1.0 lb	LV: 15 pt SP: 5.0 lb	48	Varies with rate and crop use.	–
	1B	*Dibrom 8E (naled)	1.0 pt	4.5 pt	48	1	Ground application only; not for cowpeas and field peas intended for livestock feed.
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2.0 pt per year	48	Mechanical harvesting: 0	Do not use on field peas.
	1B	Malathion 8F (malathion)	1.0 pt	2.0 pt	12	3	Green and dried peas only. Do not graze or feed forage to livestock.
	1B	Orthene 97 (acephate)	0.50–1.0 lb	2.0 lb a.i.	24	Dry succulent: 14 Lima beans succulent form: 1	Do not apply to succulent beans for fresh market or processing. Do not feed treated vines or seeds to livestock.
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	4A	Admire Pro (imidacloprid)	Soil: 7–10.5 fl oz Foliar: 1.2 fl oz	Soil: 10.5 fl oz Foliar: 3.6 fl oz	12	Soil: 21 Foliar: 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	Assail 30SG (acetamidprid)	2.5–5.3 fl oz	16 fl oz	12	7	Edible podded legumes, succulent shelled peas and beans.
	4A	Transform WG (sulfoxaflor)	0.75–1.0 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans.
	4A + 15	Cormoran (novaluron + acetamiprid)	9–12 fl oz	36 fl oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	7.0–10.5 fl oz	28.0 fl oz per year	4	7	Reapplications at least 10 days apart.
	23	Movement (spirotetramat)	4–5 fl oz	10 fl oz	24	Succulent: 1 Dry: 7	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Armyworm, corn earworm, lesser cornstalk borer, loopers, cutworm, caterpillar, grubs, root maggots, wireworms	1A	*Lannate LV; *SP (methomyl)	LV: 1.50–3 pt SP: 0.50–1.0 lb	LV: 15 pt SP: 5.0 lb	48	See label: varies with rate and crop use.	–
	1A	Sevin 4F (carbaryl)	0.50–1.5 qt	6.0 qt per year	12	Fresh beans and peas: 3 Grazing or forage: 14 Dried beans seed or hay: 21	Use on succulent shelled peas and beans prohibited. Harmful to bees.
	1B	*Diazinon 50W AG 500 (diazinon)	50W: 4.8 lb AG500: 2–4 qt	–	72	Broadcast at planting	Only for cutworms and wireworms. Succulent beans and peas only. Soil application only. No more than 1 application per year.
	1B	*Dibrom 8E (naled)	1–1.5 pt	4.5 pt	48	1	Ground application only. Not for cowpeas and field peas intended for livestock forage.
	1B	Orthene 97 (acephate)	0.75–1.0 lb	2.0 lb a.i.	24	Dry or succulent: 14 Lima beans, succulent form: 1	Do not apply to succulent beans for fresh market or processing. Do not feed treated vines or seeds to livestock.
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.
	3A	*Baythroid XL (beta-cyfluthrin)	Dry beans and peas: 0.8–3.2 fl oz Southern pea: 0.8–2.1 fl oz	Dry beans and peas: 6.4 fl oz Southern peas: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	Not for use on succulent beans or peas. Do not feed treated vines or hay to livestock.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Capture LFR (bifenthrin)	3.4–6.8 fl oz	25.5 fl oz	12	At plant	Do not exceed allowed amounts including use of other products containing bifenthrin.
3A		*Declare Insecticide (gamma-cyhalothrin)	1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Mustang *Mustang Maxx (zeta-cypermethrin)	3.0-4.3 oz Maxx: 1.28-4.0 oz	25.8 oz Maxx: 24 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5-10 fl oz	31 fl oz	24	Edible podded and succulent shelled: 7 Dry shelled: 21	-
	5	Entrust SC (spinosad)	1.25-2.0 oz	Succulent: 9.0 fl oz Dry: 3.75 fl oz	4	Succulent: 3 Dry: 28	Do not feed forage or hay to meat or dairy animals.
	5	Radiant SC (spinetoram)	4-8 fl oz	Succulent: 28.0 fl oz Dry: 12.0 fl oz	4	Succulent: 3 Dry: 28	-
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	7.5-10 fl oz	20 fl oz	12	7	-
	15	Rimon 0.83 EC (novaluron)	6-12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	18	Intrepid 2F (methoxyfenozide)	4-16 fl oz	64 fl oz	12	7	-
	22	Avaunt (indoxacarb)	3.5 oz	14 fl oz	12	7	Southern pea (dry) varieties only.
	28	Coragen (chlorantraniliprole/rynaxypyr)	3.5-7.5 fl oz	15.4 fl oz of chlorantraniliprole products per year 0.4 lb a.i. of Group 28 products	4	1	Foliar application only.
	28	Exirel (cyantraniliprole/cyazypyr)	10.5-20.5 oz		12	Succulent: 1 Dried: 7	Label contains pollinator warning language.
	1A	*Lannate LV; *SP (methomyl)	LV: 0.75-3 pt SP: 0.25-1.0 lb	LV: 15 pt SP: 5.0 lb	48	See label; varies with rate and crop	-
Cucumber beetle, bean leaf beetle, Mexican bean beetle, cowpea curculio	1A	Sevin 4F (carbaryl)	0.50-1.5 qt	6.0 qt per year	12	Fresh beans and peas: 3 Grazing or forage: 14 Dried beans, peas, seed, or hay: 21	Use on succulent shelled peas and beans prohibited. Harmful to bees.
	1B	Dimethoate 4EC (dimethoate)	0.5-1.0 pt	2.0 pt per year	48	Mechanical harvesting: 0	Do not feed treated vines. Do not use on field peas.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	1B	Orthene 97 (acephate)	0.50–1.0 lb	2.0 lb a.i.	24	Dry succulent: 14 Lima beans succulent form: 1	Do not apply to succulent beans for fresh market or processing.
	1B	*Thimet 20G EZ Load (phorate)	4.9–9.4 oz/1000 ft row	–	48	60	Poison. Label pending in Florida. Do not graze livestock on treated forage. No direct contact with seed. No more than 1 application, only applied at plant.
	3A	*Baythroid XL (beta-cyfluthrin)	Dry beans and peas: 0.8–3.2 fl oz Southern pea: 0.8–2.1 fl oz	Dry beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	Not for use on succulent beans or peas. Do not feed treated vines or hay to livestock.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	*Mustang *Mustang Maxx (zeta-cypermethrin)	3.0–4.3 oz Maxx: 2.72–4.0 oz	25.8 oz Maxx: 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	–
	4A	Assail 30SG (acetamidprid)	2.5–5.3 fl oz	16 fl oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A + 15	Cormoran (novaluron + acetamidprid)	9–12 fl oz	36 fl oz	12	7	–
	15	Rimon 0.83 EC (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Fire ants	7A	Extinguish (S-methoprene)	1–1.5 lb broadcast	No limit	4	0	IGR (insect growth regulator). Colonies will get reduced after 3 weeks and eliminated after 8–10 weeks.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	0.134 lb a.i.	12	1	IGR. Apply at first sign of ant activity.
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2.0 pt per year	48	Mechanical harvesting: 0	Do not feed treated vines. Do not use on field peas.
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.
Grasshoppers	3A	*Baythroid XL (beta-cyfluthrin)	Beans and peas: 2.4–3.2 fl oz Southern pea: 1.6–2.1 fl oz	Beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	Not for use on succulent beans or peas. Do not feed treated vines.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	*Mustang *Mustang Maxx (zeta-cypermethrin)	3.0–4.3 oz Maxx: 3.2–4.0 oz	25.8 oz Maxx: 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded and succulent shelled: 7 Dry shelled: 21	–
Leafhopper	1A	*Lannate LV; *SP (methomyl)	LV: 0.75–3 pt SP: 0.25–1.0 lb	LV: 15 pt SP: 5.0 lb	48	See label; varies with rate and crop.	–
	1B	*Dibrom 8E (naled)	1.0 pt	4.5 pt	48	1	Ground application only; not for cowpeas and field peas intended for livestock forage.
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2.0 pt per year	48	Mechanical harvesting: 0	Do not feed treated vines. Do not use on field peas.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
<i>Liriomyza</i> leafminers	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Mustang *Mustang Maxx (zeta-cypermethrin)	3.0–4.3 oz Maxx: 2.72–4.0 oz	25.8 oz Maxx: 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	4A	Admire Pro (imidacloprid)	Soil: 7–10.5 fl oz Foliar: 1.2 fl oz	Soil: 10.5 fl oz Foliar: 3.6 fl oz	12	Soil: 21 Foliar: 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	Assail 30SG (acetamidprid)	2.5–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	15 + 4A	Cormoran (novaluron + acetamiprid)	9–12 fl oz	36 fl oz	12	7	–
	4D	Sivanto Prime (flupyradifurone)	7.0–10.5 fl oz	28.0 fl oz per year	4	7	Reapplications at least 10 days apart.
	16	Courier 40 SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	14	IGR. For succulent beans only. Good coverage essential.
	28	Exirel (cyantraniliprole/cyazapir)	10.5–20.5 oz	0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	Label contains pollinator protection warnings.
	5	Radiant SC (spinetoram)	5–8 fl oz	Succulent: 28 fl oz Dry: 12 fl oz	4	Succulent: 3 Dry: 28	Time applications to small larvae.
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.5 fl oz	12	7	To avoid illegal residues, must be mixed with a nonionic activator-type wetting, spreading and/or penetrating spray adjuvant. Do not feed treated vines or hay to livestock.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	7.5–10 fl oz	20 fl oz	12	7	–
	17	Trigard (cyromazine)	2.66 oz 1 packet	0.75 lb a.i.	12	7	Not for use on soybeans or peas.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Lygus bug, stink bug, kudzu bug	28	Coragen (chlorantraniliprole/rynaxy pyr)	7.5 fl oz	15.4 fl oz of chlorantraniliprole products per year	4	1	Foliar application only.
	28	Exirel (cyantraniliprole/cyazapyr)	10.5–20.5 oz	0.4 lb a.i. of Group 28 products LV: 15 pt SP: 5.0 lb	12	Succulent: 1 Dry: 7	–
	1A	*Lannate LV; *SP (methomyl)	LV: 1.50–3 pt SP: 0.50–1.0 lb		48	See label; varies with rate and crop.	–
	1A	Sevin 4F (carbaryl)	1.0–1.5 qt	6.0 qt per year	12	Fresh beans and peas: 3 Grazing or forage: 14 Dried beans, peas, seed, or hay: 21	Use on succulent shelled peas and beans prohibited. Harmful to bees.
	1B	*Dibrom 8E (naled)	1–1.5 pt	4.5 pt	48	1	Ground application only; not for cowpeas and field peas intended for livestock feed.
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2.0 pt per year	48	Mechanical harvesting: 0	Do not feed treated vines. Do not use on field peas.
	3A	*Baythroid XL (beta-cyfluthrin)	Beans and peas: 2.4–3.2 fl oz Southern pea: 1.6–2.1 fl oz	Beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	Not for use on succulent beans or peas. Do not feed treated vines or hay to livestock.
	3A	*Brigade 2 EC (bifenthrin)	5.12–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	*Mustang *Mustang Maxx (zeta-cypermethrin)	3.4–4.3 oz Maxx: 3.2–4.0 oz	25.8 oz Maxx: 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	–
3A + 28	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Transform WG (sulfoxaflo ^r)	2.25 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans. Stink bug suppression.
	15 + 4A	Cormoran (novaluron + acetamiprid)	12 fl oz	36 fl oz	12	7	-
	15	Rimon 0.83 EC (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	3A	*Brigade 2 EC (bifenthrin)	5.12–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	-
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.5 fl oz	12	7	To avoid illegal residues, must be mixed with a nonionic activator-type wetting to spread and/or penetrate spray adjuvant. Do not feed treated vines or hay to livestock.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	7.5–10 fl oz	20 fl oz	12	7	-
	20B	Kanemite 15 SC (acequinocyl)	31 fl oz	62 fl oz	12	7	Succulent beans, including succulent soybean vegetable only.
	20D	Acramite-50WS (bifentzate)	1.0–1.5 lb	3.0 lb	12	3	Succulent beans, peas, and soybean.
	21A	Magister (Fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt	12	1	Snap bean only. Reapplications at least 14 days apart.
Thrips	1A	*Lannate LV; *SP (methomyl)	LV: 1.50–3 pt SP: 0.50–1.0 lb	LV: 15 pt SP: 5.0 lb	48	See label: varies with rate and crop use	-
	3A	*Hero (zeta-cypermethrin + bifenthrin)	10.3 oz	27.39 oz	12	Succulent: 3 Dry: 21	-
	3A+ 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz	24	Edible podded and succulent shelled: 7 Dry shelled: 21	Does not include Western Flower Thrips.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Only soil applied Admire Pro is labeled. For foliar-feeding thrips only.
	4A	Assail 30SG (acetamiprid)	4.5–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A	Transform WG (sulfoxaflor)	2.25 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans.
	4A + 15	Cormoran (novaluron + acetamiprid)	12 fl oz	36 fl oz	12	7	No more than 2 applications against thrips per season.
	5	Radiant SC (spinetoram)	5–8 fl oz	Succulent: 28 fl oz Dry: 12 fl oz	4	Succulent: 3 Dry: 28	–
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	12	7	Suppression of foliage-feeding only.
	15	Rimon 0.83 EC (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	23	Movement (spirotetramat)	4–5 fl oz	10.0 fl oz	24	Succulent: 1 Dry: 7	–
	28	Exirel (cyantraniliprole/cyazapyr)	10.5–20.5 oz	0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	Label contains pollinator protection warnings.
	3A	*Brigade 2 EC (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.4–4.3 oz Maxx: 3.2–4.0 oz	25.8 oz Maxx: 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	–
	4A	Admire Pro (imidacloprid)	Soil: 7–10.5 fl oz Foliar: 1.2 fl oz	Soil: 10.5 fl oz Foliar: 3.6 fl oz	12	Soil: 21 Foliar: 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	Assail 30SG (acetamiprid)	4.0–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A + 15	Cormoran (novaluron + acetamiprid)	12 fl oz	36 fl oz (see remarks)	12	7	No more than 2 applications against whiteflies per season.
	4D	Sivanto Prime (flupyradifurone)	10.5–14 fl oz	28.0 fl oz per year	4	7	Reapplications at least 10 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	12	7	-
	7C	Knack IGR (pyriproxyfen)	8-10 fl oz	20 fl oz	12	7	-
	15	Rimon 0.83 EC (novaluron)	12 fl oz	24 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	16	Courier 40 SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz	12	14	For succulent beans only. Reapplications at least 14 days apart.
	21A	Magister (Fenazaquin)	24-36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	23	Movento (spirotetramat)	4-5 fl oz	10.0 fl oz	24	Succulent: 1 Dry: 7	-
	28	Exirel (cyantraniliprole/cyazapyr)	10.5-20.5 oz	0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	-
	¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in the table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide						

Table 9. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria blight/leaf spot	3	Provysof fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	-
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	-
	7	Fontelis (penthiopyrad)	30 fl oz	Dry: 41 fl oz Succulent: 72 fl oz	Dry: 21 Succulent: 0	0.5	-
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 2SC, A-Zox 25SC, AzoxyStar, Azoxystrobin SC, GCS Azoxy 2SC, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	AZteroid FC 3.3 (azoxystrobin)	9.7 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Evito 480SC (fluoxastrobin)	4.75 fl oz	9.5 fl oz	7	0.5	-
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21 SC: 7	4 hr SC: 0.5	-
	3 + 7	Revvylok Fungicide (mefentrifluconazole + fluxapyroxad)	6.5 fl oz	13 fl oz	21	0.5	-
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	-
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe PlusAtticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	9.2 fl oz	-	14	0.5	Reapplications at least 14 days apart.
	3 + 7 + 11	Revvytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-
	7 + 3 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	Reapplications at least 14 days apart.
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	11.8 lb	0	2	-
Anthracnose	M1	Cueva Fungicide Concentrate (copper octanoate)	30 gal	-	0	4 hr	OMRI-listed. ³
	M1	Nordox 75 WG (cuprous oxide)	2.5 lb	-	-	0.5	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	2 pt	SC: 16.6 pt X2: 16.9 pt	0	Greenhouse: 1 Field: 2	-
	M1 + M1	C-O-C-S WDG (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb	-	2	-
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, Incognito 4.5F, Incognito 85 WDG, Nufarm T-Methyl 4.5F Fungicide, Nufarm T-Methyl SPC 4.5F Fungicide, Talaris 4.5 F, Talaris 50 WPS, Talaris 70 WSB, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	See individual label	See individual label	14 to 28 (see label)	Succulent beans: 1 Dry beans: 3	Apply once at 50%-70% bloom or twice (max = 1.5 lb per application) with first at 10%-30% bloom and second at peak bloom.
	3	Ace 3.8L ST (ipconazole)	0.085 fl oz/100 lb seed	-	-	0.5	Partial control for seed-borne <i>Colletotrichum</i> .

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	Supplemental label: For control of web blight caused by <i>Rhizoctonia solani</i> . Not labeled for cowpea used for livestock feed.
	7	Fontelis (penthioopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 25C, A-Zox 25SC, AzoxyStar, Azoxystrobin SC, GCS Azoxy 25C, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Azteroid FC 3.3 (azoxystrobin)	9.7 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21 SC: 7	4 hr SC: 0.5	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Evito 480SC (fluoxastrobin)	4.75 fl oz	9.5 fl oz	7	0.5	-
	1 + 3 + 11	Trevo Packed (thiophanate-methyl + tebuconazole + azoxystrobin)	30 fl oz	-	Fresh: 14 Dry: 28	1	-
	3 + 7 + 11	Revytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Ascochyta blight	3 + 7 + 11	Miravis Neo (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	-
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe Plus, Atticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.
	3	Ace 3.8L ST (ipconazole)	0.085 fl oz/100 lb seed	-	-	0.5	For seedling blight
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	Supplemental label: For control of web blight caused by <i>Rhizoctonia solani</i> . Not labeled for cowpea used for livestock feed.
	3	Provysol fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	Only labeled for chickpea, lentils, and dry-edible peas and beans.
	7	Bonafide (boscalid)	6 oz	22 oz	Dry: 14 Succulent: 7	0.5	Make application at the beginning of flowering.
	7	Endura fungicide (boscalid)	11 oz	22 oz	Dry: 21 Succulent: 7	0.5	No more than 2 applications per crop, and alternate chemistry.
	7	Fontelis (pentiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	3 + 7	Revyllok Fungicide (mefentrifluconazole + fluxapyroxad)	6.5 fl oz	13 fl oz	21	0.5	-
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	-
	3 + 7 + 11	Revytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	Reapplications at least 14 days apart.
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	9.2 fl oz	36.5 fl oz	14	0.5	Reapplications at least 14 days apart.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz/1000 row ft	116 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 25C, A-Zox 25SC, Azoxystar, Azoxystro bin SC, GCS Azoxy 25C, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Azteroid FC 3.3 (azoxystrobin)	9.7 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Evito 480SC (fluoxastrobin)	4.75 fl oz	9.5 fl oz	7	0.5	-
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe Plus, Atticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Bacterial brown spot, Bacterial blight, Common blight, Halo blight	M1	(copper compounds) Many brands available: Americop 40 DF, Basic Copper 53, Champ Dry Prill, Champ Formula 2 Flowable, ChampION++, Champ WG, Cueva Fungicide Concentrate, Cuprofix Flex, Kalmor, Kocide 2000, Kocide 3000, KOP-Hydroxide, KOP-Hydroxide 50W, Kop-5, MasterCop, Nordox 75 WG, Nu-Cop 30 HB, Nu-Cop 3 L, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See individual label	See individual label	Varies	Varies from 4 hr to 2 days	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	2 pt	SC: 16.6 pt X2: 16.9 pt	0	Green-house: 1 Field: 2	-
	M1 + M1	C-O-C-S WDG (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb	-	2	-
	M2	(sulfur) Many brands available: Microfine Sulfur, Microthiol Disperss, Suflla, Sulfur 80 WDG, Sulfur 90W, THAT Flowable Sulfur, Thiolux	See individual label	-	1	-	Do not apply during periods of warm weather to avoid phytotoxicity.
Bean Rust (<i>Uromyces appendiculatus</i>)	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chlorothalonil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 720 SST, Initiate 720, Initiate ZN, Oranil 6L, Praiz, Praiz NG, Rialto 720 F	See individual label	Snap: 12 pt Dry: 8 pt	Snap: 7 Dry: 14	0.5	Do not use on crops for livestock.
	3	(tebuconazole) Many brands available: Monsoon, Onset 3.6L Fungicide, Tebucon 3.6F, Tebu-Crop 3.6F, TebuStar 3.6L, Tebuzol 3.6F, Toledo, Willowood Teb 3.6SC	6 fl oz	Fresh: 24 fl oz Dry: 12 fl oz	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	-
	3	Provyzol fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	-
	3	Rally 40WSP Fungicide Relix 40 WSP (myclobutanil)	5 oz	1.25 lb	0	1	30-day plant-back interval
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	-
	3 + 7	Luna Experience (tebuconazole + fluopyram)	12.8 fl oz	25.6 fl oz	14	0.5	-
	3 + 7	Revyllok Fungicide (mefentrifluconazole + fluxapyroxad)	6.5 fl oz	13 fl oz	21	0.5	-
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	-
	3 + 11	Veltyrna fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	1 + 3 + 11	Trevo Packed (thiophanate-methyl + tebuconazole + azoxystrobin)	30 fl oz	-	Fresh: 14 Dry: 28	1	-
	7 + 3 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	Reapplications at least 14 days apart.
	3 + 7 + 11	Revytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 114 Succulent: 0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 2SC, A-Zox 25SC, AzoxyStar, Azoxystrobin SC, GCS Azoxy 2SC, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	6 fl oz	92.3 fl oz	Dry beans: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Azteroid FC 3.3 (azoxystrobin)	3.9 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	Succulent: 7 Dry: 21	0.5	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Evito 480SC (fluoxastrobin)	4.75 fl oz	9.5 fl oz	7	0.5	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	Flint Extra (trifloxystrobin)	3.8 fl oz	15.2 fl oz	7	0.5	No more than 4 applications per year.
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe Plus, Atticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.
Botrytis or Gray mold	M1	Cueva Fungicide Concentrate (copper octanoate)	30 gal	-	0	4 hr	OMRI-listed. ³
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chlorothalonil 720, Chlorothalonil-Zn, Echo 720, Echo 90 DF, Echo Zn, Equus 720 SST, Initiate 720, Initiate ZN, Oranil 6L, Praiz, Praiz NG, Rialto 720 F	See individual label	Snap: 12 pt Dry: 8 pt	Succulent: 7 Dry: 14	0.5	Do not use on crops for livestock.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, Incognito 4.5 F, Incognito 85 WDG, Nufarm T-Methyl 4.5 F Fungicide, Talaris 4.5 F, Talaris 50 WSP, Talaris 70 WSB, Topsin 4.5 FL Fungicide, Topsin M WSB Fungicide	See individual label	See individual label	14–28 (see label)	Succulent: 1 Dry: 3	Apply once at 50%–70% bloom or twice (max = 1.5 lb per application) with first at 10%–30% bloom and second at peak bloom.
	2	Meteor Fungicide, Rovral 4 Flowable (iprodione)	2 pt	4 pt	0	1	No more than 2 applications per season. Not for use as livestock feed.
	7	Endura fungicide, Bonafide (boscalid)	11 oz	22 oz	Succulent: 7 Dry: 21	0.5	No more than 2 applications per crop, and alternate chemistry.
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	–
	7	Kenja 400SC fungicide (isofetamid)	17 fl oz	34 fl oz	Snap bean: 7 Dry bean: 30	0.5	–
	9	Vango WG (cyprodinil)	7 oz	28 oz	7	0.5	–
	29	Omavo, Orbus 4 F (fluzinam)	13.6 fl oz	84 fl oz	Succulent: 14 Dry: 30	0.5	–
	29	Omega 500F (fluzinam)	13.6 fl oz	81.6 fl oz	14	0.5	–
	29	Vantana (fluzinam)	13.6 fl oz	27.2 fl oz	Succulent: 14 Dry: 30	0.5	–
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	–
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Reapplications at least 14 days apart.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Cercospora leaf spot	9 + 12	Alterity 62.5 WG Switch 62.5WG Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	1 + 3 + 11	Trevo Packed (thiophanate-methyl + tebuconazole + azoxystrobin)	30 fl oz	-	Fresh: 14 Dry: 28	1	-
	3 + 7 + 11	Revvytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	11.8 lb	0	2	-
	M1	Nordox 75 WG (cuprous oxide)	2.5 lb	-	-	0.5	-
	M1	Previsto (copper hydroxide)	2 pt	62 pt	-	2	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	2 pt	SC: 16.6 pt X2: 16.9 pt	0	Greenhouse: 1 Field: 2	-
	M1 + M1	C-O-C-S WDG (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb	-	2	-
	3	Provysol fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	-
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	-
	3 + 7	Revyllok fungicide (mefentrifluconazole + fluxapyroxad)	6.5 fl oz	13 fl oz	21	0.5	-
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	-
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	3 + 7 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	No more than 2 applications per crop. Reapplications at least 14 days apart.
	3 + 7 + 11	Revvytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Downy mildew	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	9.2 fl oz	36.5 fl oz	14	0.5	Reapplications at least 14 days apart.
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	Succulent: 7 Dry: 21	0.5	No more than 2 applications per crop, and alternate chemistry.
	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Basic Copper 53, Champ Formula 2 Flowable, ChampION++, Cueva Fungicide Concentrate, Cuprofix Flex, Kalmor, Kocide 2000, Kocide 3000, Nordox 75 WG, Nu-Cop 30 HB, Previsto	See individual label	See individual label	4 hr to 2 days (see label)	-	-
	M1 + M1	Badge SC Badge X2 (copper hydroxide + copper oxychloride)	2 pt	SC: 16.6 pt X2: 16.9 pt	0	Greenhouse: 1 Field: 2	-
	M1 + M1	C-O-C-S WDG (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb	-	2	-
	M1 + 4	Ridomil Gold/Copper (copper hydroxide + mefenoxam)	2 lb	8 lb	3	2	No more than 4 applications per crop.
	4	Ridomil Gold SL ReCon Bold SL (mefenoxam)	0.2 pt	0.8 pt	3	2	Apply on a 14-day schedule before infection. Must be tank mixed with other effective fungicides.
	4	Thrive 4M (mefenoxam)	3.1 fl oz	15.7 fl oz	3	2	-
	4	Ultra Flourish (mefenoxam)	0.4 pt	Soil: 2.0 pt Foliar: 1.6 pt	3	2	Must be tank mixed with other effective fungicides.
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	Suppression only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	3 + 7 + 11	Revvytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	Suppression only.
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	7	0.5	No more than 2 applications per crop, and alternate chemistry.
	21	Ranman 400SC Fungicide (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Not labeled for cowpea used for livestock feed. No more than 3 sequential applications before rotating chemistry.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	-
Fusarium seedling blight, Fusarium root rot (Most are biologicals and biorationals – see Chapter 19)	3	Ace 3.8L ST (ipconazole)	0.085 fl oz/100 lb seed	-	-	0.5	-
	4	STartUp MEFEN (mefenoxam)	0.47 fl oz/100 lb seed	-	-	0.5	Seed treatment.
Phytophthora (Most are biologicals and biorationals – see Chapter 19)	21	Ranman 400SC Fungicide (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	-
	M1	Cueva Fungicide Concentrate (copper ocanoate)	30 gal	-	0	4 hr	OMRL-listed. ³
Powdery mildew	M2	(sulfur) Many brands available: Microfine Sulfur, Microthiol Disperss, Suffa, Sulfur 80 WDG, Sulfur 90W, THAT Flowable Sulfur, Thiolux, Wettable Sulfur	See individual label	See individual label	1	-	Do not apply during periods of warm weather to avoid phytotoxicity.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Provysol fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	-
	7	Fontelis (penthioopyrad)	30 fl oz	72 fl oz	0	0.5	-
	3 + 7	Revyllok Fungicide (mefentrifluconazole + fluxapyroxad)	6.5 fl oz	13 fl oz	21	0.5	-
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	-
	3 + 11	Veltyma fungicide (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	-
	7 + 3	Luna Experience (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	14	0.5	No more than 2 sequential applications of Luna Experience or any Group 7- or Group 3-containing fungicide before rotating with a fungicide of a different group.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	9.2 fl oz	36.5 fl oz	14	0.5	Reapplications at least 14 days apart.
	3 + 7 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	Reapplications at least 14 days apart.
	3 + 7 + 11	Revytek Fungicide (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	13 fl oz	26 fl oz	21	0.5	-
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	Succulent: 7 Dry: 21	0.5	No more than 2 applications per season.
	11	Aproach (picoxystrobin)	12 fl oz	24 fl oz	14	0.5	-
	11	Flint Extra (trifloxystrobin)	3.8 fl oz	15.2 fl oz	7	0.5	No more than 4 applications per year.
	11	Headline fungicide Headline SC fungicide (pyraclostrobin)	9 fl oz	18 fl oz	7	0.5	No more than 2 applications per crop, and alternate chemistry.
	4	ReCon 4F (metalaxyl)	2 pt	-	-	2	May be made preplant incorporated or as a soil surface spray after planting.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Rhizoctonia diseases	4	ReCon Bold SL (mefenoxam)	1.0 pt	1.0 pt	-	2	May be made preplant incorporated or as a soil surface spray after planting.
	4	Ridomil Gold SL (mefenoxam)	0.2 pt	0.8 pt	3	2	Must be tank-mixed with other effective fungicides.
	4	STartUp MEFEN (mefenoxam)	0.47 fl oz/100 lb seed	-	-	0.5	Seed treatment.
	4	Thrive 4M (mefenoxam)	3.1 fl oz	15.7 fl oz	3	2	For succulent beans.
	4	Ultra Flourish (mefenoxam)	2 pt	-	-	2	Apply as a broadcast soil application at preplant or as a surface application at planting.
	4	Xyler FC Fungicide (metalaxyl)	45.7 fl oz	45.7 fl oz	-	2	Broadcast or banded application as a soil application prior to planting.
	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row	-	-	0	-
	3	Ace 3.8L ST (ipconazole)	0.085 fl oz/100 lb seed	0.00545 lb	-	0.5	For seed rot, damping off, and seedling blights by seed- and/or soil-borne <i>Rhizoctonia</i> .
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	For web blight (<i>Rhizoctonia solani</i>).
	7	Zeltera Fungicide (inpyrfluxam)	0.2 fl oz/100 lb seed	-	-	0.5	-
	3 + 7 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	For web blight (<i>Rhizoctonia solani</i>).
	4 + 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row	-	-	0	No more than 1 application per season.
	11	Acadia LFC (azoxystrobin)	1.0 fl oz/1000 row ft	116 fl oz	Dry: 14 Succulent: 0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Southern blight	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 2 SC, Azoxystrobin SC, GCS Azoxy 25C, Quadris	0.8 fl oz/1000 row ft	-	Dry: 14 Succulent: 0	4 hr	For <i>Rhizoctonia</i> root rot (<i>Rhizoctonia solani</i>).
	11	Azoxystar (azoxystrobin)	3.75 fl oz/100 lb seed	-	-	4 hr	Seed treatment.
	11	Azteroid FC 3.3 (azoxystrobin)	9.7 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	For web blight (<i>Rhizoctonia solani</i>).
	11	Evito 480SC (fluoxastrobin)	0.24 fl oz/1000 row feet	-	7	0.5	-
	11	(azoxystrobin) Many brands available: A-Zox 25SC, Quadris Flowable, Tetraban Fungicide, Trevo	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	For web blight (<i>Rhizoctonia solani</i>).
	11	(azoxystrobin) Many brands available: Satori Fungicide, Tetraban Fungicide, Trevo	0.8 fl oz/1000 row ft	-	-	-	For <i>Rhizoctonia</i> root rot (<i>Rhizoctonia solani</i>).
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe Plus, Atticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	For web blight (<i>Rhizoctonia solani</i>).
	11	(azoxystrobin) Many brands available: Aframe, Arius 250, Atticus Acadia 2SC, A-Zox 25SC, Azoxystar, Azoxystrobin SC, GCS Azoxy 25C, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Acadia LFC (azoxystrobin)	19.5 fl oz/1000 row ft	116 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Azteroid FC 3.3 (azoxystrobin)	9.7 fl oz	58.2 fl oz	Dry: 14 Succulent: 0	4 hr	-
	11	Evito 480SC (fluoxastrobin)	4.75 fl oz	9.5 fl oz	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Tilt (propiconazole)	4 fl oz	12 fl oz	7	0.5	-
	11 + 3	(azoxystrobin + propiconazole) Many brands available: Aframe Plus, Atticus Aquila XL, Cover XL, GCS AzoxyProp, MiCrop Fungicide, Propaz, Quilt Xcel, Trevo P	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	-
	M1	Cueva Fungicide Concentrate (copper ocanoate)	30 gal	-	0	4 hr	OMRL-listed. ³
White mold	1	(thiophanate-methyl) Many brands available: 3336 EG, 3336 F, Incognito 4.5 F, Incognito 85 WDG, Nufarm T-Methyl 4.5 F Fungicide, Nufarm T-Methyl SPC 4.5 F Fungicide, Talaris 4.5 F, Talaris 50 WSP, Talaris 70 WSB, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	See individual label	See individual label	14-28 (see label)	Succulent: 1 Dry: 3	Apply once at 50%-70% bloom or twice (max = 1.5 lb per application) with first at 10%-30% bloom and second at peak bloom.
	1 + 3 + 11	Trevo Packed (thiophanate-methyl + tebuconazole + azoxystrobin)	30 fl oz	-	Fresh: 14 Dry: 28	1	-
	2	Meteor Fungicide, Rovral 4 Flowable Fungicide (iprodione)	2 pt	4 pt	0	1	No more than 2 applications per season. Not for use as livestock feed.
	7	Bonafide (boscalid)	11 oz	22 oz	Dry: 14 Succulent: 7	0.5	Make application at the beginning of flowering. No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	7	Endura Fungicide (boscalid)	11 oz	22 oz	Succulent: 7	0.5	No more than 2 applications per crop, and alternate chemistry.
	7	Kenja 400SC fungicide (isofetamid)	17 fl oz	34 fl oz	Snap bean: 7 Dry bean: 30	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Fontelis (penthioopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	3 + 7	Zorina Fungicide (mefentrifluconazole + boscalid)	20 fl oz	60 fl oz	21	0.5	–
	7 + 11	Priaxor Xemium (fluxapyroxad + pyraclostrobin) (Suppression only)	8 fl oz	16 fl oz	7 or 21	0.5	No more than 2 applications per season. Crop cannot be used for livestock until 14 days after last application.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Suppression only. Reapplications at least 14 days apart.
	9 + 12	Alterity 62.5 WG Switch 62.5 WG Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	–
	29	Omavo Orbus 4 F (fluzazinam)	13.6 fl oz	84 fl oz	Succulent: 14 Dry: 30	0.5	–
	29	Omega 500F (fluzazinam)	13.6 fl oz	81.6 fl oz	Edible, podded, and succulent beans: 14	2	–
	29	Vantana (fluzazinam)	13.6 fl oz	27.2 fl oz	Succulent: 14 Dry: 30	0.5	–
	7 + 3 + 11	Miravis Neo (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	Suppression only. Reapplications at least 14 days apart.
	¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; https://www.frac.info/ (FRAC = Fungicide Resistance Action Committee). ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by Organic Materials Review Institute for use in organic production.						

Table 10. Nonfumigant nematicides for legume crops in Florida.

Product	Application Directions
Mocap 15G (a.i. ethoprop)	Apply 13 lb/A (36 in. row spacing) or 0.9 lb/1,000 linear row ft in a band of 15 in. wide on the row at-planting. Mix with the top 2–4 in. of soil with mechanical equipment right after application. If broadcast, apply 34 lb/A from 1 week before planting to at planting time and mix with 2–4 in. of soil. DO NOT use as a seed furrow treatment or allow granules to contact the seed. No more than 1 application per season.
Velum (a.i. fluopyram)	Apply 4.0–5.0 fl oz/A in seed furrow and cover with soil, or chemigation into root-zone through low-pressure drip or trickle irrigation. No more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation or method of application (soil or foliar). Do not apply within 14 days of harvest.
Biological nematicides	See chapter 19.

Table 11. Fumigant nematicides for legume crops in Florida.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 12. Onion, Leek, and Chive Production¹

Johan Desaegeer, Peter J. Dittmar, Pamela D. Roberts, Xavier Martini, and Lincoln Zotarelli²

Botany and Planting

Onion—*Allium cepa*, Alliaceae (Amaryllidaceae)

Leek—*Allium ampeloprasum*

Chive—*Allium schoenoprasum*

Bunching onion—*Allium fistulosum*

Table 1. Planting dates for onion and alliums.

Planting Region	Dates	
	Seeded	Transplanted
North Florida	mid-Sept–mid-Nov	Nov–Jan
Central Florida	Oct	Dec–Jan
South Florida	Oct	Dec–Jan

Table 2. Planting information for onion and alliums.

Planting Parameters	Measurements	
	Seeded	Transplanted
Distance between rows (in)	14–18	14–18
Distance between plants (in)	3–4	4–6
Seeding depth (in)	0.25–0.5	–
Seed per acre (lb)	3–4	1
Days to maturity	100–130	100–130
Plant populations (acre)	149,343	112,123

Cultivars

Table 3. Onion and leek cultivars.

Crop	Cultivars
Onion	Dawn (H), Granex 33 (H), Pirate (H), Plethora (H), Prowler (H), Red Hunter, Savannah Sweet (H), Sweet Caroline (H), Sweet Harvest (H), Sweet Success (H), Vidurra (H)
Bunching Onion	Perfecto Blanco, Tokyo Long White, White Portugal
Leeks	Chives, Jolant, King Richard, Lancelot, Megathon, Staro, Tivi, Tornado, Verina
H=hybrid	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 4. Herbicides approved for managing weeds in onion, garlic, and shallot. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Dry bulb vegetables: onion, garlic, shallot	Annual broadleaf and grass control. Incorporate or irrigate 1–2 in. deep within 36 hr of application. Consult label for rotational restrictions.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Onion, garlic, leek, chive, shallot	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Flumioxazin up to 0.06	(Chateau) EZ up to 2 fl oz	14	Garlic, onion (dry bulb)	Broadleaf control. Apply to transplanted onions between the 2- and 6-leaf stage. Apply to direct seeded onions between the 3- and 6-leaf stage.
	Glyphosate	(various formulations) consult label	9	Onion, garlic, leek, chive, shallot	Control of emerged broadleaf and grass weeds. Consult individual labels for restrictions.
	Oxyfluorfen 2.0	(Goal 2XL) 2 EC 2.0 pt (GoalTender) 4 EC 1.0 pt	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Transplanted only. Apply within 2 days of transplanting. Necrotic lesions, twisting, or stunting of plants can occur if applications are made during cool, wet weather or prior to the full development of the true leaves.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2–4 pt	22	Onion (dry bulb)	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. No more than 2 applications per season. Use a nonionic surfactant.
	Paraquat 0.63–1.0	(Gramoxone) 2 SL 2.5–4.0 pt (Firestorm) 3 SL 1.7–2.7 pt	22	Onion (seeded), garlic	Emerged broadleaf and grass weeds. Apply as a preplant burndown. No more than 1 lb a.i./A per season.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Onion, garlic, leek, chive, shallot	Emerged broadleaf and grass weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity.
	Pendimethalin Mineral 0.5–0.75 Muck 1.0–2.0	(Prowl) 3.3 EC Mineral: 1.2–1.8 pt Muck: 2.4–4.8 pt (Prowl H2O) 3.8 Mineral: 1.0–1.5 pt Muck: 2.0–4.0 pt	3	Onion (dry bulb), shallot (dry bulb), garlic	Mineral soils: Apply when crop has 2–9 true leaves. Muck soils: May be applied as sequential application: preemergence through loop stage, early postemergence (2–6 true leaf stage), late postemergence (6–9 true leaf stage). No more than 5.9 lb a.i./A per growing season. PHI 45 days.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Bulb vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
POSTEMERGENCE	Bromoxynil 0.38-0.5	(Buttril) 2 EC 1.5-2.0 pt	6	Garlic	Broadleaf weeds. Apply after emergence but before 12 in. tall. Weeds are most susceptible up to the 4-leaf stage, 2 in. tall, or 1 in. wide. PHI 112 days.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Onion (dry bulb), garlic, leek, chive, shallot	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
	Clethodim 0.09-0.25 0.07-0.25	(Arrow) 2 EC 6-16 fl oz (Select Max) 1 EC 9-32 fl oz	1	Onion (dry bulb), garlic, shallot (dry bulb)	Annual and perennial grass control. Some labels include green onion. Consult label for use of a crop oil concentrate or nonionic surfactant. PHI 45 days.
	Clethodim 0.09-0.13	(Arrow) 2 EC 6-8 fl oz (Select Max) 1 EC 12-16 fl oz	1	Chive, leek	Emerged annual and perennial grasses. Consult label rate of COC or NIS. No more than 0.5 lb a.i./A per season. Select Max is not registered in leek. PHI 14 days.
	Dimethenamid-p up to 1.0	(Outlook) 6 EC up to 21 fl oz	15	Onion (dry bulb), garlic, leek, shallot (dry bulb, green)	Broadleaf and grass weeds. Apply after the 2-true-leaf stage. Apply as a single application or split application. Split application of 10-14 fl oz, followed by 7-10 fl oz/A with 14 days between applications. No more than 21 fl oz/A per growing season. PHI 30 days.
	Fluazifop 0.188	(Fusilade DX) 12 fl oz	1	Onion (dry bulb), garlic	Annual and perennial grass weeds. No more than 48 fl oz/A per season. Include a COC or NIS. PHI 45 days.
	Oxyfluorfen 0.5	(Goal 2 XL) 2 EC 0.5 pt direct seeded (GoalTender) 4 EC 0.25 pt direct seeded	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Direct seeded only. Apply after the crop has 2 true leaves. Multiple treatments can be applied. No more than 0.5 lb a.i./A. Necrotic lesions, twisting, or stunting of plants can occur if applications are made during cool, wet weather or prior to development of true leaves. PHI 60 days.
	Sethoxydim 0.19-0.28	(Poast) 1.5 EC 1.0-1.5 pt	1	Onion (dry bulb, green), garlic, leek, shallot	Grass weeds. Include a surfactant. No more than 4.5 pt/A per season. PHI 30 days.
	Treflan 0.35-0.5	(Treflan) 4 EC 0.75-1.0 pt (Treflan TR-10) 3.75-5.0 lb	3	Onion (dry bulb)	Broadleaf and grass weeds. Apply at layby to the soil surface between onion rows. Remove weeds that are present. Do not apply in muck soils. PHI 60 days.

Table 5. Insecticides labeled for management of arthropod pests of garlic, leeks, and shallots. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center—Quincy.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1–1.56 pt	40 fl oz	24	3	Leeks, shallots, garlic. No more than 3 applications per year for garlic and 2 for all others.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, and garlic.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 oz	12	30	–
Beet armyworm	1A	*Lannate LV; *SP (methomyl)	LV: 1.5 pt SP: 0.5 lb	2.7 lb a.i.	48	7	Garlic only.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	2.56–3.84 fl oz	0.12 lb a.i.	24	14	–
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 fl oz	12	30	–
	28	Coragen (chlorantraniliprole)	3.5–5.0 fl oz	15.4 fl oz	4	1	No more than 4 foliar applications. For entire bulb vegetable group.
Caterpillars (includes cutworms and armyworms)	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb and garlic only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, and garlic.
	3A	*Pounce 25 WP (permethrin)	Garlic: 6.4–12.8 oz	0.8 lb a.i.	12	1	Garlic.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.20 fl oz	1.92 pt	12	14	Onion and garlic.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 oz	12	30	–
	5	Entrust SC (spinosad)	3–8 fl oz	29 fl oz	4	1	No more than 5 applications per year. For leeks, garlic, and shallots. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	–	4	1	Use with an adjuvant. No more than 5 applications per year.
	18	Intrepid 2F (methoxyfenozide)	4–12 fl oz	32 fl oz per year	4	1	Slow-acting IGR (insect growth regulator) that only affects larvae. Not for garlic.
	6	Clinch (abamectin)	Broadcast application: 1 lb Per ant mound: 5–7 tablespoons	4 lb per year	4	0	Only apply when ants are active and no rain is forecast for the next 6 hr.
Fire ants	7A	Extinguish (S-methoprene)	1–1.5 lb	–	4	0	Slow-acting IGR. Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8–10 weeks. May be applied by ground equipment or aerially.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	–	12	1	Dry bulb only.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	–
Flea beetles	5	Entrust SC (spinosad)	3–8 fl oz	29 fl oz	4	1	No more than 5 applications per year. For leeks, garlic, and shallots. OMRI-listed. ³
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Label is registered only for garlic.
<i>Liriomyza</i> Leafminers	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, garlic.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 oz	38 oz	12	30	-
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	-
	5	Entrust SC (spinosad)	3–8 fl oz	29 fl oz	4	1	No more than 5 applications per year. For leeks, garlic, and shallots. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	-	4	1	Use with an adjuvant. No more than 5 applications per year.
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	7–10 fl oz	20.0 fl oz	24	30	-
	17	Trigard (cyromazine)	2.66 oz	-	12	7	No more than 6 applications per crop.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Toxic to bees. Do not allow drift to blooming crops or weeds.
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	-	72	Preplant	No more than 1 soil application per year. For leeks, garlic, and shallots.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1–1.56 pt	40 fl oz	Leeks, shallots, garlic: 24	3	Leeks, shallots, and garlic. No more than 3 applications per year for garlic and 2 for all others.
Onion maggot (<i>Delia antiqua</i>)	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Label is registered only for garlic.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	-
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, and garlic.
	3A	*Pounce 25 WP (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	0.8 lb a.i.	12	1	Garlic.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Plant bugs	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.20 fl oz	1.92 pt	12	14	Onion and garlic.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 oz	12	30	–
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	2.56–3.84 fl oz	1.92 pt	12	14	Onion and garlic.
Stink bugs	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Garlic only. Label is registered only for garlic.
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	Karate (lambda-cyhalothrin)	2.56–3.84 fl oz	30.72 fl oz	24	14	–
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, and garlic.
	3A	*Pounce 25 WP (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	0.8 lb a.i.	12	1	Garlic.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	2.56–3.84 fl oz	1.92 pt	12	14	Onion and garlic.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 oz	12	30	–
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips (check label for species controlled)	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	2.7 lb a.i.	48	7	–
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1–1.56 pt	40 fl oz	Leeks, shallots, garlic: 24	3	Leeks, shallots, and garlic. No more than 3 applications per year for garlic and 2 for all others.
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Garlic only. Label is registered only for garlic.
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Garlic.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Leeks, shallots, and garlic.
	3A	*Pounce 25 WP (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	0.8 lb a.i.	12	1	Bulb onions and garlic.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	2.56–3.84 fl oz	1.92 pt	12	14	Onion and garlic.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (garlic).
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	38 oz	12	30	–
	4A	Admire Pro (imidacloprid)	14.0 fl oz	14 fl oz	12	21	–
	4A	Assail 30SG (acetamiprid)	5.0–8.0 oz	32 oz	12	7	No more than 4 applications per season.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	–
	5	Entrust SC (spinosad)	3–8 fl oz	29 fl oz	4	1	No more than 5 applications per year. For leeks, garlic, and shallots. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	–	4	1	Use with an adjuvant. No more than 5 applications per year.
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	10 fl oz	20.0 fl oz	12	30	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	7C	Knack IGR (pyriproxyfen)	8 fl oz	-	12	3	No more than 2 applications per year. Reapplications at least 14 days apart. No activity against adult insects.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Label contains pollinator protection warnings.
Wireworms	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	-	72	Preplant	No more than 1 soil application per year. For leeks, garlic, and shallots.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 6. Insecticides registered for managing arthropod pests of onions. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center—Quincy.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1.5 pt	40 fl oz	12	3	Onions, bulb and green. No more than 2 applications per year. Suppression only.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions and garlic), not green onions. Suppression only.
Caterpillars (includes cutworms and armyworms)	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb and garlic only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Pounce 25 WP (permethrin)	6.4–19.2 oz	0.8 lb a.i.	12	1	Bulb onions.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions), not green onions.
	5	Entrust SC (spinosad)	3–6 fl oz	29 fl oz	4	1	No more than 5 applications per year. For onions, bulb and green. OMRI-listed. ³
	5	Radiant SC (spinetoram)	5–10 fl oz	30 fl oz per year	4	1	Use with an adjuvant. No more than 5 applications per year.
	11A	Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	1.0–2.0 lb	–	4	0	Apply when larvae are small for best control.
	11A	Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed. ³

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	11A	Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25–1.5 lb	–	4	0	Use higher rates for armyworms. OMRI-listed. ³
	11A	DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25–2.0 lb	–	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed. ³
	11A	Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12–1.5 lb	–	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed. ³
	11A	Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5–2.0 lb	–	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. OMRI-listed. ³
	18	Intrepid 2F (methoxyfenozide)	4–8 fl oz	32 fl oz per year	4	1	Green onion subgroup only.
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz per crop	4	1	Beet armyworm only. No more than 4 foliar applications.
	7A	Extinguish (S-methoprene)	1–1.5 lb	–	4	0	Slow-acting IGR. Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8–10 weeks. May be applied by ground equipment or aerially.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	–	12	1	Dry bulb only.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz	10.5 fl oz	12	Foliar: 1	–
Flea beetles	5	Entrust SC (spinosad)	3–6 fl oz	29 fl oz	4	1	No more than 5 applications per year. For onions, bulb and green. OMRI-listed. ³
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb only.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.54 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Pounce 25 WP (permethrin)	Onions: 6.4–19.2 oz	1.0 lb a.i.	12	1	Bulb onions. No more
	4A	Scorpion 35SL (dinotefuran)	Foliar: 5.25–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	-
	5	Entrust SC (spinosad)	3–6 fl oz	29 fl oz	4	1	No more than 5 applications per year. For onions, bulb and green. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6–10 fl oz	30 fl oz per year	4	1	Use with an adjuvant. No more than 5 applications per year.
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	17	Trigard (cyromazine)	2.66 oz	-	12	7	No more than 6 applications per year.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Toxic to bees. Do not allow drift to blooming crops or weeds.
	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	-	72	preplant	No more than 1 soil application per year. For onions, bulb and green.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1.5 pt	40 fl oz	12	3	Onions, bulb and green. No more than 2 applications per year.
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	0.77–1.28 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Pounce 25 WP (permethrin)	6.4–19.2 oz	0.8 lb a.i.	12	1	Bulb onions.
Onion maggot							

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions and garlic), not green onions.
Plant bugs	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions and garlic), not green onions.
Stink bugs	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Pounce 25 WP (permethrin)	6.4–19.2 oz	0.8 lb a.i.	12	1	Bulb onions.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions), not green onions.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 3.5–7.0 fl oz	10.5 fl oz	12	1	–
Thrips (check label for species controlled)	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2 pt 8F: 1.56 pt	40 fl oz	12	3	Onions, bulb and green. No more than 2 applications per year.
	3A	*Ambush 25W (permethrin)	6.4–19.2 oz	2 lb a.i.	12	1	Dry bulb only.
	3A	*Declare Insecticide (gamma-cyhalothrin)	1.02–1.54 fl oz	0.77 pt	24	14	Bulb onions.
	3A	*Mustang (zeta-cypermethrin)	3.2–4.3 oz	21.5 oz	12	7	Onions, bulb and green.
	3A	*Pounce 25 WP (permethrin)	9.6–19.2 oz	0.8 lb a.i.	12	1	Bulb onions.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	15.36 fl oz	24	14	For bulb crops only (onions and garlic), not green onions.
	4A	Admire Pro (imidacloprid)	14.0 fl oz	14 fl oz	12	21	–
	4A	Assail 30SG (acetamiprid)	5.0–8.0 oz	32 oz	12	7	No more than 4 applications per season.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 5.25–7.0 fl oz Soil: 8.75–10.5 fl oz	10.5 fl oz	12	Foliar: 1 Soil: N/A	–
	5	Entrust SC (spinosad)	3–8 fl oz	29 fl oz	4	1	No more than 5 applications per year. For onions, bulb and green. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6–10 fl oz	30 fl oz per year	4	1	Use with an adjuvant. No more than 5 applications per year.
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	7C	Knack IGR (pyriproxyfen)	8 fl oz	–	12	3	No more than 2 applications per year. Reapplications at least 14 days apart. No activity against adult insects.
	23	Movento (spirotetramat)	5 fl oz	10 fl oz	24	3	–
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Toxic to bees. Rotate with other effective modes of action. Begin making applications when populations are low. If populations are above threshold, use an effective knockdown product prior to applying Exirel.
Wireworms	1B	*Diazinon AG500 *Diazinon 50W (diazinon)	AG500: 3–4 qt 50W: 4–8 lb	–	72	Preplant	No more than 1 soil application per year. For onions, bulb and green.

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions.

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*Restricted use insecticide.

Table 7. Onion fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Pamela Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Bacterial blight (<i>Xanthomonas axonopodis</i> pv. <i>allii</i>)	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Champ DP, Champ F2 FL, Champ WG, Cuprofix Ultra 40D, Cuproxat, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kop-hydroxide, Master Cop, Nu-Cop 50WP, Nu-Cop 50DF, Nu-Cop HB, Previsto	See individual label	See individual label	0	Varies by product from 4 hr to 2 days	Frequent use of copper fungicides may cause foliar burn.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	P01	Actigard 50WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days of transplanting. Suppression only.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	See label. Suppression only.
Black mold (<i>Aspergillus niger</i>)	9 + 12	Switch 62.5WG Alterity 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See individual label	-	-	See label. Suppression only.
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	Suppression only.
	9 + 12	Alerity 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	7	0.5	Suppression only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Botrytis leaf blight (<i>Botrytis squamosa</i>)	M1 + M3	ManKocide (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	See individual label	See individual label	7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	See individual label	See individual label	Dry bulb: 7 Green: 14	1	-
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	See individual label	See individual label	7	1	-
	3	(propiconazole) Many brands available: Amcide Propiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness, Propicure, Propimax EC, Propistar EC, Shar-Shield PPZ, Tide Propiconazole EC, Tilt	See individual label	See individual label	See label	0.5	Suppression only.
	3 + 7	Luna Experience (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	See label	-	Dry bulb: 7 Green: 14–21	2	-
	7	Endura (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	See label.
	7 + 3	Aprovia Top (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. No more than 4 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	7	0.5	No more than 2 applications per year.
	7 + 11	Merivon Xemium (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	No more than 2 consecutive applications.
	9	Vanguard WG Vango WG (cyprodinil)	10 oz	28 oz	7	0.5	No more than 2 consecutive applications.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See individual label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.
	9 + 12	Switch 62.5WG Alterity 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz per year	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last applications.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. No more than 5 applications per crop. Suppression only.
	11	Quadris Aframe Many products: see label (azoxystrobin)	See individual label	See individual label	See label	4 hr	Alternate applications with a different fungicide group.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See individual label	14	0.5	Alternate applications with different fungicide groups. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz per year	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Botrytis neck rot (<i>Botrytis allii</i>)	11 + 3	Quilt Xcel (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	No more than 1 application before alternating to a non-group 11 fungicide.
	11 + 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	No more than 2 consecutive applications. No more than 6 applications per crop.
	14	Botran 5F (DCNA dicloran)	2–3.2 lb	See individual label	14	See label	–
	22 + M5	Zing! (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	No more than 8 applications per year.
	29	Omega 500F (fludioxinam)	1 pt	6 pt	7	2	–
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	See individual label	See individual label	7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	See individual label	See individual label	Dry bulb: 7 Green: 14	1	–
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	See individual label	See individual label	7	1	–
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	–
	7 + 3	Aprovia Top (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. No more than 4 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxinil)	11.4 fl oz	34.2 fl oz	7	0.5	–

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	No more than 2 consecutive applications.
	9	Vanguard WG Vango WG (cyprodinil)	10 oz	28 oz	7	0.5	No more than 2 consecutive applications. Suppression only.
	9 + 12	Switch 62.5WG Alterity 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application. Suppression only.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See individual label	14	0.5	Alternate applications with different fungicide groups. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant. Suppression only.
	11 + 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	No more than 2 consecutive applications. No more than 6 applications per crop.
	14	Botran 5F (DCNA dicloran)	3.5 lb	See individual label	14	See label	-
	29	Omega 500F (fluzinam)	1 pt	6 pt	7	2	-
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	No more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
Cercospora leaf spot (<i>Cercospora dudidae</i>)							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Cladosporium leaf blotch (<i>Cladosporium allii</i>)	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	0.5	Alternate applications with a different fungicide group not in 7 or 11.
	7 + 3	Aprovia Top (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. No more than 4 applications per year.
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	12 hr	-
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See individual label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.
	11	Quadris Aframe Many products available (azoxystrobin)	See individual label	See individual label	See label	4 hr	Alternate applications with a different fungicide group.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See individual label	14	0.5	Alternate applications with different fungicide groups. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	11 + 3	Quilt Xcel (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	No more than 1 application before alternating to a non-group 11 fungicide.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	7	1	Do not apply to exposed bulbs.
Damping-off							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	2	(iprodione) Many brands available: Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	See individual label	See individual label	7	1	-
	4	Ridomil Gold Subdue Maxx (mefenoxam)	-	-	-	-	See individual label.
	4 + 11	Uniform (mefenoxam, azoxystrobin)	0.34 fl oz/1000 row ft	0.34 fl oz/1000 row ft	-	-	-
	12	Cannonball WG (fludioxonil)	7 oz	32 oz	7	0.5	-
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb seed	-	-	-	Seed treatment only.
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	See individual label	See individual label	0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn.
Downy mildew (<i>Peronospora destructor</i>)	M1 + M2	Top Cop with sulfur (basic copper sulfate + sulfur)	2-3 qt	See label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	7	1	Do not apply to exposed bulbs.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	See individual label	See individual label	Green: 14 Dry bulb: 7	1	Suppression only.
	4 + M1	Ridomil Gold/Copper (mefenoxam + copper hydroxide)	2 lb	-	Green: 7 Dry bulb: 10	2	No more than 0.4 lb a.i./A of metalaxyl or mefenoxam.
	4 + M3	Ridomil Gold MZ WG (mefenoxam + mancozeb)	2.5 lb	-	Dry bulb: 7	2	-
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	See label	-	Dry bulb: 7 Green: 14–21	2	-
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. No more than 5 applications per crop.
	11	Quadris Aframe (azoxystrobin)	See individual label	See individual label	See label	4 hr	Alternate applications with a different fungicide group.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with a different fungicide group. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	Quilt Xcel (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	No more than 1 application before alternating to a non-group 11 fungicide.
	11 + 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	No more than 2 consecutive applications. No more than 6 applications per crop. Suppression only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Suppression only.
	21	Ranman (cyazofamid)	3 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action. No more than 3 sequential applications.
	22 + M5	Zing! (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	No more than 8 applications per year.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	-
	29	Omega 500F (fluzinam)	1 pt	6 pt	7	2	-
	33	Aliette WDG Linebacker WDG (fosetyl-Al)	3 lb	-	See label	See label	Do not tank mix with copper fungicides, adjuvants, or foliar fertilizers. No more than 7 applications per season.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosiphite, Fungi-Phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	See individual label	See individual label	0	4 hr	-
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Must be applied in a tank mix with another fungicide active against downy mildew. No more than 2 sequential applications.
	40	Revus (mandipropamid)	8 fl oz	Dry: 32 fl oz Green: 24 fl oz	7	4 hr	No more than 2 consecutive applications before switching to a non-group 40 fungicide. A silicon-based adjuvant must be added at recommended rates.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	40 + 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	-
	43	Presidio (fluopicolide)	4 fl oz	-	2	0.5	No more than 4 applications of Presidio per season.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	No more than 2 sequential applications and do not exceed more than 33% of all fungicide applications with Orondis.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	Dry: 32 fl oz Green: 24 fl oz	7	4 hr	No more than 2 sequential applications and do not exceed more than 33% of all fungicide applications with Orondis.
Iris Yellow Spot (Iris yellow spot virus)	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Suppression only.
Powdery mildew	M2	(sulfur) Many brands available: Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, Yellow Jacket Wettable Sulfur	See individual label	See individual label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	0.5	Alternate applications with a different fungicide group not in 7 or 11.
	7	Fontelis (pentiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 3	Aprovia Top (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. No more than 4 applications per year.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Purple blotch (<i>Alternaria porri</i>)	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. No more than 5 applications per crop.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	M1	(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-hydroxide, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	See individual label	See individual label	0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn.
	M1 + M2	Top Cop with sulfur (basic copper sulfate + sulfur)	3 qt	See individual label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	See individual label	See individual label	7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	See individual label	See individual label	Green: 14 Dry bulb: 7	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	See individual label	See individual label	7	1	-
	3	(propiconazole) Many brands available: Amide Propiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness, Propimax EC, Propistar EC, Shar-Shield PPZ, Tide Propionazole EC, Tilt	See individual label	See individual label	See label	0.5	-
	3	(tebuconazole) Many brands available: Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	See individual label	See individual label	7	0.5	-
	3	Cevya (Mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	-
	3 + M5	Muscle ADV (tebuconazole + chlorothalonil)	1.6 pt	3.2 pt	7	0.5	Apply in a protective fungicide schedule.
	3 + 7	Luna Experience (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	0.5	Alternate applications with a different fungicide group not in 7 or 11.
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	See label	-	Dry bulb: 7 Green: 14/21	2	-
	7	Endura (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	Fontelis (penthiofpyrad)	24 fl oz	72 fl oz	3	0.5	See label.
	7 + 3	Aprovia Top (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. No more than 4 applications per year.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	7	0.5	No more than 2 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Merivon Xemium (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	-
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	No more than 2 consecutive applications.
	9	Vangard WG Vango WG (cyprodinil)	10 oz	28 oz	7	0.5	No more than 2 consecutive applications.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.
	9 + 12	Switch 62.5WG Alterity 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. No more than 5 applications per crop.
	11	Quadris (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Quilt Xcel (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	No more than 1 application before alternating to a non-group 11 fungicide.
	11 + 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	No more than 2 consecutive applications. No more than 6 applications per crop.
	22 + M5	Zing! (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	No more than 8 applications per year.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	-
	29	Omega 500F (fluazinam)	1 pt	6 pt	7	2	-
	33	Aliette WDG Linebacker WDG (fosetyl-Al)	3 lb	-	See label	See label	Do not tank mix with copper fungicides, adjuvants, or foliar fertilizers. Suppression only. No more than 7 applications per season.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	No more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
	4	(mefenoxam) Many brands available: Apron XL, Ridomil Gold EC, Ridomil Gold SL, Ultra Flourish	See individual label	See individual label	N/A	2	-
	4	(metalaxyl) Many brands available: Allegiance, Aquire, MetaStar 2E, Sebring 2.65 ST, Sebring 318 FS, Sebring 480 FS	-	-	-	-	-
	11 + 4	Uniform (azoxystrobin + mefenoxam)	See individual label	-	-	-	-
Rhizoctonia damping-off	11	Dynasty (azoxystrobin)	0.38 fl oz/100 lb seed	See individual label	See label	4 hr	Seed treatment only.
	11	Quadris (azoxystrobin)	0.8 fl oz/1000 row feet	See individual label	0	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 4	Uniform (azoxystrobin + mefenoxam)	See label	-	-	-	-
Rust (<i>Puccinia allii</i>)	3	(tebuconazole) Many brands available: Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	See individual label	See individual label	7	0.5	-
	3 + M5	Muscle ADV (tebuconazole + chlorothalonil)	1.6 pt	3.2 pt	7	0.5	Apply in a protective fungicide schedule.
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	0.5	Alternate applications with a different fungicide group not in 7 or 11.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	See individual label	See individual label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. No more than 5 applications per crop.
	11	Quadris (azoxystrobin)	See individual label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11 + 3	Quilt Xcel (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	No more than 1 application before alternating to a non-group 11 fungicide.
Seedling blight	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	See individual label	See individual label	7	1	Do not apply to exposed bulbs.
	11	Dynasty (azoxystrobin)	0.38 fl oz/100 lb seed	See individual label	See label	4 hr	-
	12	Maxim 4FS Spirato 480 FS (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	14	Botran 5F (DCNA dicloran)	3.5 lb	See label	14	See label	-
Stemphylium blight (<i>Stemphylium vesicarium</i>)	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	See individual label	See individual label	7	1	-
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	0.5	Alternate applications with a different fungicide group not in 7 or 11.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	-
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	See individual label	Green: 14 Dry bulb: 7	0.5	No more than 2 applications before alternating with a different fungicide group.
	9 + 12	Switch 62.5WG Alterity 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11 + 3	Quadris Top Acadia (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	No more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	11 + 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	No more than 2 consecutive applications. No more than 6 applications per crop.
	29	Omega 500F (fluazinam)	1 pt	6 pt	7	1	Begin sprays at first development and continue on 7- to 14-day schedule.
White rot (<i>Sclerotium cepivorum</i>)	1	(thiophanate-methyl) Many brands available: Incognito 4.5 F, NuFarm T-Methyl 4.5 F, NuFarm T-Methyl 70 WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin M 70 WDG, Topsin M 70 WP, Topsin M WSB	See individual label	See individual label	-	3	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	(tebuconazole) Many brands available: Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	See individual label	See individual label	7	0.5	-
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	7	0.5	Spray into empty furrow at time of planting.
	7 + 3	Luna Flex (fluopyram + difenocoazole)	13.6 fl oz	27.2 fl oz	7	0.5	-
	9 + 12	Switch 62.5WG Alterity 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See individual label	14	0.5	Alternate applications with different fungicide groups. No more than 3 applications per crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	12	Cannonball WG (fludioxonil)	7 oz	32 oz	7	0.5	-
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	-
	14	Botran 5F (DCNA dicloran)	3.5 lb	See individual label	14	0.5	-
	¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; https://www.frac.info/ (FRAC = Fungicide Resistance Action Committee). ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.						

Table 8. Nonfumigant nematicides for onion and alliums.

Product	Application Directions
Velum (a.i. fluopyram)	Apply 6.5–6.8 fl oz/A either (1) preplant banded or broadcast spray directed to the soil and incorporated into the planting bed or (2) via chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent irrigation. Reapplications at least 14 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation or method of application (soil or foliar). Do not apply within 30 days of harvest.
Biological nematicides	See chapter 19.

Table 9. Fumigant nematicides for onion and alliums.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60 ^{2,3}	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other use and rate-modifying recommendations and restrictions.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 13. Pepper Production¹

Craig Frey, Eugene J. McAvoy, Johan Desaegeer, Gary E. Vallad, Jawwad Qureshi, and Nathan S. Boyd²

Botany and Planting

Bell pepper—*Capsicum annuum*, Solanaceae

Habanero and Bird's-eye pepper—*Capsicum chinense*

Cultivars

Disease Key: R = resistant, IR = intermediate resistance, HR = high resistance, T = Tolerant. Xcv = *Xanthomonas campestris* pv. *vesicatoria* (bacterial leaf spot), TMV = tobacco mosaic virus, PVY = potato virus Y, TSWV = tomato spotted wilt virus, Pc = *Phytophthora capsici* (Blight), Tm = tobamovirus, TEV = tobacco etch virus, PepMo = pepper mottle virus, and ToM = tomato mosaic virus. Races indicated by their numbers.

Sweet Bell

Antebellum. Green, sweet pepper with earlier setting patterns and more concentrated fruit set, deep-green color, and blocky shape. R to Xcv 1–10 and TMV 0; IR to TSWV.

Aristotle. Green-to-red blocky bell with great yield potential. Extra-large, thick-walled. Very vigorous plant that produces dark-green, anthocyanin-less fruit. R to Xcv 1–3, PVY, and Tm 0.

Autry. Uniformly blocky fruit that ripens red. Fruit set is concentrated, with high first-pick yields. R to Xcv 1–10 and Tm 0; IR to TSWV.

Blitz. Early-maturing, extra-large, blocky, green-to-red bell with great yield potential at first harvest. Fruit is high quality with thick walls and a uniformly blocky shape. HR to TMV 0, Xcv 0–5, 7–9; IR to TEV.

Boca. Fruit is very dark green with thick, firm walls. TSWV in addition to bacterial leaf spot resistance. R to Xcv 1–10.

Green Machine. Main-season hybrid bell pepper for the spring and fall season. Robust plant produces dark green, deep blocky, anthocyanin-less fruit turning red at maturity. HR to TMV 0; IR to Xcv 1–10 and TSWV.

Nitro S10®. A mid-maturing hybrid suited for place pack. It is adapted to fall and spring in the Southeast. Fruit has

good size uniformity; is smooth, firm, and glossy dark green; and matures to red color. R to TMV 0; IR to Pc, TSWV, and Xcv 0–10.

Placepack. Main-season, high-quality, dark-green pepper with high percentage of four lobes. Plants provide good cover. R to Xcv 1–10, PVY 0–1, and Tm 0; IR to TEV.

Provider. Dark-green fruit with plant structure and fruit set, making it ideal for extended harvest. R to Xcv 1–10, PVY 0–1, and Tm 0; IR to TEV.

PS 09979325. Main-season hybrid that develops a mid-sized plant with green, maturing-to-red fruit targeted to the southeastern United States. The plants produce a high, concentrated set of firm, dark-green, smooth, blocky fruit 74 days after transplant. R to Tm 0 and Xcv 0–10 (X10R).

PS 9928302. Combines a large, robust plant with large, dark-green to firm-red fruits. In trials, very adaptable with good size, shape, uniformity, and color. It is anthocyanin-less. HR to Xcv 1–5, Tm 0, and Xcv 1–5 (X5R).

Regulator. Widely adapted. Strong plant with good cover. Produces a high percentage of uniform, four-lobed fruit. R to Xcv 1–10 and Tm 0; IR to TSWV 0.

Seedway 48. Medium plant size with large-to-jumbo, uniform, dark-green fruit. R to Xcv 1–10.

Shogun S10®. Extra-large, dark-green fruit with high yield potential. Adapted to late fall, winter, and spring in the Southeast. R to TMV 0; IR to TSWV and Xcv 1–10.

SV3255PB. Main-season variety with blocky green-to-red fruit. IR to Xcv 0–10.

Standout. Uniformly shaped, extra-large to jumbo-sized dark, glossy fruit.

Vanguard. Medium plant with good foliage. Fruit is dark green, blocky, four-lobed, and extra large with thick, firm walls. Early maturity with concentrated harvest. R to Xcv 1–5, PepMo, and ToM.

Sweet Peppers

Boris. Sweet banana type with light-yellow to red fruit. R to TSWV.

Lemon Delite, Orange Delite, Ruby Delite. Series consists of large-fruited snack pepper varieties with very early maturity and hot set potential. R to TMV 0 and Xcv 0–3, 7, 8.

Natasha. Sweet banana type with a vigorous plant and light-yellow to red fruit. R to Xcv 1–3.

Sopron. Sweet banana type with light-yellow to red fruit. R to Xcv 1–3.

Cubanelle

Aruba. Early-maturing, erect plant with three-to-four lobed, elongated fruit that matures from a pale lime green to a bright red.

Bimini. Thick-walled, heavy fruit with good setting ability and excellent flavor. Performs well in both fall and spring seasons. T to Xcv 1–10.

Granada. Good canopy provides protection against sun scald, well-adapted to the Southeast. Heavy yields of sweet, thick-walled Cubanelle peppers. Peppers turn from light green to red at maturity. R to Xcv 0–3, 7, 8.

Key West. Long, lime-green fruit that matures to red. R to Xcv 1–3.

Hot Ancho Poblano

Hitman. Dark green and glossy open-field fruit with high percentage of two-lobed fruit. Medium-early maturity. R to Tm 0.

Massivo. Mostly two-lobed dark-green fruit. R to TMV.

Hot Cayenne

Arapaho. Cayenne type with early maturity on a medium-sized plant. Produces long (8–9 in.), medium-high pungent fruit with great flavor and aroma.

Iberia. Long hot type similar to Mesilla but longer and slightly hotter. R to TMV.

Mesilla. Long hot type produces very long (9–11 × 1.5 in.) fruit that can be used green or red. Pods grow pendant from a large plant, maturing at mid-season. R to Tm 0 and PVY; IR to TEV.

Hot Jalapeño

Baluarte. Large, thick-walled fruit with low cracking. R to Xcv 1–3.

Compadre. Medium-to-late fruiting. Vigorous plant with good tolerance to high temperatures. Medium spicy (2,500–8, SHU). Continuous picking. Uniform, smooth, large fruit. No purpling. R to PVY and Tm; Xcv 2, 5.

Everman. Shiny and uniform fruit with excellent weight and shelf life and no cracking. Open plant with good regrowth and continuous set during the cycle. R to Xcv 1–3.

Jedi (Jaguar). Vigorous plant with jumbo fruit. R to Xcv 1–3.

Lexus. Concentrated early-season fruit set. Glossy dark-green fruit. HR to Xcv 1–3.

Mixteco. Early-maturing, heavy and thick-walled fruit with deep-green color. Strong plant with good regrowth that brings high yield potential. R to Tm 0; IR to Xcv 1–3.

Orizaba. Large, strong fruit with excellent leaf cover. Spicy with little cracking. R to Xcv 1–3.

PS 11435807. Vigorous medium plant with concentrated fruit set. Smooth dark-green fruit. R to PVY and TEV. IR to root-knot nematode.

PS 11435810. Vigorous tall plant with pungent, dark-green, smooth fruit. R to root-knot nematode, Pc, PVY, and TEV.

Other Hot Peppers

Altiplano. Vigorous serrano pepper with uniform and glossy green fruit.

Balada. Finger hot Asian-type pepper. Fruit matures from green to red, is slightly curved, tapers to a point, and is highly pungent.

Camino Real. Serrano type with medium maturity and large green-fruit size. R to PVY; IR to TEV.

Canario Real. A main-season hot banana pepper with large, heavy fruit and vigorous plant habit.

Charger. Anaheim type with smooth, flat, thick-walled fruit that is mildly hot. IR to TSWV.

Devil Serrano. Early, large, dark-green glossy fruit. Semi-indeterminate bush. HR to TMV and PVY; IR to TEV.

Don Picoso. Dark-green serrano type with thick-wall fruit.

Flaming Flare. Widely adapted Fresno pepper with 4 in. long, thin-walled fruit with a sweet and mildly hot flavor. R to TMV.

Fresno 3429. Vigorous medium-to-tall plant. 75 days to maturity. A thick, firm wall makes fruit a good shipper. Deep red at maturity.

Habanero. Habanero type (100,000–350,000 SHU) that is ready for harvest 90–100 days from transplant, extremely pungent, and suitable for both fresh and processing markets. The wrinkled fruit tapers to a point and measures approximately 2 × 1 in. The thin flesh is light green to orange pink at full maturity.

Inferno. This Hungarian hot wax hybrid produces high yields of uniform fruit. The thick-walled pods mature from yellow to red and are pendant, large, smooth, tapered, and well-suited for fresh market and pickling.

Lone Ranger. Serrano pepper medium-heat variety with excellent plant cover, good heat setting (10,000–23,000 SHU), large size averaging between 4 and 4.5 in., and thick walls for great shelf life. R to Xcv 0–3, 7, 8.

Megalodon. Large, habanero-type pepper with compact growth habit. Fruit green to orange to red.

Pathfinder. Serrano pepper with excellent plant and foliar cover and an average fruit length of 4.5–5 in. Dark-green fruit with thick walls is suitable for the export market. R to Xcv 0–3, 7, 8.

Rio de Oro. Very large Santa Fe type with wide shoulders that matures from golden yellow to red.

Rio Tesoro. Hybrid yellow Caribe pepper fruit measuring 3.5 × 2 in.

Super Habanero. Bright-red fruit with good shelf life. Medium-to-high plant vigor with good canopy coverage.

Table 1. Planting dates for pepper.

Planting Region	Dates	
	Traditional	Bird's Eye
North Florida	July–Aug; Feb–Mar	Aug; Feb–Mar
Central Florida	Aug–Sept; Jan–Mar	Aug–Sept; Jan–Mar
South Florida	Aug–Feb	Aug–Feb

Table 2. Planting information for pepper.

Planting Parameters	Measurements	
	Traditional	Bird's Eye
Distance between rows (in)	36–48 60–72	36–48
Number of rows/bed	1–2	1
Distance between rows/bed	15–18	10–24
Distance between plants (in)	9–15	0.5–0.75
Seed per acre in transplant (lb)	0.25–0.5	0.25–0.5
Days to maturity from transplant	65–75	–
Plant population (acre)	14,520–19,400	17,500

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 3. Herbicides approved for managing weeds in peppers. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREPLANT/ PREEMERGENCE	Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Broadleaves and grasses. Incorporate mechanically 1–2 in. deep or with irrigation 2–4 in. deep.
	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds up to 4 in. tall or rosettes less than 3 in. across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
	Clomazone 0.25–1	(Command) 3ME 0.67 to 2.67 pt	15	Annual broadleaves and grasses. Do not use on banana peppers. Place the roots of transplanted peppers below the chemical barrier.
	Flumioxazin up to 0.128	(Chateau) EZ up to 4 oz	14	Annual broadleaves and grasses. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middles and with a 24 in. bed width. Do not apply after transplant. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
	Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Broadleaves and yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label, and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bare-ground production 7 days before transplanting or to a formed bed but prior to laying plastic. Use shields or hooded sprayers if applying to row middles and prevent contact with plastic mulch. PHI 60 days.
	Glufosinate up to 0.79	(Rely) 280 43 oz		Burndown of emerged broadleaves, grasses, and nutsedge. May be applied as a pre-plant burndown and pre-plant to plastic mulch covered beds. See label for planting intervals. PHI 30 days. Note: Rely 280 label is still valid if the applicator has product on hand. Registration has since moved to Liberty label through December 2026 for row middles weed management in pepper.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply as a preplant burndown. Allow 3 days between application and planting. Consult label for individual product directions.
	Halosulfuron 0.024–0.05	(Sandeia, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. No more than 2 oz/A per 12-month period. PHI 30 days.
	Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the row middles only with a shielded or hooded sprayer. Product must not contact green foliage or fruit to avoid excessive injury. Drift of lactofen-treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. PHI 30 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Napropamide 1.0-2.0	(Devrinol) 2-XT 2-4 qt (Devrinol DF XT) 50 DF 4-8 lb	15	Annual broadleaves. Apply to bed tops after forming beds but before plastic application. Rainfall or overhead irrigate to 1 in. within 24 hr of application. For row-middle treatments, do not apply between bloom and harvest, and no more than 2 lb a.i./A per crop cycle.
	Oxyfluorfen 0.25-0.5	(Goal 2 XL) 2 EC 1-2 pt (GoalTender) 4 E 0.5-1.0 pt	14	Broadleaves. Apply as a preemergence broadcast or banded to preformed beds. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
	Paraquat 0.5-1.0	(Gramoxone) 2 SL 2.0-4.0 pt (Firestorm) 3 SL 1.3-2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
	Pendimethalin 0.48-0.72	(Prowl H20) 3.8 1.0-1.5 pt	3	Annual broadleaves and grasses. May be applied to row middles or under the plastic. No more than 3.0 pt/A per year. PHI 70 days.
	Pyraflufen 0.001-0.003	(ET Herbicide) 0.208 EC 0.5-2.0 fl oz	14	Emerged broadleaves less than 4 in. tall or rosettes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
	S-metolachlor 0.64-0.95	(Dual Magnum) 7.62 EC 0.67-1.0 pt	15	Annual broadleaves, grasses, and suppression of yellow/purple nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic. No more than 1.68 pt/A of Dual Magnum per crop cycle. PHI 60 days.
	Sulfentrazone 0.09	(Willowood Sulfentrazone) 3 fl oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
	Trifluralin 0.5-0.75	(Treflan, Trifluralin) 4 EC 1.0-1.5 pt (Treflan) 10 G 5.0-7.5 lb	3	Annual broadleaves and grasses. Incorporate 4 in. or less within 8 hr of application. Results in Florida are erratic on sandy soils with low organic matter. Note label precautions against planting noncrops within 5 months. Do not apply after transplanting. PHI 60 days.
	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaves. Apply as hooded application to row middles only. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. PHI 0 days.
POSTEMERGENCE/ POSTTRANSPLANT	Clethodim 0.09-0.13 0.07-0.13	(Select Max) 1 EC 9-16 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. PHI 20 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Diquat 0.5	(Reglone Dessiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. No more than 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. PHI 30 days.
	Glufosinate up to 1.24	(Rely) 280 64 oz		Burndown of emerged broadleaves, grasses, and nutsedge present between rows of established peppers. Apply with a hooded applicator. PHI 30 days. Note: Rely 280 label still valid if the applicator has product on hand. Registration has since moved to Liberty label through December 2026 for row middles weed management in pepper.
	Halosulfuron 0.024-0.05	(Sande, Profine) 75 DF 0.5-1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. No more than 2 oz/A per 12-month period. Nonionic surfactant recommended. PHI 30 days.
	Imazosulfuron 0.19-0.30	(League) 75 DF 4.0-6.4 oz	2	Broadleaves and yellow/purple nutsedge suppression. Pepper must be well established and 10 in. tall. Direct sprays to base of stem and avoid contact with leaves or fruit. No more than 6.4 oz/A per crop season. Observe crop rotation restrictions. Nonionic surfactant recommended. PHI 21 days.
	Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1-6 in. tall in-the-row middles between mulched beds. Use low pressure and shields to control drift. No more than 3 times per season. Nonionic surfactant recommended. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Pendimethalin 0.48-0.72	(Prowl H20) 3.8 1.0-1.5 pt	3	Broadleaves and grasses. May be applied posttransplant to row middles if previously untreated. No more than 3.0 pt/A per year. PHI 70 days.
	Sethoxydim 0.19-0.28	(Poast) 1.5 EC 1.0-1.5 pt	1	Actively growing grasses. No more than 4.5 pt/A per season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. PHI 20 days.
	S-metolachlor 0.95	(Dual Magnum) 7.62 EC 1.0 pt	15	Annual broadleaves, grasses, and yellow/purple nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only with minimal contact to plants and plastic. No more than 1.68 pt/A Dual Magnum per crop. PHI 60 days.
	Diquat 0.5	(Reglone Dessiccant) 2.0 pt	22	No more than 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.
POSTHARVEST				

Table 4. Insecticides labeled for management of arthropod pests of peppers. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Jawwad Qureshi, UF/IFAS Southwest Florida Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids (including aphid-transmitted viruses, green peach aphid, potato aphid)	1A	*Lannate LV, *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 12 pt SP: 4 lb	48	3	No more than 8 applications per crop.
	1A	*Vydate L (oxamyl)	Foliar: 2–4 pt Drip chemigation and soil injection systems: 2–4 pt/A of plant bed	24 pt	48	7	No more than 8 applications per season.
	1B	Acephate 90 WDG (acephate)	0.55–1.11 lb	2.22 lb	24	7	–
	1B	*Dibrom 8EC (naled)	1 pt	5 pt	48	1	No more than 5 applications. Do not apply when temperatures are >90°F.
	1B	Dimethoate LV, EC, 2.67 (dimethoate)	LV, EC: 0.5–0.66 pt 2.67 : 0.75–1.0 pt	1.65 lb a.i.	48	0	Highly toxic to bees.
	1B	Malathion 5EC (malathion)	1.5–2.5 pt	–	12	3	No more than 2 applications per year.
	1B	Orthene 97 (acephate)	Bell peppers: 0.5–1.0 lb Non-bell peppers: 0.5 lb	2 lb a.i. per crop cycle or 1 lb a.i. for non-bell peppers	24	7	–
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	Suppression only.
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	Suppression only.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz of product	24	5	Toxic to bees.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz of product per year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart. Suppression only.
	4A	Actara (thiamethoxam)	2.0–3.0 oz	11 oz	12	0	Toxic to bees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Admire Pro (imidacloprid)	7–14.0 fl oz	14.0 fl oz	12	Soil: 21	Most effective if applied to soil at transplanting.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	0.44 fl oz/10,000 plants	12	Soil: 21	Planthouse: 1 Application to transplants: see label.
	4A	Assail 30SG (acetamiprid)	2.0–4.0 oz	16 oz	12	7	No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Assail 70WP (acetamiprid)	0.8–1.7 oz	6.8 oz	12	7	No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.8–6.2 oz	12	30	Soil application. See label for rotational restrictions.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Suppression only. Use only 1 application method (soil or foliar). Follow label restrictions to protect pollinators.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz Soil: 5–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Suppression only. Use only 1 application method (soil or foliar). No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	No more than 1 soil application per crop season. Several methods of soil application.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4-7 oz	14 oz	12	1	Not for greenhouses, transplants, or if seed was treated with thiamethoxam or other Group 4A insecticides. Do not use adjuvant on chili pepper or pimento. Highly toxic to bees.
	4C	Transform WG (sulfoxaflor)	0.75-1.0 oz	8.5 oz per year	12	1	No more than 2 applications per crop cycle.
	4D	Sivanto Prime (flupyradifurone)	7.0-12.0 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz per crop	12	0	No more than 2 applications.
	9B	PQZ (pyrfluquinazon)	2.4-3.2 fl oz	4.8 fl oz per crop cycle	12	1	No more than 2 applications per crop cycle.
	9D	Sefina Inscalis Insecticide (afidopyropen)	3.0 fl oz	28 fl oz of product	12	0	No more than 2 sequential applications per year.
	23	Movement (spirotetramat)	4.0-5.0 fl oz	10 fl oz	24	1	Reapplications at least 7 days apart.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per crop	12	1	Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant trays: 6.75-13.5 fl oz Drip chemigation or soil injection: 6.75-10 fl oz	See label	4	1	Suppression only.
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	10 fl oz	20 fl oz	12	7	-
	29	Beleaf 50 SG (flonicamid)	2.8-4.28 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Beetles (including beetle larvae, blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	Carbaryl 4L (carbaryl)	0.5–2 qt	8 qt per crop per year	12	3	DO NOT apply to weeds or crops in bloom.
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 0.5–2.0 qt	8 qt per crop	12	3	No more than 7 applications. Do not apply to crops or weeds in bloom.
	1B	*Dibrom 8EC (naled)	1 pt	5 pt	48	1	No more than 1 pt/A in Florida. Do not apply when temperatures are over 90°F.
	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	1.6 lb a.i.	12	3	Bell peppers only.
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	0.35 lb a.i.	12	7	Repeat applications at 7-to-10-day intervals to achieve control.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	27.39 oz of product	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	3	Labeled for bell peppers. Reapplications at least 5 days apart.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	Reapplications at least 5 days apart. Toxic to bees.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart.
	4A	Actara (thiamethoxam)	2.0–3.0 oz	11 oz	12	0	Toxic to bees.
	4A	Admire Pro (imidacloprid)	7–14.0 fl oz	14.0 fl oz	12	Soil: 21	Most effective if applied to soil at transplanting.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Assail 70WP (acetamiprid)	0.6–1.1 oz	–	12	7	No more than 4 applications per season. Reapplication within 7 days.
	4A	Belay 50 WDG (clothianidin)	1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Provado 1.6F (imidacloprid)	3.8–6.2 oz	19.2 fl oz per crop	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Reapplications at least 5 days apart.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Application restrictions exist because of risk to bees and other insect pollinators. Follow directions for use to protect pollinators. Use only 1 application method.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz Soil: 5–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz of product	12	30	No more than 1 soil application per crop season. Several methods of soil application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz of product	12	1	Not for greenhouses, transplants, or if seed was treated with thiamethoxam or other Group 4A insecticides. Do not use adjuvant on chili pepper or pimienta. Highly toxic to bees.
	4D	Sivanto 200 SL (flupyradifurone)	10.5–14.0 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	Reapplications at least 4 days apart. No more than 6 applications per year.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6	Abba Ultra (abamectin)	4.0–8.0 fl oz	24 fl oz foliarly applied per year	12	7	No more than 2 sequential applications of product with same active ingredient. Reapplications at least 7 days apart.
	28	Coragen (chlorantraniliprole)	Foliar: 3.5–7.5 fl oz	15.4 fl oz per crop	4	1	Can apply by drip chemigation, at planting to soil and foliar. No more than 4 applications per crop.
	28	Exirel (cyantraniliprole)	7.0–13.5 fl oz	0.4 lb a.i. per crop	12	1	Spray reapplication at least 5 days apart.
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant trays: 6.75–13.5 fl oz Drip chemigation or soil injection: 6.75–10 fl oz	0.4 lb a.i. per crop	4	1	–
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	5.5–10 fl oz	20 fl oz per calendar year	12	7	–
	U	Azatin XL (azadirachtin)	5–16 fl oz	–	4	0	Antifeedant, repellent, insect growth regulator (IGR).
	U	Surround (kaolin)	12.50–50 lb	–	4	0	12.5 lb/25 gal preferred up to fruit set. Apply only up to 1/4 of desired fruit size unless washing capabilities are sufficient.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (including cabbage looper, corn earworm, garden webworm loopers, hornworms, salt marsh caterpillars, tobacco budworm, tomato fruitworm, tomato pinworm, beet armyworm, fall armyworm, southern armyworm)	1A	Carbaryl 4L (carbaryl)	1-2 qt	8 qt per crop per year	12	3	Do not apply to target crop or weeds in bloom. No more than 7 applications per year.
	1A	*Lannate LV, *SP (methomyl)	LV: 0.75-3.0 pt SP: 0.25-1.0 lb	LV: 12 pt SP: 4 lb	48	3	No more than 8 applications per crop.
	1A	Sevin XLR: 4F (carbaryl)	XLR, 4F: 1-2 qt	8 qt	12	3	No more than 7 applications. Do not apply to crops or weeds in bloom.
	1B	Acephate 90 WDG (acephate)	0.55-1.11 lb	2.22 lb per crop cycle	24	7	Bell-type peppers only.
	1B	Lorsban 75WG (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb	24	7	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. No more than 8 applications.
	1B	Orthene 97 (acephate)	Bell peppers: 0.50-1.00 lb	2 lb a.i.	24	7	-
	3A	*Ambush 25W (permethrin)	6.4-12.8 oz	1.6 lb a.i.	12	3	Bell peppers only.
	3A	*Asana XL (esfenvalerate)	5.8-9.6 fl oz	0.35 lb a.i.	12	7	-
	3A	*Baythroid XL (beta-cyfluthrin)	1.6-2.8 fl oz	16.8 fl oz	12	7	Beet armyworm 1st and 2nd instars only. No more than 2.8 fl oz/A within 7 days.
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	42.67 oz	24	3	Do not mix with copper. No more than 4 applications.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0-10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96-1.92 fl oz	23.04 fl oz or 0.36 lb a.i.	24	5	-
	3A	*Pounce 25 W (permethrin)	6.4-12.8 oz	0.8 lb a.i.	12	3	Labeled for bell peppers. Reapplications at least 5 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	0.36 lb a.i.	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz of product	24	5	Toxic to bees.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	Cabbage looper, cutworms and hornworms: 5.0–8.0 fl oz All others: 6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Make only 1 soil application per crop season. Several methods of soil application.
	4A + 28	VoliAm Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz or 0.172 lb a.i. of thiamethoxam or 0.2 lb a.i. of chlorantraniliprole products	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	Reapplications at least 4 days apart. No more than 6 applications per year.
	6	Abba Ultra (abamectin)	8.0 fl oz	24 fl oz per year	12	7	Tomato pinworm. No more than 2 sequential applications of product or same active ingredient. Reapplications at least 7 days apart.
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	28.8 oz	12	7	–
	15	*Dimilin 25W, *2L (diflubenzuron)	4–8 oz	24 oz	12	7	No more than 5 applications per season. IGR effects not seen for 5–7 days.
	15	Rimon 0.83EC (novaluron)	9–12 fl oz	36 fl oz	12	1	Do not use with an adjuvant.
	18	Confirm 2F (tebufenozide)	6–16 fl oz	1.0 lb a.i.	4	7	–
	18	Intrepid 2F (methoxyfenozide)	4–16 fl oz	64 fl oz	4	1	–
	22A	Avaunt eVo (indoxacarb)	2.5–6.0 fl oz	24 fl oz	12	3	No more than 4 applications per season.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz per crop	4	1	Can be applied as drip, soil, or foliar application. See label.
	28	Exirel (cyantraniliprole)	7–17 fl oz	0.4 lb a.i. per crop	12	1	Spray reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant tray treatment: 5–13.5 fl oz Drip, soil injection or chemigation: 5–10 fl oz	0.4 lb a.i. per crop	4	1	–
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	Tomato pinworms: 10 fl oz Loopers: 7.5–10 fl oz All others: 5.5–10 fl oz	20 fl oz per calendar year	12	7	–
	U	Azatin XL (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellent, IGR.
	7A	Extinguish (S-methoprene)	1.0–1.5 lb	–	4	0	–
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	–	12	1	Apply when ants are actively foraging.
	1B	Acephate 90 WDG (acephate)	0.28–1.11 lb	2.22 lb per crop cycle	24	7	Bell-type peppers only.
	1B	Orthene 97 (acephate)	Bell peppers: 0.25–0.5 lb	2 lb a.i.	24	7	Bell-type peppers only.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	27.39 oz of product	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
Grasshoppers	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	–
	3A	Pyganic EC 5.0 (pyrethrins)	4.5–15.6 fl oz	See individual label	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. No more than 10 applications. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz of product	24	5	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz of product	12	7	Do not reapply this product
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz Soil: 5.0–7.5 oz	Foliar: 6 oz Soil: 12 oz (soil)	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). No more than 3 applications per season. Toxic to bees.
	U	Surround (kaolin)	12.50–50 lb	–	4	0	12.5 lb is the preferred rate up to fruit set.
Lace bugs	1A	Carbaryl 4L (carbaryl)	1–2 qt	8 qt per crop per year	12	3	Do not apply to crops in bloom. No more than 7 applications per year.
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 1.0–2.0 qt	8 qt per crop	12	3	No more than 7 times. Do not apply to crops or weeds in bloom.
Leafhoppers	1A	Carbaryl 4L (carbaryl)	0.5–1 qt	8 qt per year	12	3	Do not apply to crops or weeds in bloom. Toxic to bees.
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 0.5–1.0 qt	8 qt per crop	12	3	No more than 7 applications. Do not apply to crops or weeds in bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	7	–
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	27.39 oz	12	7	Follow label.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz of product or 0.036 lb of avermectin or 0.078 lb per cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	Admire Pro (imidacloprid)	7-14.0 fl oz	14.0 fl oz	12	Soil: 21	Most effective if applied to soil at transplanting.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6-2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8-6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5-11 fl oz	11 fl oz of Platinum or 0.172 lb a.i.	12	30	Soil application. See label for rotational restrictions.
	4A	Provado 1.6F (imidacloprid)	3.8-6.2 oz	19.2 fl oz per crop	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Reapplications at least 5 days apart.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2-7 fl oz Soil: 9-10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators. Use 1 application method.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10-13 fl oz	13.0 fl oz	12	30	Make only 1 soil application per crop season.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4-7 oz	14 oz per growing season	12	1	Reapplications at least 5 days apart. Highly toxic to bees.
	4D	Sivanto 200 SL (flupyradifurone)	7.0-10.5 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	16	Courier SC (buprofezin)	9.0-13.6 fl oz	27.2 fl oz per crop cycle	12	1	No more than 2 applications per season. Reapplication at least 5 apart.
	U	Surround (kaolin)	12.5-50 lb	-	4	0	12.5 is the preferred rate up to fruit set.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
<i>Liriomyza</i> leafminers (includes leafminer larvae)	1A	*Vydate L (oxamyl)	Foliar: 2-4 pt	24 pt	48	7	May also be applied by drip chemigation or soil injection systems. See label for rate.
	1B	*Dibrom 8EC (naled)	1 pt	6 pt	48	1	No more than 1 pt/A in Florida. Do not apply when temperatures are over 90°F.
	1B	Dimethoate LV, EC, 2.67 (dimethoate)	LV, EC: 0.5-0.66 pt 2.67: 0.75-1.0 pt	1.65 lb a.i. per year	48	0	Highly toxic to bees.
	3A	*Ambush 25W (permethrin)	6.4-12.8 oz	1.6 lb a.i.	12	3	Bell peppers only.
	3A	*Baythroid XL (beta-cyfluthrin)	2.8 fl oz	16.8 fl oz	12	7	Suppression only.
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0-10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28-1.92 fl oz	23.04 fl oz	24	5	Suppression only.
	3A	*Pounce 25 W (permethrin)	6.4-12.8 oz	0.8 lb a.i.	12	3	Labeled for bell peppers. Reapplications at least 5 days apart.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19.0 fl oz	24	5	Suppression only. For control: tank-mix with 2-2.5 oz/A of Actara.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per 12-month cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6-2.1 oz	6.4 oz	12	7	Suppression only. Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8-6.4 oz	6.4 oz	12	Apply at planting	Suppression only. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–13 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz of product or 0.172 lb a.i. of thiamethoxam or 0.2 lb a.i. of chlorantraniliprole products	12	1	Suppression only. Do not use in greenhouses or on transplants. Highly toxic to bees.
	5	Radiant SC (spinetoram)	6–10 fl oz	34 fl oz per year	4	1	Reapplications at least 4 days apart. No more than 6 applications per year.
	6	Abba Ultra (abamectin)	4.0–8.0 fl oz	24 fl oz foliarly applied per year	12	7	No more than 2 sequential applications of product or same active ingredients. Reapplications at least 7 days apart.
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications per year. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Do not use with an adjuvant.
	17	Trigard (cyromazine)	2.66 oz (1 packet)	15.96 oz	12	0	No more than 6 applications per crop.
	28	Coragen (chlorantraniliprole)	5.0–7.5 fl oz	15.4 fl oz per crop	4	1	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. No more than 4 applications per crop.
	28	Exirel (cyantraniliprole)	13–20.5 fl oz	0.4 lb a.i. per crop	12	1	Spray reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant tray treatment: 6.75–13.5 fl oz Drip, soil injection or chemigation: 6.75–10 fl oz	0.4 lb a.i. per crop	4	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	5.5–10 fl oz	20 fl oz per calendar year	12	7	–
	U	Requiem 25EC (extract of <i>Chenopodium ambrosioides</i>)	3–4 qt	–	4	0	Begin before pests reach damaging levels.
Mealybugs	1B	*Dibrom 8EC (naled)	1 pt	6 pt	48	1	No more than 1 pt/A in Florida. Do not apply when temperatures are over 90°F.
Mites (including broad mites, carmine spider mite, tomato russet mite, two spotted spider mite)	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	0.8 lb a.i.	24	3	Do not apply with copper. No more than 4 applications per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	Suppression only (spider mite species).
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	Suppression only (spider mite species).
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19.0 fl oz	24	5	Suppression only. For control: tank-mix with 2–2.5 oz/A of Actara.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per 12-month cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	6	Abba Ultra (abamectin)	4.0–8.0 fl oz	24 fl oz product foliarly applied per year	12	7	No more than 2 sequential applications of product.
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications per year. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Plant bugs (includes tarnished plant bug)	10B	Zeal WDG Miticide (etoxazole)	2.0–3.0 oz	3.0 fl oz	12	7	Do not use with an adjuvant or surfactant. No more than 1 application.
	20B	Kanemite 15 SC (acequinoyl)	31.0 fl oz	62 fl oz	12	1	Reapplications at least 21 days apart. No more than 2 applications per year. Do not use an adjuvant.
	20D	Acramite-50WS (bifenazate)	0.75–1.0 lb	1.0 lb	12	3	No more than 1 application.
	21A	Magister (fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt per crop cycle	12	1	No more than 2 applications per season. Reapplications at least 14 days apart.
	23	Oberon 25C (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	12	1	No more than 3 applications.
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	5.5–10 fl oz	20 fl oz per calendar year	12	7	–
	U	MET52 EC (<i>Metarhizium anisopliae</i> strain F52)	Drench: 40–80 fl oz/ 100 gal Foliar: 0.5 pt–2 qt	–	4	0	–
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 1–2 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications. Do not apply to crops or weeds in bloom.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.
	4C	Transform WG (sulfoxaflor)	1.15–2.25 oz	8.5 oz per year	12	1	No more than 2 applications per crop cycle.
	29	Beleaf 50 SG (flonicamid)	2.0–4.28 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels.
	U	M-Pede 49% EC (soap, insecticidal)	1%–2% v/v	–	12	0	OMRL-listed. ³
	U	Suffoil-X (petroleum oil)	1–2 gal/100 gal of water	–	4	0	OMRL-listed. ³
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only 1 application method.
Planthoppers	16	Courier SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz per crop cycle	12	1	Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Reapplications at least 5 days apart.
	4D	Sivanto 200 SL (flupyradifurone)	10.5–14.0 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	6	Abba Ultra (abamectin)	4.0–8.0 fl oz	24 fl oz foliarly applied per year	12	7	No more than 2 sequential applications of product or same active ingredient. Reapplications at least 7 days apart.
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	1	Reapplications at least 7 days apart.
Stinkbugs (including brown stinkbug, green stinkbug, southern green stinkbug)	1A	Carbaryl 4L (carbaryl)	1–2 qt	8 qt per crop per year	12	3	Suppression only.
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	Suppression. No more than 7 applications. Do not apply to crops or weeds in bloom.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	7	–
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67 fl oz	0.8 lb a.i.	24	3	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	–
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	Actara (thiamethoxam)	3.0–5.5 oz	11 oz per growing season	12	0	Toxic to bees.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators. Use only 1 application method.
	4A	Venom (dinotefuran)	Foliar (only): 1–4 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Use only 1 application method. No more than 3 applications per season.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.4 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	Highly toxic to bees.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Do not use with an adjuvant.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips Check label for species controlled (includes eastern flower thrips, foliar feeding thrips, chilli thrips, melon thrips, western flower thrips)	1A	Carbaryl 4L (carbaryl)	1-2 qt	8 qt per crop per year	12	3	Suppression.
	1A	Sevin XLR; 4F (carbaryl)	XLR, 4F: 1.0-2.0 qt	10 lb or 8 qt	12	3	Suppression. No more than 7 applications. Do not apply to crops or weeds in bloom.
	1A	*Vydate L (oxamyl)	Foliar: 2-4 pt	24 pt	48	7	Does not control western flower thrips.
	1B	Lorsban 75WG (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb	24	7	No more than 8 applications.
	3A	*Baythroid XL (beta-cyfluthrin)	2.1-2.8 fl oz	16.8 fl oz	12	7	Not effective on <i>Thrips palmi</i> .
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Warrior II (lambda-cyhalothrin)	1.28-1.92 fl oz	0.36 lb a.i.	24	5	Will not control Western Flower Thrips.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19.0 fl oz	24	5	Will not control Western Flower Thrips.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per 12-month cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	Admire Pro (imidacloprid)	7-14.0 fl oz	14.0 fl oz	12	Soil: 21	Most effective if applied to soil at transplanting.
	4A	Assail 30SG (acetamiprid)	4.0 oz	16 oz	12	7	No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Assail 70WP (acetamiprid)	1.7 oz	6.8 oz	12	7	-
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8-6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz Soil: 5.0–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Use only 1 application method. No more than 3 applications per season.
	4C	Transform WG (sulfoxaflor)	2.75 oz	8.5 oz per year	12	1	No more than 2 applications per crop cycle.
	4D	Sivanto Prime (flupyradifurone)	12–14.0 fl oz	28.0 fl oz per year	4	1	Suppression—Chilli thrips. Reapplications at least 7 days apart.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	No more than 1 soil application per crop season. Several methods of soil application—see label.
	5	Entrust SC (spinosad)	4–8 fl oz	29 fl oz	4	1	No more than 6 applications per year. Do not apply to seedlings grown for transplant. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6–10 fl oz	34 fl oz	4	1	Reapplications at least 4 days apart. No more than 6 applications per year.
	6	Abba Ultra (abamectin)	4.0–8.0 fl oz	24 fl oz applied per year	12	7	<i>Thrips palmi</i> . No more than 2 sequential applications.
	6	*Agri-Mek SC (abamectin)	1.7–3.5 fl oz	10.25 fl oz	12	7	<i>Thrips palmi</i> . No more than 2 sequential applications per year. No more than 10.25 fl oz/A of any other foliar-applied abamectin-containing product in a growing season.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Do not use with an adjuvant. No more than 2 applications targeting thrips.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per crop	12	1	Spray reapplications at least 5 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant tray treatment: 10–13.5 fl oz Drip, soil injection or chemigation: 10 fl oz	0.4 lb a.i. per crop	4	1	–
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	5.5–10 fl oz Foliage-feeding species: 10 fl oz	20 fl oz per calendar year	12	7	Suppression: Foliage feeders.
	29	Beleaf 50 SG (flonicamid)	Greenhouse: 4.2 oz	8.4 oz	12	0	Apply before pests reach damaging levels. Rotate MOA after 2 consecutive Beleaf applications. Reapplications at least 7 days apart. No more than 2 applications per season.
Weevils (including pepper weevil, vegetable weevil)	1A	*Vydate L (oxamyl)	Foliar: 2–4 pt	24 pt	48	7	–
	1B	Lorsban 75WG (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop	24	7	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. No more than 8 applications. Reapplication at least 10 days apart.
	3A	*Ambush 25W (permethrin)	6.4–12.8 oz	1.6 lb a.i.	12	3	Bell peppers only.
	3A	*Asana XL (0.66EC) (esfenvalerate)	5.8–9.6 fl oz	0.35 lb a.i.	12	7	Aids in control. No more than 7 applications at highest rate per season.
	3A	*Baythroid XL (beta-cyfluthrin)	2.8 fl oz	16.8 fl oz	12	7	Suppression.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz	24	5	Suppression.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Mustang (zeta-cypermethrin)	2.4–4.3 fl oz	245.8 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Pounce 25 W (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	3	Labeled for bell peppers. Reapplications at least 5 days apart.
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	0.36 lb a.i.	24	5	Suppression.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19.0 fl oz	24	5	Suppression only. For control, tank-mix with 2–2.5 oz/A of Actara.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per 12-month cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart.
	4A	Assail 30SG (acetamiprid)	2.5–4.0 oz	16 oz of Assail 30SG per growing season, including any pretransplant application of acetamiprid	12	7	Begin applications for whitefly when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Assail 70WP (acetamiprid)	1.1–1.7 oz	6.8 oz	12	7	–
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Provado 1.6F (imidacloprid)	6.2 oz	19.2 fl oz	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Reapplications at least 5 days apart.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only 1 application method.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Whiteflies (adults, immatures)	15	*Dimilin 25W, *2L (diflubenzuron)	4-8 oz	24 oz	12	7	No more than 5 applications per season. IGR effects not seen for 5-7 days. Will not control adults; however, eggs laid by adults will exhibit reduced hatching in fruits once adults have consumed or contacted residues on plant tissue.
	15	Rimon 0.83EC (novaluron)	9-12 fl oz	36 fl oz	12	1	Do not use with an adjuvant. Apply at initial flowering stage.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i.	12	1	Suppression only. Use as part of an effective control program. Rotate in other modes of action. Start applications when populations are low.
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	10 fl oz	20 fl oz per calendar year	12	7	Suppression.
	3A	*Brigade 2EC (bifenthrin)	2.1-6.4 fl oz	0.2 lb a.i.	12	7	Reapplications at least 7 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	27.39 oz	12	7	Refer to label's maximum usage table when applying another product containing one of the same active ingredients.
	3A	*Karate with Zeon (lambda-cyhalothrin)	1.28-1.92 fl oz	23.04 fl oz	24	5	Suppression.
	3A	*Warrior II (lambda-cyhalothrin)	1.28-1.92 fl oz	0.36 lb a.i.	24	5	Suppression.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19.0 fl oz	24	5	Suppression only. For control, tank-mix with 2-2.5 oz/A of Actara.
	3A + 6	*Gladiator (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz per 12-month cropping year	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6.0-9.0 fl oz	31.0 fl oz per year	24	5	Reapplications at least 5 days apart. Suppression only.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Actara (thiamethoxam)	3.0–5.5 oz	11 oz	12	0	Toxic to bees.
	4A	Admire Pro (imidacloprid)	7–14.0 fl oz	14.0 fl oz	12	Soil: 21	Most effective if applied to soil at transplanting.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	–	12	Soil: 21	Planthouse: 1 application to transplants. See label.
	4A	Assail 30SG (acetamiprid)	2.5–4.0 oz	16 oz of Assail 30SG per growing season, including any pretransplant applications of acetamiprid.	12	7	Begin applications for whitefly when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Assail 70WP (acetamiprid)	1.1–1.7 oz	6.8 oz of Assail 70WP per growing season, including any pretransplant applications of acetamiprid	12	7	–
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–3.2	6.4 oz	12	7	Suppression. Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	11 fl oz	12	30	Soil application. See label for rotational restrictions.
	4A	Provado 1.6F (imidacloprid)	3.8–6.2 oz	19.2 fl oz	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Reapplication at least 5 days apart.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–7 fl oz Soil: 9–10.5 fl oz	Foliar: 10.5 fl oz Soil: 21 fl oz (soil)	12	Foliar: 1 Soil: 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only 1 application method.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Venom (dinotefuran)	Foliar: 1–4 oz Soil: 5.0–7.5 oz	Foliar: 6 oz Soil: 12 oz	12	Foliar: 1 Soil: 21	Use only 1 application method (soil or foliar). No more than 3 applications per season.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	No more than 1 soil application per crop season. Several methods of soil application—see label.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	Transform WG (sulfoxaflor)	2.0–2.25 oz	8.5 oz per year	12	1	No more than 2 applications per crop cycle.
	4D	Sivanto Prime (flupyradifurone)	10.5–14.0 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	7C	Knack IGR Section 2(ee) #59639-95 FL (pyriproxyfen)	5 fl oz	20 fl oz	12	1	Immatures only. Apply when nymphs first appear. Alternate or mix application with active ingredient of different mode of action.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz	12	0	Suppression. No more than 2 applications.
	9D	Sefina Inscalis Insecticide (afidopyropen)	14.0 fl oz	28 fl oz	12	0	No more than 2 sequential applications per year before using a different mode of action.
	15	Rimon 0.83EC (novaluron)	12 fl oz	36 fl oz	12	1	Do not use with an adjuvant. No more than 2 applications targeting whitefly.
	16	Courier SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz per crop cycle	12	1	Immatures only. Slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Reapplications at least 5 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt per crop cycle	12	1	Suppression. No more than 2 applications per season. Reapplications at least 14 days apart.
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	1	Reapplications at least 7 days apart.
	23	Oberon 25C (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	12	1	No more than 3 applications.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Spray reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Soil at-planting or transplant tray treatment: 6.75–13.5 fl oz Drip, soil injection or chemigation: 6.75–10 fl oz	0.4 lb a.i.	4	1	–
	28 + 6	*Minecto Pro (cyantraniliprole + abamectin)	10 fl oz	20 fl oz per calendar year	12	7	–
	28 + 16	Vetica (flubendiamide + buprofezin)	12.0–17.0 fl oz	38 fl oz	12	1	No more than 3 times per season. Use 14–17 fl oz to control whiteflies.
	29	Beleaf 50 SG (flonicamid)	2.8–4.2 oz	8.4 oz	12	0	Reapplications at least 7 days apart. No more than 2 applications per season.

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet.

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*Restricted use insecticide.

Table 5. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Anthracnose	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	-
	M3	(mancozeb) Many brands available: Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	See individual label	See individual label	7	1	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	3	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year. Suppression.
	9 + 3	Inspire Super Vango ESQ Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: AFrame, Arius, Azoxystar, Azoxystrobin 100ST, Azoxystrobin Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraaban, Trevo, Willowood Azoxy 2SC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides/season.
	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	No more than 4 applications per season. Alternate with a fungicide from a different FRAC group. Suppression.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 4 applications per season. No more than 2 sequential applications. Use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	No more than 5 applications in a 10-to-14-day interval. Alternate with a fungicide from a different FRAC group. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	-
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	For best possible chemical control of bacterial spot, tank-mix copper with a mancozeb fungicide.
Bacterial spot	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	See individual label	See individual label	7	1	Bacterial spot control only when tank-mixed with a copper fungicide. Use of 1 lb/A of mancozeb per application is sufficient.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Combine with a fixed-copper fungicide. Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group. Tank-mix with copper fungicides for suppression of Phytophthora blight, bacterial spot, and bacterial soft rot.
	13	Quintec (quinoxifen)	6 fl oz	24 fl oz	3	0.5	Supplemental Section 2(ee) label: Must be alternated with another product effective against bacterial spot. If multiple applications are made, at least 1 application must be a tank mix with another product effective against bacterial spot. Suppression.
	21	*Actigard (acibenzolar-S-methyl)	0.75 oz	6 oz	14	0.5	Labelled for chili pepper only. Begin applications within 1 week of transplanting or emergence. No more than 8 weekly sequential applications.
	25	Agri-mycin 17 Agri-mycin 50 FireWall 17 FireWall 50 (streptomycin sulfate)	200 ppm	-	-	0.5	See label for details. For transplant production only. Many isolates are resistant to streptomycin.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Bacterial soft rot (suppression)	11 + 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group. Suppression.
Bacterial wilt (<i>Ralstonia solanacearum</i>)	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
Botrytis or Gray mold	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	3	1	-
	7	Endura (boscalid)	3.5 oz	21 oz	0	0.5	No more than 6 applications per season. No more than 2 sequential applications before alternating with another effective fungicide from another FRAC group. Suppression.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	Luna Flex	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production. Suppression.
	9	Vango (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications. No more than 4 applications per year. Can be applied via chemigation.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before rotating with another effective fungicide from another FRAC group.
	9 + 12	Alterity 62.5WG Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications of Switch, alternate with another effective fungicide from a different FRAC group.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides per season. Suppression.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.
	12	Spirato GHN Spirato 480SC (fludioxonil)	7 fl oz	28 fl oz	0	0.5	For use in greenhouse and other enclosed structures only. No more than 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	17	Decree 50 WDG (fenhexamid)	1.5 lb	6 lb	0	0.5	Transplant and greenhouse use only. No more than 2 consecutive applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	No more than 5 applications on 10-to-14-day interval. Alternate with a fungicide from a different FRAC group.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	-
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Frogeye leaf spot, Cercospora leaf spot (<i>Cercospora</i> spp.)	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	For best possible chemical control of bacterial spot, a copper fungicide should be tank-mixed with a mancozeb fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	-
	M3	(mancozeb) Many brands available: Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	See individual label	See individual label	7	1	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	3	1	-
	3	Indar 2F (fenbuconazole)	12 fl oz	48 fl oz	7	0.5	No more than 2 consecutive applications before alternating with a fungicide from another FRAC group. A 35-to-210-day plant-back interval exists for nonlabeled crops.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 4 applications per season. No more than 2 sequential applications. Use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	-
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Gray leaf spot (<i>Stemphylium</i> spp.)	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.
	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	No more than 4 applications per season. Alternate with a fungicide from a different FRAC group.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 4 applications per season. No more than 2 sequential applications. Use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew	M2	(sulfur) Many brands available: Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Thiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Follow label closely; sulfur may cause phytotoxicity.
		(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	3	1	-
	3	Cevya Provsol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	No more than 3 applications per year.
	3	Indar 2F (fenbuconazole)	12 fl oz	48 fl oz	7	0.5	No more than 2 sequential applications before alternating with a fungicide from a different FRAC group. A 35-to-210-day plant-back interval exists for nonlabeled crops.
	3	Rally Sonoma 40WSP (myclobutanil)	5 oz	20 oz	0	1	No more than 4 applications per season on a 10-to-14-day treatment interval. Should be alternated or tank-mixed with a fungicide from a different FRAC group.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7	Tesaris (fluxapyroxad)	4.6 fl oz	13.8 fl oz	0	0.5	No more than 3 applications per year. No more than 2 sequential applications. before rotating to a non FRAC-7 fungicide. See label regarding tank- mixture restrictions.
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only. No more than 2 applications per year. The first foliar fungicide application following Velum should be from a different FRAC group.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1-0.25 in./A of water. Not for use in transplant or greenhouse production.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9	Vango (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications. No more than 4 applications per year. Can be applied via chemigation.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before rotating to another effective fungicide from another FRAC group.
	9 + 12	Alterity 62.5WG Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications of Switch, alternate with another effective fungicide from a different FRAC group.
	11	(azoxystrobin) Many brands available: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxystrobin, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	No more than 4 applications per season. Alternate with a fungicide from a different FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide. Suppression.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	No more than 4 applications per season. No more than 2 sequential applications. Use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Veltyma (pyraclostrobin + mefen trifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	12	Spirato GHN Spirato 480SC (fludioxonil)	7 fl oz	28 fl oz	0	0.5	For use in greenhouse and other enclosed structures only. No more than 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	13	Quintec (quinoxifen)	6 fl oz	24 fl oz	3	0.5	Will not control latent or established infections. Must alternate or tank-mix with an effective fungicide from a different FRAC group.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	No more than 5 applications on 10-to-14-day intervals. Alternate with a fungicide from a different FRAC group.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	-
	39	Torac (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	Primarily an insecticide. No more than 2 applications per season. No more than 4 applications per year. Reapplications at least 14 days apart. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	50	Prolio (pyriofenone)	5 fl oz	16 fl	0	4 hr	No more than 2 sequential applications. No more than 4 applications per year.
	50	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. Do not mix with horticultural oils.
	U6	Torino (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	No more than 3 applications per season. Reapplications at least 14 days apart.
	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
Phytophthora blight, Phytophthora root rot, Phytophthora crown rot (<i>Phytophthora</i> spp.)	M1 + M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	See individual label	See individual label	7	1	-
	4	Metastar 2E ReCon 4F ReCon Bold SL Xyler FC (metalaxyl)	Metastar: 8 qt ReCon 4F: 4 qt ReCon SL: 1 pt Xyler: 4 qt	Metastar: 12 qt ReCon 4F: 6 qt ReCon SL: 3 pt Xyler: 4.3 qt	2	7	Must be soil applied.
	4	Ridomil Gold SL Ultra Flourish (mefenoxam)	Ridomil: 1 pt Ultra: 2 pt	Ridomil: 3 pt Ultra: 6 pt	7	2*	No more than 1.5 lb/A of mefenoxam per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 + M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	-
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Ground application only. Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details. Suppression.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group. Suppression.
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	No more than 6 applications per crop. Must be rotated with an effective fungicide from a different FRAC group. See label for application instructions, including the recommended use of specific surfactants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	21	Segway O Ranman (cyazofamid)	3.2 fl oz/100 gal	13.5 fl oz/plant	0	-	Greenhouse production only; apply at transplant or up to first fruit set, followed by second application 42 days later. Soil drench only. Do not use any surfactant.
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz	2	0.5	No more than 2 applications per year. Reapplications at least 14 days apart. Do not apply sequentially. Alternate with an effective fungicide from a different FRAC group. See label of additional instructions for foliar and soil applications.
	28	Previcur Flex Promess (propamocarb hydrochloride)	See individual label	See individual label	5	0.5	Greenhouse application: No more than 6 applications per crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Field application: Apply prior to infection when conditions are favorable for disease.
	29	Omega 500F Orbus 4F Oxelid Lektivar Vantana (fluazinam)	24 fl oz	144 fl oz	30	0.5	Apply as soil drench at transplant. Start foliar applications 7 days after transplant and reapply on 7- to 14- day interval. No more than 9 applications per year.
	33	Aliette 80 WDG (fosetyl-al)	5 lb	20 lb	14	0.5	See label for warnings concerning the use of copper compounds.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Drexel Phiticide, Phostrol, Confine Extra, Fungi-Phite, Rampart 6.8, Reliant, Sparra, Fosphite, K-Phite	See individual label	See individual label	-	4 hr	See specific label for mixing instructions and precautions.
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Apply with another fungicide from a different FRAC group.
	40	Micora (mandipropamid)	8 fl oz/5,000 sq ft	16 fl oz/5,000 sq ft	N/A	4 hr	Micora is only labeled for transplant and retail sale to consumers. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. Alternate with another effective fungicide. See label.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	No more than 4 applications per season. No more than 2 sequential applications. Spray reapplications at least 10 days apart. Tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops.
	45 + 40	Zapro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. No more than 3 applications per season.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	0	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Pythium damping-off, Pythium root rot, or Pythium seedling blights (<i>Pythium</i> spp.)	4	Allegiance-FL Acquire (metalaxyl)	0.75 fl oz/100 lb seed	-	-	-	Seed treatment only.
	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb seed	-	-	-	Seed treatment only.
	4	Metastar 2E ReCon 4F ReCon Bold SL Xyler FC (metalaxyl)	Metastar: 8 qt ReCon 4F: 4 qt ReCon SL: 1 pt Xyler: 4 qt	Metastar: 12 qt ReCon 4F: 6 qt ReCon SL: 3 pt Xyler: 4.3 qt	2	7	Must be soil applied. See labels.
	4	Ridomil Gold SL Ultra Flourish (mefenoxam)	Ridomil: 1 pt Ultra: 2 pt	Ridomil: 3 pt Ultra: 6 pt	7	2*	No more than 1.5 lb/A of mefenoxam per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 + M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional applications. Use 1 pt/A and apply at a 30-day interval.
	12	Maxim 4 FS (fludioxonil)	0.16 fl oz/100 lb seed	-	-	-	Seed treatment only. Suppression.
	21	Ranman Segway O (cyazofamid)	3.2 fl oz/100 gal	13.5 fl oz/plant	0	-	Greenhouse production only; apply at transplant or up to first fruit set, followed by second application 42 days later. Soil drench only. Do not use any surfactant.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Apply prior to infection when conditions are favorable for disease. See label for greenhouse applications.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Drexel Phiticide, Phostrol, Confine Extra, Fungji-Phite, Rampart 6.8, Reliant, Sparra, Fosphite, K-Phite	See individual label	See individual label	-	4 hr	See specific label for mixing instructions and precautions.
	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
	U17	Vyantis (picarbutrazox)	0.384 fl oz/100 lb seed	-	-	-	Seed treatment only.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
<i>Rhizoctonia solani</i>	11	(azoxystrobin) Many brands available: AFrame, Arius, Azoxystar, Azoxystrobin 100ST, Azoxystrobin 100ST, Azoxystrobin 100ST, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxystrobin 2SC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides per season.
	11 + 3	Veltya (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Southern blight (<i>Sclerotium rolfsii</i>)	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7+ 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use. Suppression.
	11	Aftershock Evito Tepera (fluoxastrobin)	Aftershock, Evito: 5.7 fl oz Tepera: 12.6 fl oz	Aftershock, Evito: 22.8 fl oz Tepera: 12.6 fl oz	3	0.5	No more than 4 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides per season.
	11 + IRAC 3	Tepera Plus (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	7	0.5	Contains bifenthrin insecticide. No more than is 4 applications per year. Reapplications at least 7 days apart. No use in greenhouse.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
White mold (<i>Sclerotinia sclerotiorum</i>) (suppression)	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per a year.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides per season.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. White mold suppression only.
¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number. Source: FRAC Code List; https://www.frac.info/ (FRAC = Fungicide Resistance Action Committee). ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.							

Table 6. Nonfumigant nematicides for peppers in Florida.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½–1 gal/A at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. No more than 3 gal/A per season. Reapplications at least 7 days apart unless a longer interval is stated. No more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Reapplications at least 5 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A of fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Salibro (a.i. fluazaindolizine)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as pre-plant incorporated, via preplant drip, or via at-plant drip. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year. No more than 4 applications per calendar year. Re-entry interval is 12 hr. Reapplications at least 14 days apart. Pre-harvest interval is 1 day.
Biological nematicides	See chapter 19.
Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 7. Fumigant nematicides for peppers in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine ^{2,3}	13–20.5	–	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60 ^{2,3}	19.5–31.5	57–90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC ^{2,3}	19.5–31.5	–	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 14. Potato Production¹

Lincoln Zotarelli, De-Fen Mou, Peter J. Dittmar, Pamela D. Roberts, Johan Desaegeer, Prissy Fletcher, and Bonnie Wells²

Botany and Planting

Potato—*Solanum tuberosum*, Solanaceae

Table 1. Planting dates for potato.

Planting Region	Dates
North Florida	Jan–Feb
Central Florida	Nov–Feb
South Florida	Oct–Jan

Table 2. Planting information for potato.

Planting Parameters	Measurements
Distance between rows (inch)	36–42
Distance between plants (inch)	7–10
Planting depth (inch)	3–4
Average seed piece size (oz)	2.5–3.0
Average seed per planted acre (lb)	2,000–3,000

Cultivars

The University of Florida Potato Variety Evaluation Program screens new germplasm from public and private breeding programs and identifies the most promising cultivars for commercial potential, considering broad adaptability to Florida climate and conditions and market purpose: processing, fresh-market, and specialty-type varieties. The Florida Potato Variety Trial Report is available at <https://hos.ifas.ufl.edu/extension/variety-trials/>. A summary of the most popular potato clones for Florida is presented in the following sections.

Total yield key: High = >300 cwt/A, medium-high = 250–299 cwt/A, medium = 200–249 cwt/A, low-medium = 150–199 cwt/A. **Tuber specific gravity (SG) key:** High = >1.075, medium-high = 1.070–1.074, medium = 1.065–1.069, low = <1.064.

1. Chipping Types

Atlantic. Mid-season; high yield; high SG. Mostly round; shallow eye depth; tan skin color; cream flesh; good appearance; susceptible to internal heat necrosis and hollow heart. <https://ask.ifas.ufl.edu/publication/HS1278>

Elkton. Mid-season; high yield; medium-high SG. Mostly oblong; shallow eye depth; white skin color; white flesh; good appearance. <https://ask.ifas.ufl.edu/publication/HS1237>

Harley Blackwell. Mid-late season; high yield; high SG. Mostly round; shallow eye depth; tan skin color; white flesh; good appearance. <https://ask.ifas.ufl.edu/publication/HS1298>

Lamoka. Mid-late season; medium-high yield; medium SG. Round to oblong; intermediate eye depth; tan skin color; cream flesh; fair to good appearance.

Pike. Late season; medium-high yield; medium-high SG. Round to oblong; shallow eye depth; buff skin color; white flesh; good appearance.

Snowden. Mid-season; high yield; high SG. Round; intermediate eye depth; tan skin color; white flesh; fair to good appearance.

<https://ask.ifas.ufl.edu/publication/HS1286>

Superior. Mid-season; medium yield; medium SG. Round to oblong; intermediate eye depth; buff skin color; white flesh; fair to good appearance.

2. All-Purpose Types

LaChipper. Mid-season; high yield; medium SG. Round to oblong; intermediate eye depth; white skin and white flesh; good appearance.

<https://ask.ifas.ufl.edu/publication/HS1297>

Marcy. Mid-late season; high yield; low SG. Round to oblong; shallow eye depth; buff skin color; white flesh; good appearance.

<https://ask.ifas.ufl.edu/publication/HS1277>

Sebago. Early-mid season; high yield; medium SG. Mostly oblong; intermediate eye depth; buff skin color; white flesh; good appearance.

3. Fresh-Market/Table Types—Whites/Yellows

Almera. Early-mid season; high yield; low SG. Oblong to long; intermediate eye depth; buff skin color; light-yellow flesh; good appearance.

Colomba. Mid-season; high yield; low SG. Mostly oblong; very shallow eye depth; cream skin color and light-yellow flesh; excellent appearance.

Coronada. Mid-season; medium-high yield; low SG. Mostly oblong; very shallow eye depth; white skin color and light-yellow flesh; excellent appearance.

Electra. Mid-season; high yield; low SG. Round to oblong; shallow eye depth; white skin and white flesh; good appearance.

Fabula. Mid-late season; medium-high yield; low SG. Mostly oblong; shallow eye depth; white-cream skin color; light-yellow flesh; good appearance.

<https://ask.ifas.ufl.edu/publication/HS1294>

Francisca. Mid-late season; medium-high yield; low SG. Round to oblong; shallow eye depth; buff skin color; light-yellow flesh; good appearance.

Jelly. Early-mid season; high yield; low SG. Round to oblong; shallow eye depth; cream skin color and dark-yellow flesh; good to excellent appearance.

Malou. Mid-late season; high yield; low SG. Round to oblong; intermediate eye depth; white skin color; medium-yellow flesh; good to excellent appearance.

Natasha. Mid-season; medium-high yield; low SG. Mostly oblong; shallow eye depth; cream skin color; light-yellow flesh; excellent appearance.

Satina. Mid-season; medium-high yield; low SG. Round to oblong; shallow eye depth; cream skin color; medium-yellow flesh; good to excellent appearance.

4. Fresh-Market/Table Types—Reds

Cerata. Early-mid season; high yield; low SG. Round to oblong; shallow eye depth; pink skin color and white flesh; good to excellent appearance.

Chieftain. Mid-late season; high yield; low SG. Round to oblong; intermediate eye depth; red skin color and white flesh; fair to good appearance

LaRouge. Early-mid season; high yield; medium SG. Round to oblong; intermediate eye depth; pink-red skin color; white flesh; fair to good appearance.

Red Lasoda. Mid-late season; medium yield; low SG. Mostly oblong; intermediate to deep eye depth; red skin color; white flesh; good appearance.

Strawberry Paw. Mid-late season; high yield; low SG. Round to oblong; shallow eye depth; red skin color; cream flesh; good appearance.

5. Fresh-Market/Table Types—Purples

Adirondack Blue. Mid-late season; medium yield; medium SG. Oblong to long; intermediate eye depth; purple skin color; purple flesh; fair to good appearance.

<https://ask.ifas.ufl.edu/publication/HS1293>

All Blue. Mid-late season; medium yield; medium SG. Oblong to long; intermediate eye depth; purple skin color; purple flesh; fair to good appearance.

Michigan Purple. Mid-late season; high yield; medium SG. Mostly oblong; intermediate eye depth; purple skin color; white flesh; good appearance.

Peter Wilcox. Mid-late season; medium-high yield; medium SG. Round to oblong; intermediate eye depth; purple skin color; medium-yellow flesh; good appearance.
<https://ask.ifas.ufl.edu/publication/HS1295>

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 3. Herbicides approved for managing weeds in potato. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREPLANT/ PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Dimethenamid-p 0.56–0.84	(Outlook) 6 L 12–18 fl oz	15	Apply after planting or drag-off. Consult label for exact rates based on soil texture. In cold, wet conditions, delayed crop emergence or stunting may occur. PHI 40 days.
	EPTC 1.0	(Eptam) 20 G 15 lb	8	Broadleaf and grass weeds and nutsedge. Apply preplant or after drag-off. Incorporate mechanically or with irrigation 2–4 in. deep. Do not apply the emulsifiable formulation preemergence in winter and early spring potatoes.
	Flumioxazin 0.05	(Chateau) EZ 1.5 fl oz	14	Annual broadleaf weeds. Apply after hilling with a minimum of 2 in. of soil covering the vegetative portion of the potato plant. Should be tank-mixed with other herbicides, especially for grass control.
	Fomesafen 0.25	(Reflex, Ringside) 2 EC 1.0 pt	14	Annual broadleaf and grass weeds. Effectiveness reduced if later cultural practices expose untreated soil. Can be applied after drag-off and before crop emergence. Variety tolerance may vary; test on a small sample before application to the entire field. PHI 7 days.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
	Imazosulfuron 0.19–0.3	(League) 75 WG 4–6.4 oz	2	Broadleaf and grass weeds. No more than 2 applications per year and no more than 6.4 oz/A per year.
	Linuron 0.75–1.25	(Lorox DF) 50 DF 1.5–2.5 lb (Linex) 4 L 1–1.6 pt	7	Apply after final drag-off. If weeds are present include a NIS. Best results are obtained in moist fields at application followed by rain or irrigation within 2 weeks.
	Metribuzin 0.25–1.0	(Tricor DF) 75 DF 0.3–1.3 lb	5	Annual broadleaf weeds. Apply after drag-off but before crop emergence. Do not incorporate. Use lower rates on sandy soil.
	Metribuzin + S-metolachlor	(Boundry) 6.5 EC 1.5–2.0 pt	5 + 15	Broadleaf and grass weeds. Apply before potato emergence. This includes drag-off. Do not incorporate.
	Paraquat 0.25–0.5	(Gramoxone) 2 SL 1.0–2.0 pt (Firestorm) 3 SL 0.7–1.3 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Apply up to ground cracking before potatoes have emerged. Use a nonionic surfactant.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
	Pendimethalin 0.75	(Prowl H20) 3.8 1.5 pt	3	Annual broadleaf and grass weeds. Apply after planting but before potatoes and weeds emerge or after drag-off. Incorporate with rainfall or mechanically into the top 1–2 in. of soil within 7 days. Do not use on peat or muck soils.
	Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
	Pyroxasulfone ethyl 0.08–0.11	(Zidua Herbicide) 1.5–2.0 oz	15	Broadleaf and grass weeds. Apply after drag-off and before potato and weed emergence. No PHI between a preemergence application and harvest. Efficacy is decreased if the untreated soil is exposed.
	Rimsulfuron 0.016–0.023	(Matrix) 25 DF 1.0–1.5 oz	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3–1.0 in. required with 5 days after application. No more than 2.0 oz/A per year.
	S-metolachlor 0.95–1.9	(Dual Magnum) 7.62 EC 1.0–2.0 pt	15	Annual broadleaf and grass weeds. Apply after drag-off before crop and weed emergence. If cool, wet soil conditions occur after application, a delay in maturity and/or reduced yield may occur. PHI 60 days.
	Sulfentrazone 0.09–0.14	(Willowood sulfentrazone) 4SC 3.0–4.5 fl oz	14	Broadleaf and grass weed control. Nutsedge suppression. Do not apply on sands with less than 1% organic matter. No more than 8 fl oz/A within a 12-month period. Should be trialed in a small area to find suitable rate for the soil type in your area.
	Trifluralin 0.5	(Trust, Treflan TR-10) 10 G 5 lb (Trifluralin, Treflan) 4 L 1 pt	3	Broadleaf and grass weeds. Apply after drag-off or prior to crop emergence. Incorporate the herbicide into the soil profile. If applied after plant emergence, do not allow soil contact with the emerged plants.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
POSTEMERGENCE	Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl oz (Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use a COC or NIS at recommended rates. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. PHI 7 days.
	Clethodim 0.09-0.25 0.07-0.25	(Arrow) 2 EC 6-16 fl oz (Select Max) 1 EC 9-32 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.
	EPTC 3 3.1-7.9	(Eptam) 20 G 15 lb (Eptam) 7 E 3.5 to 9 pt	8	Annual broadleaf, grass weeds, and nutsedge. Apply at layby to a clean cultivated soil. Incorporate mechanically or with irrigation. Apply Eptam 7 E after true leaves have formed and apply as a layby treatment. No more than 12.25 lb a.i. per season. PHI 45 days.
	Imazosulfuron 0.19-0.3	(League) 75 WG 4-6.4 oz	2	Broadleaf and grass weeds. No more than 2 applications per year and no more than 6.4 oz/A per year. PHI 45 days.
	Metribuzin 0.23-0.5	(Tricor) 75 DF 0.3-0.6 lb	5	Broadleaf and grass weeds. Do not apply to early smooth-skinned, red-skinned, and other specified varieties on the label. No more than 1.3 lb/A. PHI 60 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%-10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Rimsulfuron 0.016-0.023	(Matrix) 25 DF 1.0-1.5 oz	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3-1.0 in. required within 5 days of application. Apply as a sequential treatment 14-28 days after the first application. No more than 2.0 oz/A per year.
	Sethoxydim 0.28-0.47	(Poast) 1.5 EC 1.5-2.5 pt	1	Control growing grass weeds. No more than 5.0 pt/A per year. Include crop oil concentrate. Unsatisfactory results may occur if applied to grass under stress. PHI 30 days.

Table 4. Insecticides approved for management of arthropod pests of potato. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: De-Fen Mou, UF/IFAS Everglades Research and Education Center.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1A	*Lannate LV; *SP (methomyl)	LV: 1.5-3.0 pt SP: 0.5-1.0 lb	LV: 15 pt per crop SP: 5 lb per crop	48	6	No more than 10 applications per crop. No more than.
	1B	Dimethoate 4EC (dimethoate)	0.5-1.0 pt	2 pt per year	48	Mechanically harvested: 0 Otherwise: 14	Highly toxic to bees. Applications at least 7 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5-2.5 pt 8F: 1-1.5 pt	1.56 pt	12	0	No more than 2 applications per year.
	3A	*Ambush 25W (permethrin)	3.2-12.8 oz	1.6 lb a.i.	12	14	Apply by air or ground equipment.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9-9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
	3A	*Mustang Maxx (zeta-cypermethrin)	3.4-4.3 fl oz	25.8 fl oz	12	1	Reapplications at least 4 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4-12.8 oz	0.8 lb a.i.	12	14	-
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7	Only exposed insects can be controlled.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5-4.5 fl oz	10 fl oz	24	14	Do not use with other Group 4A insecticides.
	4A	Actara (thiamethoxam)	3.0 oz	6 oz	12	14	Highly toxic to bees. Do not use following soil application of other Group 4A insecticides.
	4A	Admire Pro (imidacloprid)	Soil: 5.7-8.7 fl oz Seed-piece: 3.5-7 fl oz Foliar: 1.3 fl oz	Soil and seed-piece: 8.7 fl oz per year Foliar: 5.6 fl oz per year	12	Foliar: 7	Do not use treated seed-pieces for food, feed, or fodder.
	4A	Assail 30SG (acetamiprid)	2.5-4.0 oz	16 oz per year	12	7	Reapplications at least 7 days apart. No more than 4 applications per year.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Belay Insecticide (clothianidin)	In-furrow or side dress application: 9–12 fl oz Foliar: 2–3 fl oz	0.2 lb a.i. per year	12	Soil: at planting, side dress, or hilling Foliar: 14	Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for 5 days after application.
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting or at plant emergence.	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. Only 1 soil application per year.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–2.75 fl oz Soil: 11.5–13.25 fl oz	Foliar: 8 fl oz Soil: 13.25 fl oz	12	Foliar: 7 Soil: Apply prior to planting	Apply as foliar or soil application, but not both. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1–1.5 oz Soil: 6.5–7.5 oz	Foliar: 4.5 oz Soil: 7.5 oz	12	Foliar: 7 Soil: Apply prior to planting	No more than 1 soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4A + 3A	Leverage 360 (imidacloprid + cyfluthrin)	2.8 fl oz	12.8 fl oz	12	7	Apply when aphids first appear. Reapplications at least 7 days apart.
	4C	Transform WG (sulfoxaflor)	0.75–1.0 oz	8.5 oz	24	7	Bloom and tank-mix restrictions apply.
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	Reapplications at least 7 days apart.
	9B	Fulfill (pymetrozine)	2.75–5.5 oz	11.0 fl oz	12	14	Apply when aphids first appear.
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	9.6 fl oz	12	7	Reapplications at least 7 days apart.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until 14 days after emergence.
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	7	Reapplications at least 7 days apart.
	28	Exirel (cyazypyr)	13.5–20.5 fl oz	0.4 lb a.i.	12	1	Reapplications at least 5 days apart.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Verimark (cyazypyr)	Soil: 6.75–13.5 fl oz at planting Drip chemigation: 6.75–10 fl	0.4 lb a.i. per year	4	1	No more than 2 drip chemigation applications.
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	7	Begin applications before pest populations reach damaging levels.
Beetles (including blister beetles, flea beetles, Colorado potato beetles, cucumber beetles, white-fringed beetles)	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 15 pt SP: 5 lb	48	6	No more than 10 applications per crop.
	1A	Sevin XLR, 4F; 80S (carbaryl)	XLR, 4F: 0.5–2.0 qt 80S: 0.63–2.5 lb	XLR, 4F: 6 qt 80S: 7.5 lb	12	7	–
	1B	Imidan 70 W (phosment)	1.3 lb	6.6 lb	5 days	7	Reapplications at least 10 days apart. Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	*Thimet 20 G (phorate)	Light or sandy soils: 8.5–11.3 oz/1000 row ft Heavy or clay soils: 13–17.3 oz/1000 row ft	Light or sandy soils: 11.5 lb Heavy or clay soils: 17.7 lb	48	90	Apply at planting. No more than 1 application per season.
	3A	*Ambush 25W (permethrin)	3.2–12.8 oz	1.6 lb a.i.	12	14	Apply by air or ground equipment.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9–9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	Reapplications at least 5 days apart.
	3A	*Brigade 2 EC (bifenthrin)	Soil at-plant: 19.2 oz Soil layby: 3.2–9.6 oz Foliar: 2.1–6.4 fl oz	32 fl oz	12	21	No more than 2 foliar applications. Reapplications at least 21 days apart.
	3A	*Mustang Maxx (zeta-cypermethrin)	1.9–4.3 fl oz	25.8 fl oz	12	1	See label for use rate on specific species. Reapplications at least 4 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	14	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Only exposed insects can be controlled.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5-4.5 fl oz	10 fl oz	24	14	Do not use with other Group 4A insecticides.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-9 fl oz	27 fl oz per year	24	14	Reapplications at least 7 days apart.
	4A	Actara (thiamethoxam)	1.5-3.0 oz	6 oz	12	14	Highly toxic to bees. Do not use following soil application of other Group 4A insecticides.
	4A	Admire Pro (imidacloprid)	Soil: 5.7-8.7 fl oz Seed-piece: 3.5-7 fl oz Foliar: 1.3 fl oz	Soil and seed-piece: 8.7 fl oz per year Foliar: 5.6 fl oz per year	12	Foliar: 7	Do not use treated seed-pieces for food, feed, or fodder.
	4A	Assail 30SG (acetamiprid)	1.5-4.0 oz Flea beetle: 1.5-2.5 oz	16 oz per year	12	7	Reapplications at least 7 days apart. No more than 4 applications per year.
	4A	Belay Insecticide (clothianidin)	In-furrow or side dress: 9-12 fl oz Foliar: 2-3 fl oz	0.2 lb a.i. per year	12	Foliar: 14 At planting or side dress or spray: at ground crack over row at hilling	Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for 5 days after application.
	4A	Platinum 75SG (thiamethoxam)	1.66-2.67 oz	2.67 oz	12	Applied at planting or at plant emergence	Only 1 soil application per year.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2-2.75 fl oz Soil: 11.5-13.25 fl oz	Foliar: 8 fl oz Soil: 13.25 fl oz	12	Foliar: 7 Soil: Apply prior to planting	Apply as foliar or soil application, but not both. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 1-1.5 oz Soil: 6.5-7.5 oz	Foliar: 4.5 oz Soil: 7.5 oz	12	Foliar: 7 Soil: Apply prior to planting	No more than 1 soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4 oz	8 oz	12	14	Reapplications at least 7 days apart. No more than 2 applications.
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz	4	7	Reapplications at least 7 days apart.
	5	Entrust SC (spinosad)	3–10 fl oz	21 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. No more than 4 applications per crop. OMRI-listed. ³
	5	Radiant SC (spinetoram)	4.5–8 fl oz	32 fl oz per year	4	7	Reapplications at least 7 days apart. No more than 4 applications per year. See label for species-specific rates.
	15	Rimon 0.83EC (novaluron)	6–12 fl oz	24 oz	12	14	Does not affect adult insects.
	17	Trigard (cyromazine)	2.66–5.32 oz	1.0 lb	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until 14 days after emergence.
	22A	Avaunt eVo (indoxacarb)	3.5–6.0 oz	24 oz; 72 oz per year	12	7	Reapplications at least 5 days apart.
	28	Coragen (rynaxypyr)	3.5–5.0 fl oz	15.4 fl oz	4	14	Foliar or overhead sprinkler irrigation systems only.
	28	Verimark (cyazypyr)	6.75–13.5 fl oz	13.5 fl oz at planting	4	N/A—applied at planting	The pH of application solution must be between 4 and 6.
	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 15 pt SP: 5 lb	48	6	No more than 10 applications per crop.
	1A	Sevin XLR, 4F; 80 S (carbaryl)	XLR, 4F: 0.5–2.0 qt 80S: 0.63–2.5 lb	XLR, 4F: 6 qt 80S: 7.5 lb	12	7	–
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9–9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
Caterpillars (including armyworms, webworms, cutworms, loopers, corn earworms)	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	Reapplications at least 5 days apart.
	3A	*Mustang Maxx (zeta-cypermethrin)	1.9–4.0 oz	25.8 fl oz	12	1	See label for use rate on specific species. Reapplications at least 4 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	14	–

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7	Only exposed insects can be controlled.
	5	Entrust SC (spinosad)	3-10 fl oz	21 fl oz	4	7	No more than 4 applications per crop. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6-8 fl oz	32 fl oz per year	4	7	Reapplications at least 7 days apart. No more than 4 applications per year.
	15	Rimon 0.83EC (novaluron)	6-12 fl oz	24 oz	12	14	Does not affect adult insects.
	22A	Avaunt eVo (indoxacarb)	3.5-6.0 oz	24 oz; 72 oz per year	12	7	Reapplications at least 5 days apart.
	28	Coragen (rynaxypyr)	3.5-7.5 fl oz	15.4 fl oz	4	14	Foliar or overhead sprinkler irrigation systems only.
	28	Exirel (cyazypyr)	10-17 fl oz	0.4 lb a.i.	12	1	Reapplications at least 5 days apart.
	28 + 6	Minecto Pro (cyantraniliprole + abamectin)	7.5-10 fl oz	20 fl oz per year	12	7	Must add an adjuvant. No more than 2 sequential applications. See label for adjuvant requirement.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-9 fl oz	27 fl oz per year	24	14	Reapplication at least 7 days apart.
European corn borer	5	Radiant SC (spinetoram)	6-8 fl oz	32 fl oz per year	4	7	Reapplications at least 7 days apart. No more than 4 applications per year.
	22A	Avaunt eVo (indoxacarb)	3.5-6.0 oz	24 oz; 72 oz per year	12	7	Reapplications at least 5 days apart.
	28	Coragen (rynaxypyr)	3.5-7.5 fl oz	15.4 fl oz	4	14	Foliar or overhead sprinkler irrigation systems only.
	28	Exirel (cyazypyr)	5-20.5 fl oz CPG: 5-13.5 fl oz Flea beetles: 13.5-20.5 fl oz	0.4 lb a.i. per year	12	1	Reapplications at least 5 days apart.
	6	Clinch (abamectin)	1 lb	4 lb per year	12	0	Reapplications at least 30 days apart. Apply when ants are actively foraging. No more than 4 applications per year.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	7A	Extinguish (S-methoprene)	1.0–1.5 lb	-	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8–10 weeks. May be applied by ground equipment or aerially.
Leaf-footed bugs, plant bugs, stink bugs, mealybugs, false chinch bugs	1A	Sevin XLR, 4F; 80S (carbaryl)	XLR, 4F: 0.5–2.0 qt 80S: 0.63–2.5 lb	XLR, 4F: 6 qt 80S: 7.5 lb	12	7	-
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1–1.5 pt	1.56 pt	12	0	No more than 2 applications per year.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9–9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	Reapplications at least 5 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	14	-
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Only exposed insects can be controlled.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	Do not use with other Group 4A insecticides.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	27 fl oz per year	24	14	Reapplications at least 7 days apart.
Leafhoppers	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	7	Begin applications before pest populations reach damaging levels.
	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 15 pt SP: 5 lb	48	6	No more than 10 applications per crop
	1A	Sevin XLR, 4F; 80 S (carbaryl)	XLR, 4F: 0.5–2.0 qt 80S: 0.63–2.5 lb	XLR, 4F: 6 qt 80S: 7.5 lb	12	7	-
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2 pt per year	48	Mechanically harvested: 0 Otherwise: 14	Highly toxic to bees. Reapplications at least 7 days apart.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	1B	Imidan 70 W (phosment)	1.3 lb	6.6 lb	5days	7	Reapplications at least 10 days apart. Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–2.5 pt 8F: 1–1.5 pt	1.56 pt	12	0	No more than 2 applications per year.
	1B	*Thimet 20 G (phorate)	Light or sandy soils: 8.5–11.3 oz/1000 row ft Heavy or clay soils: 13–17.3 oz/1000 row ft	Light or sandy soils: 11.5 lb Heavy or clay soils: 17.7 lb	48	90	Apply at planting. No more than 1 application per season.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9–9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	Reapplications at least 5 days apart.
	3A	*Mustang Maxx (zeta-cypermethrin)	1.9–4.3 fl oz	25.8 fl oz	12	1	–
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	14	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Only exposed insects can be controlled.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	Do not use with other Group 4A insecticides.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–8 fl oz	27 fl oz per year	24	14	Reapplication at least 7 days apart.
	4A	Admire Pro (imidacloprid)	Soil: 5.7–8.7 fl oz Seed-piece: 3.5–7 fl oz Foliar: 1.3 fl oz	Soil and seed-piece: 8.7 fl oz per year Foliar: 5.6 fl oz per year	12	Foliar: 7	Do not use treated seed-pieces for food, feed, or fodder.
	4A	Assail 30SG (acetamiprid)	1.5–4.0 oz	16 oz per year	12	7	Reapplications at least 7 days apart. No more than 4 applications per year.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting or at plant emergence	No more than 1 soil application per year.
	4A	Scorpion 35SL (dinotefuran)	Foliar: 2–2.75 fl oz Soil: 11.5–13.25 fl oz	Foliar: 8 fl oz Soil: 13.25 fl oz	12	Foliar: 7 Soil: Apply prior to planting	Apply as foliar or soil application, but not both. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4A	Venom Insecticide (dinotefuran)	Foliar: 2–4 oz Soil: 6.5–7.5 oz	Foliar: 6 fl oz Soil: 7.5 oz	12	At planting	Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4 oz	8 oz	12	14	Reapplications at least 7 days apart. No more than 2 applications.
	4C	Transform WG (sulfoxaflor)	0.75–1.0 oz	8.5 oz	24	7	Bloom and tank-mix restrictions apply.
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz	4	7	Reapplications at least 7 days apart.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until 14 days after emergence.
	28 + 6	Minecto Pro (cyantraniliprole + abamectin)	5.5–10 fl oz	20 fl oz per year	12	7	Must add an adjuvant. No more than 2 sequential applications. See label for adjuvant requirement.
	1B	Dimethoate 4EC (dimethoate)	0.5–1.0 pt	2 pt per year	48	Mechanically harvested: 0 Otherwise: 14	Highly toxic to bees. Reapplications at least 7 days apart.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
Leafminers	5	Entrust SC (spinosad)	3–10 fl oz	21 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. No more than 4 applications per crop. OMRI-listed. ³
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	0.056 lb a.i. per year	12	14	No more than 2 sequential applications. Must be applied with nonionic activator-type wetting, spreading, or penetrating adjuvant.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	17	Trigard (cyromazine)	2.66–5.32 oz	1.0 lb	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until 14 days after emergence.
	28	Coragen (rynaxypyr)	3.5–5.0 fl oz	15.4 fl oz	4	14	Foliar or overhead sprinkler irrigation systems only.
	28 + 6	Minecto Pro (cyantraniliprole + abamectin)	7.5–10 fl oz	20 fl oz per year	12	7	Must add an adjuvant. No more than 2 sequential applications. See label for adjuvant requirement.
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	0.056 lb a.i. per year	12	14	No more than 2 sequential applications. Must be applied with nonionic activator-type wetting, spreading, or penetrating adjuvant.
Mites	23	Oberon 2SC (spiromesifen)	8–16 fl oz	32.0 fl oz	12	7	No more than 2 applications.
	1A	*Lannate LV; *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 15 pt SP: 5 lb	48	6	No more than 10 applications per crop.
Potato tuberworm	3A	*Ambush 25W (permethrin)	3.2–12.8 oz	1.6 lb a.i.	12	14	Apply by air or ground equipment.
	3A	*Asana XL (0.66 EC) (esfenvalerate)	2.9–9.6 fl oz	0.35 lb a.i.	12	7	No more than 7 applications at highest rate.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	Reapplications at least 5 days apart.
	3A	*Pounce 25 WP (permethrin)	6.4–12.8 oz	0.8 lb a.i.	12	14	–
	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5–15.61 fl oz	15.61 fl oz	12	0	Toxic to bees. OMRI-listed. ³
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	27 fl oz per year	24	14	Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	6–12 fl oz	24 oz	12	14	Does not affect adult insects.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Coragen (rynaxypyr)	3.5-5.0 fl oz	15.4 fl oz per crop	4	14	Foliar or overhead sprinkler irrigation systems only.
Thrips	3A	Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-15.61 fl oz	15.61 fl oz	12	0	Highly toxic to bees. OMRI-listed. ³
	5	Entrust SC (spinosad)	3-10 fl oz	21 fl oz	4	7	No more than 4 times per crop. OMRI-listed. ³
	5	Radiant SC (spinetoram)	6-8 fl oz	32 fl oz per year	4	7	Reapplications at least 7 days apart. No more than 4 applications per year.
	21A	Torac (tolfenpyrad)	17-21 fl oz	42 fl oz	12	1	Do not apply until 14 days after emergence.
	4A	Belay Insecticide (clothianidin)	In-furrow or side dress: 9-12 fl oz Foliar: 2-3 fl oz	0.2 lb a.i. per year	12	Foliar: 14, or at planting or side dress or spray at ground crack over row at hilling	Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for 5 days after application.
Whiteflies	4A	Venom Insecticide (dinotefuran)	Foliar: 3-4 oz Soil: 5-6 oz	6 oz	12	Foliar: 1 Soil: apply at planting or immediately after transplanting	Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hr after application.
	4C	Transform WG (sulfoxaflor)	2.0-2.25 oz	8.5 oz	24	7	Bloom and tank-mix restrictions apply.
	4D	Sivanto Prime (flupyradifurone)	7-14 fl oz	28 fl oz	4	7	Reapplications at least 7 days apart.
	9B	Fulfill (pymetrozine)	2.75-5.5 oz	11 oz	12	14	Apply when whiteflies first appear.
	9B	PQZ (pyrifluquinazon)	2.4-3.2 fl oz	4.8 fl oz	12	14	No more than 2 applications per year.
	15	Rimon 0.83EC (novaluron)	6-12 fl oz	24 oz	12	14	Does not affect adult insects.
	23	Movento (spirotetramat)	4.0-5.0 fl oz	10 fl oz	24	7	Reapplications at least 7 days apart.
	23	Oberon 25C (spiromesifen)	8-16 fl oz	32.0 fl oz	12	7	No more than 2 applications.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28 + 6	Minecto Pro (cyantraniliprole + abamectin)	10 fl oz	20 fl oz per year	12	7	Must add an adjuvant. No more than 2 sequential applications. See label for adjuvant requirement.
Wireworms	1B	*Mocap 15 G, *EC (ethoprop)	1.4 lb/1000 row feet	6 lb a.i.	48	Preplant or at planting	Use broadcast application for moderate to heavy infestations of wireworms.
	1B	*Thimet 20 G (phorate)	Light or sandy soils: 8.5–11.3 oz/1000 row ft Heavy or clay soils: 13–17.3 oz/1000 row ft	Light or sandy soils: 11.5 lb Heavy or clay soils: 17.7 lb	48	90	Apply at planting. No more than 1 application per season.
	2B	*Regent 4SC (fipronil)	3.2 fl oz	3.2 fl oz	0	90	Many plant-back restrictions. Only 1 in. furrow application at time of planting. Must be incorporated and covered with soil. See label for rate per row spacing.
	3A	*Brigade 2 EC (bifenthrin)	Soil at plant: 19.2 oz Soil at layby: 3.2–9.6 oz	32 fl oz	12	21	No more than 2 foliar applications. Reapplications at least 21 days apart.
	3A	Capture LFR (bifenthrin)	12.75–25.5 fl oz	25.5 fl oz	–	–	In-furrow at planting.
	4A	Admire Pro (imidacloprid)	Soil: 5.7–8.7 fl oz Seed-piece treatment: 3.5–7 fl oz	8.7 fl oz	12	–	Do not use treated seed-pieces for food, feed, or fodder.
	4A	Belay Insecticide (clothianidin)	In-furrow or side dress application: 12 fl oz Seed-piece: 0.4–0.3 fl oz/ 100 lb seed	0.2 lb a.i. per year	12	–	Do not use treated seed-pieces for food, feed, or fodder.
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting or at plant emergence	For wireworms: seed-piece only. No more than 1 soil application per year.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 5. Potato fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Pamela D. Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Botrytis gray mold	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	-
	M3 + M5	Elixir (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	Suppression.
	M5	Many brands available: Bravo Ultrex, Bravo ZN, Bravo Weather Stik 6L, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 500 ZN, Equus 720SST, Initiate 720, Initiate ZN, Orondis Opti B	See individual label	See individual label	7	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	7	0.5	See label.
	3	Quash (metconazole)	2.5 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	11.4 oz	22.8 oz	14	0.5	-
	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	-
	7	Vertisan (penthioopyrad)	24 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications.
	3 + 7	Luna Pro (fluopyram + prothioconazole)	10 fl oz	20 fl oz per year	14	0.5	No more than 2 sequential applications.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	No more than 2 sequential applications. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Early blight (<i>Alternaria solani</i>)	7 + 11	Priaxor (fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 2 sequential applications.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	Use only in a tank-mix with labeled fungicide for early blight.
	9 + 12	Alerity 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	-
	11 + 4	Quadris Ridomil Gold (azoxystrobin + mefenoxam)	0.82 fl oz/1000 row ft	See label		0	Apply at planting. Suppression.
	12 + 7	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	34.2 fl oz per year	14	0.5	-
	M1	(copper compounds) Many brands available: Americop, Badge SC, Badge X2, Basic Copper 53, COC DF, COCS WDG, COC WP, Champ DP, Dry Prill, Champ 2 FL, Champion WP, Champ WG, Copper-Count-N, Copper sulfate crystals, Copper-Z 4/4, Cueva, Cuprofix MZ Disperss, Cuprofix Ultra 40 Disperss, Kantan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu Cop 50WP, Nu-Cop HB, Quimag Copper Sulfate Crystal	See individual label	See individual label	Varies by product from 0–1 day	Varies by product from 4 hr to 2 days	-
	M1 + M3	ManKocide 61.1DF (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	-
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	No more than 11.2 lb a.i. per crop.
	M3	Polyram 80DF (metiram)	2 lb	14 lb	3	1	No more than 7 applications per season.
	M3 + M5	Elixir (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik 6L, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	See individual label	See individual label	7	0.5	Read label for application directions.
	M5 + 27	Cymbol Advance (chlorothalonil + cymoxanil)	2.0 pt	17.5 pt per year	14	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	7	0.5	See label.
	2	Nevado 4F Rovral 4F (iprodione)	2 pt	8 pt	14	1	No more than 4 applications per crop. See individual See label for additional information.
	3	Provyosol (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	-
	3	Quash (metconazole)	2.5 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
	3 + 7	Luna Pro (fluopyram + prothioconazole)	10 fl oz	20 fl oz per year	14	0.5	No more than 2 sequential applications.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	11.4 oz	22.8 oz	14	0.5	-
	3 + 11	Veltyma (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	-
	4 + M3	Ridomil Gold MZ (mancozeb + mefenoxam)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak).
	4 + M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	2.5 pt	See label	14	2	No more than 4 applications per crop. Also labeled for storage rots (Pink Rot and Leak).
	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Velum Prime (fluopyram)	See label for ground or aerial application rates.	See label for ground or aerial application rates.	7	0.5	No more than 2 sequential applications.
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications.
	7 + 7	Velum Rise (penflufen + fluopyram)	13 fl oz	13 fl oz per year	-	0.5	See label for application information to apply as soil treatment
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	No more than 2 sequential applications.
	7 + 11	Priaxor (fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 2 sequential applications.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	Use only in a tank-mix with labeled fungicide for early blight.
	9	Vango WG (cyprodinil)	7 oz	28 oz	0	0.5	-
	9 + 12	Alerity 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	-
	11	Many brands available: Acadia LCF, Aframe, AzoxysSar, Azoxystrobin, Satori, Trevo, Quadris, (azoxystrobin)	See individual label	-	-	-	Alternate with non-group 11 chemistry. See label for soilborne disease applications.
	11	Aproach (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	Alternate with non-group 11 chemistry.
	11	Evito 480SC Aftershock (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	No more than 6 applications per crop. Alternate with non-group 11 chemistry.
	11	Gem 500SC Flint Extra Trilex (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	No more than 6 applications per crop. Alternate with non-group 11 chemistry.
	11	Headline 2.09F (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	See label	14	0.5	Alternate with non-group 11 chemistry.
	11 + 3	Amistar Top Acadia ESQ Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	12 + 7	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	34.2 fl oz per year	14	0.5	–
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	–
	19	Ph-D (polyoxin D zinc salt)	6.2 oz	31 oz	0	0	No more than 5 applications per season. Alternate with fungicides that have different modes of action.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb, so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 + M5	Zing! (zoxamide + chlorothalonil)	34 fl oz	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	0.5	No more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	27 + M5	Ariston (cymoxanil + chlorothalonil)	2 pt	17.5 pt cymoxanil and 11.25 lb a.i. chlorothalonil	14	0.5	–
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank mix. See label for seed-piece treatment.
	30	Agri Tin (triphenyltin hydroxide)	3.75 oz	11.5 oz	7	2	–
	30	Super-Tin 4L (triphenyltin hydroxide)	6 fl oz	18 fl oz	7	2	For use with closed tractor cabs only. Super-Tin should be tank-mixed with another fungicide.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	14	0.5	No more than 2 consecutive applications.
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	See label for seed-piece treatment.
Fusarium tuber rot	1	Mertect 340-F (thiabendazole)	0.42 fl oz/2,000 lb of tuber	–	–	0.5	–
	7 + 3	Ernesto Silver (penflufen + prothioconazole)	0.31 fl oz/100 lb seed pieces	–	–	–	See label for seed-piece treatment.
	12	Dyna-Shield Fludioxonil Maxim (fludioxonil)	See individual label	–	–	–	See label for equipment requirements.
	27 + M3 + 1	Evolve (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed pieces	–	–	1	Potato seed-piece treatment.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Late blight (<i>Phytophthora infestans</i>)	M1	(copper compounds) Many brands available: Americop, Badge SC, Badge X2, Basic Copper 53, COC DF, COCS WDG, COC WP, Champ 2 FL, Champ DP Dry Prill, Champion WP, Champ WG, Copper-Count-N, Copper sulfate crystals, Copper-Z 4/4, Cueva, Cuprofix MZ Disperss, Cuprofix Ultra 40 Disperss, Kantan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu Cop 50WP, Nu-Cop HB, Quimag Copper Sulfate Crystal	See individual label	See individual label	Varies by product from 0-1 day	Varies by product from 4 hr to 2 days	-
	M1 + M3	ManKocide 61.1DF (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	-
	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	No more than 11.2 lb a.i. per crop.
	M3	Polyram 80DF (metiram)	2 lb	14 lb	3	1	No more than 7 applications per season.
	M3 + M5	Elixir (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik 6L, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	See individual label	See individual label	7	0.5	Read label for application directions.
	M5 + 27	Symbol Advance (chlorothalonil + cymoxanil)	2.0 pt	17.5 pt per year	14	0.5	-
	M5 + 49	Orondis Opti (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	7	0.5	See label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3 + 11	Veltyma (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	-
	4 + M1	Ridomil Gold Copper 64.8W (mefenoxam + copper hydroxide)	See individual label	See individual label	14	2	No more than 3 applications per crop of this product + other Ridomil products. Add protectant fungicide; see label. Also for storage rots (Pythium leak, Pink Rot)
	4 + M3	Ridomil Gold MZ (mancozeb + mefenoxam)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak)
	4 + M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	2.5 pt	See label	14	2	No more than 4 applications per crop. Also labeled for storage rots (Pink Rot and Leak)
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	No more than 2 sequential applications.
	11	Many brands available: Acadia LFC, Aframe, AzoxyStar, Azoxystrobin, Satoria (azoxystrobin)	See individual label	-	-	-	Alternate with non-group 11 chemistry between applications. See label for soilborne disease applications.
	11	Evito 480SC Aftershock (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	No more than 6 applications per crop. Alternate with non-group 11 chemistry.
	11	Gem 500SC Flint Extra (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	No more than 6 applications per crop. Alternate with non-group 11 chemistry.
	11	Headline (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	11	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry between applications.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	See label	14	0.5	Alternate with non-group 11 chemistry between applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Suppression only.
	21	Ranman (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	-
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb, so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 + M5	Zing! (zoxamide + chlorothalonil)	34 fl oz	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	0.5	No more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	27	Curzate 60DF (cymoxanil)	3.2 oz	22.4 oz	14	0.5	No more than 7 applications per year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides, such as mancozeb or chlorothalonil. Also labeled for seed treatment.
	27 + 11	Tanos (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action.
	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank-mix. See label for seed-piece treatment.
	29	Omega 500F (fluazinam)	5.5 fl oz	3.5 pt	14	2	Rate is higher for white mold.
	30	Agri Tin Super-Tin (triphenyltin hydroxide)	See individual label	-	7	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	30	Super-Tin 80WP (triphenyltin hydroxide)	6 fl oz	18 fl oz	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, K-Phite, Fosphite, Fungi-Phite, Phiticide, Phostrol, ProPhyt, Rampart, Reveille	See individual label	-	-	-	-
	40	Forum (dimethomorph)	6 oz	30 oz	4	0.5	Tank-mix with another chemistry. No more than 2 sequential applications before alternating to a non-group 40 fungicide.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	14	4 hr	No more than 2 consecutive applications.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	14	0.5	No more than 2 consecutive applications.
	45 + 40	Zapro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	No more than 2 consecutive applications.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz per year	7	-	See label.
	4	MetaStar 2E AG (metalaxyl)	8 pt	-	-	2	See label for banding applications; for use at planting.
	4	Ridomil Gold SL Orondis Gold B Ultra Flourish (mefenoxam)	See individual label	See individual label	-	2	At planting.
	4 + M1	Ridomil Gold Copper 64.8W (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	No more than 3 applications per crop of this product + other Ridomil products. Add protectant fungicide; see label. Also for storage rots (Pythium leak, Pink Rot).
Pythium, Pink rot, and Phytophthora seed decays							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4 + M3	Ridomil Gold MZ (mefenoxam + mancozeb)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak).
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	See label	14	2	No more than 4 applications per crop. Also labeled for storage rots (Pink Rot and Leak).
	21	Ranman (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	Alternate with non-group 11 chemistry between applications.
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz	N/A	0.5	At planting or side-dress between hilling and tuber initiation at least 25 days apart
	27	Curzate 60DF (cymoxanil)	3.2 oz	22.4 oz	14	0.5	No more than 7 applications per year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides such as mancozeb or chlorothalonil. Also labeled for seed treatment.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phiticide, ProPhyt, Phostrol, Rampart, Reveille	See individual label	-	-	-	-
	40 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	27.8	-	-	-	At planting. See label.
Rhizoctonia, black scurf, and stem canker (<i>Rhizoctonia solani</i>)	M3	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	See label for seed-piece treatment.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Moncut 70DF (flutolanil)	1.1 lb	-	-	0.5	In-furrow use only.
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications.
	7 + M3	Moncoat MZ (flutolanil + mancozeb)	1.0 lb/100 lb seed	-	-	1	Seed treatment.
	7 + 3	Ernesto Silver (penflufen + prothioconazole)	0.31 fl oz/100 lb seed pieces	0.93 fl oz	-	0.5	See label for seed treatment details.
	7 + 7	Velum Rise (penflufen + fluopyram)	13 fl oz	13 fl oz per year	-	0.5	See label for application information to apply as soil treatment.
	7 + 11	Elatius (azoxystrobin + benzovindiflupyr)	5 oz/1000 linear ft	-	14	-	In-furrow use only.
	11	Azoxystrobin 100ST Azoyzone Dynasty Quadris (azoxystrobin)	See label	-	-	4 hr	Seed treatment.
	11	Headline (pyraclostrobin)	0.8 fl oz/1000 linear ft	-	-	0.5	In-furrow use only.
	12	Dyna-Shield Maxim Spirato (fludioxonil)	0.8 fl oz/100 lb seed	-	-	0.5	Seed treatment.
	12 + M3	Maxim MZ (fludioxonil + mancozeb)	0.5 lb/100 lb seed	-	-	1	Seed treatment.
	14	Blocker 10G Blocker 4F (PCNB)	See label.	-	-	-	At planting.
	27 + M3 + 1	Evolve (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed pieces	-	-	1	Potato seed-piece treatment.
	25	Agri-Mycin 17 Harbour (streptomycin)	100 ppm	-	-	0.5	Seed treatment. Check individual labels for specific rates and instructions.
Soft rot							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Soilborne pathogens (see specific pathogens)	M2	(mancozeb) Many brands available: Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	See individual label	See individual label	3	1	See label for seed-piece treatment.
	11	Dynasty (azoxystrobin)	3.75 fl oz/100 lb seed	-	-	4 hr	For suppression of black scurf and stem canker and seed-borne black dot and for protection against silver scurf.
	12	Maxim 4FS Spirato (fludioxonil)	0.16 oz/100 lb seed	-	-	0.5	Seed treatment. Must be made using specific equipment.
	12	Maxim Potato Seed Protectant Maxim PSP (fludioxonil)	0.5 lb/100 lb seed	-	-	0.5	Seed treatment.
	12 + M3	Maxim MZ (fludioxonil + mancozeb)	0.5 lb/100 lb seed	-	-	1	Seed treatment.
	1	Incognito 4.5F, Topsin M WSB (thiophanate-methyl)	See individual label	See individual label	21	2	-
White mold (<i>Sclerotinia sclerotiorum</i>)	2	Meteor, Nevado 4F, Rovral 4F (iprodione)	See individual label	See individual label	14	1	No more than 4 applications per crop. See individual label for additional information.
	3	Quash (metconazole)	4.0 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
	3 + 7	Luna Pro (fluopyram + prothioconazole)	10 fl oz	20 fl oz per year	14	0.5	No more than 2 sequential applications.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	11.4 oz	22.8 oz	14	0.5	-
	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Velum Prime (fluopyram)	See label for ground or aerial application rates.	See label for ground or aerial application rates.	7	0.5	No more than 2 sequential applications.
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications.
	7 + 7	Velum Rise (penflufen + fluopyram)	13 fl oz	13 fl oz per year	-	0.5	See label for application information to apply as soil treatment.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	No more than 2 sequential applications. Suppression.
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	No more than 2 sequential applications. Suppression.
	11	Aproach (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	Alternate with non-group 11 chemistry.
	11	Headline (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	12 + 7	Miravis Prime (fludioxonil + pydiflumetofen)	11.4 fl oz	34.2 fl oz per year	14	0.5	-
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	-
	29	Omega 500F (fluazinam)	5.5 fl oz	3.5 pt	14	2	-
¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; https://www.frac.info/ (FRAC = Fungicide Resistance Action Committee). ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.							

Table 6. Nonfumigant nematicides for potatoes in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Broadcast or Overall Rates		Row Rates	
	Per acre	Per 1000 sq ft	Per acre, 36" row spacing	Per 1000 row ft, any row spacing
Mocap 15G (a.i. ethoprop)	40–60 lb	0.9–1.4 lb	20 lb	1.4 lb
Mocap EC* (a.i. ethoprop)	1–1.5 gal	2.9–4.4 fl oz	2 qt	4.4 fl oz
Vydate C-LV** (a.i. oxamyl)	–	–	1–2 gal	9.8–19.5 oz
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.			
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using overhead chemigation equipment. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year regardless of formulation (Velum or Luna) or method of application (soil or foliar). Do not apply within 7 days of harvest. For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.			
Salibro (a.i. fluazaindolizine)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated or 15.6–61.4 fl oz/A for in-furrow treatment. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year and no more than 30.7 fl oz/A applied post-emergence. No more than 2 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 14 days apart. Preharvest interval: Do not apply within 40 days of harvest.			
Biological nematicides	See chapter 19.			

*Do not apply Mocap in furrow because it can cause crop injury when in contact with the seed piece. Do not apply Mocap where sorghum will be grown during the same year because its residual activity may cause serious injury to sorghum. Mix into the top 2–4 in. of soil. No more than 9 lb a.i./A Mocap 15G and 12 lb a.i./A for Mocap EC.

**Vydate C-LV has registration for nematode suppression in potatoes as an in-furrow and foliar treatment program only. Each application of Vydate C-LV should be applied in a minimum of 20 gal of water per acre, the spray solution water always buffered to a pH of 5.0 or lower. No more than 2.4 gal/A (9 lb a.i./A) per season or 8 applications of Vydate C-LV per crop; the last application should be made at least 7 days prior to harvest.

Mocap and Vydate are insecticide-nematicides; Velum is a fungicide-nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.

Table 7. Fumigant nematicides for potatoes in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12 gal	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1 gal	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5 gal	38.2–60.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5 gal	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Chloropicrin 99%	150–350 lb	–	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40 gal	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions

¹ Gallons/acre and fl oz/1,000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), applicator training certification, and other new rate modifying recommendations.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 15. Root Crop Production¹

Julien M. Beuzelin, Peter J. Dittmar, Johan Desaegeer, Lincoln Zotarelli, Shouan Zhang, Qingren Wang, Craig Frey, and Anna Mészáros²

Beet, Carrot, Radish, and Sweetpotato Botany and Planting

Beet—*Beta vulgaris*, Chenopodiaceae

Carrot—*Daucus carota*, Apiaceae (Umbelliferae)

Radish—*Raphanus sativus*, Brassicaceae (Cruciferae)

Sweetpotato/Boniato—*Ipomoea batatas*, Convolvulaceae

Table 1. Planting dates for beet, carrot, radish, and sweetpotato/boniato.

Planting Region	Dates			
	Beet	Carrot	Radish	Sweetpotato/Boniato
North Florida	Aug–Feb	Aug–Mar	Sept–Mar	Mar–June
Central Florida	Sept–Feb	Aug–Mar	Sept–Mar	Feb–June
South Florida	Oct–Jan	Sept–Mar	Oct–Mar	Dec–Sept (orange flesh type) Year-round (boniato/batatas type)

Table 2. Planting information for beet, carrot, radish, and sweetpotato/boniato.

Planting Parameters	Measurements			
	Beet	Carrot	Radish	Sweetpotato/Boniato
Distance between rows (in)	12–30	10–12	6	36–48
Distance between plants (in)	2–4	1–3	1	10–12
Seeding depth (in)	0.5–1.0	0.25	0.25	3–4
Seed per acre (lb)	10–15	2–4	10–20	9,000–15,000
Days to maturity from seed	50–70	70–120	20–30	85–130
Plant population (acre)	261,360	630,000	1 million+	9,000–15,000

Cultivars

Table 3. Common cultivars of beet, carrot, and sweetpotato/boniato.

Crop	Cultivars
Beet	Bohan, Boro, Bulls Blood (tops), Golden Beets (yellow), Green Top, Pacemaker III, Red Ace, Red Cloud
Carrot	Apache, Choctaw, Navajo, Top Notch
Radish	Diego, Escala F ¹ , Fuego ¹ , Red Castle, Red Pearl, Red Satin F ¹ , Red Silk ² , Rudi
Sweetpotato/Boniato	Beauregard, Covington, Evangeline, Hernandez, Picadito (Boniato)

¹ Resistant to yellows; tolerant to black root and rhizoctonia scurf.

² Resistant to pithing; intermediate resistance to black root, yellows, clubroots, rhizoctonia scurf.

Tropical Root Crops

Tropical root crops are planted primarily for their edible roots, tubers, corms, or cormels. In this regard, tropical root crops require a longer period of time to mature than many other vegetable crops. Some root crops take as long as 14 months to reach maturity. Some people also eat the edible leaves of sweetpotato/boniato, cassava, and taro. In the case of these crops, plants grown for edible leaves can be grown in cooler locations than would otherwise be possible. For pest control products, these crops are included in root and tuber vegetables.

Botany and Planting

Table 4. Planting dates for cassava, taro, and malanga.

Planting Region	Dates		
	Cassava	Taro	Malanga
Miami-Dade County	Year-round (mainly February to April)	Year-round	Year-round

Table 5. Planting information for cassava, taro, and malanga.

Planting Parameters	Measurements		
	Cassava	Taro	Malanga
Distance between rows (in)	48	52	52
Distance between plants (ft)	2	1	1
Planting depth (in)	3–4	4–6	4–6
Propagules needed per acre	5,445	2,420–3,630	2,420–3,630
Minimum propagule size	10"–12" stick or micropropagules	2 oz	2 oz
Bedded	No	Yes	Yes
Months to harvest from planting	8–12	6–10	9–14
Plant populations (acre)	5,445	10,052	10,052

Cultivars

Cassava—Known over the world by a variety of names, including manioc, yuca, mandioca, balinghoy, kamoteng, kahoy (Philippines), mogo (Africa), tapioca root (India), and manioc root in its native South America. Though the exact origins of cassava are unknown, it was likely domesticated between 7,000 and 9,000 years ago in the Amazon. This root crop is grown throughout the tropics and has become an important dietary staple in many parts of the world.

Varieties are often separated based of their cyanogenic glucoside (HCN) content into either low HCN, a.k.a. “sweet,” or high HCN, a.k.a. “bitter,” types. The term “bitter” comes from a bitter flavor that is commonly believed to accompany the HCN. Though no named varieties are currently known in southern Florida, ‘Senorita’ was locally popular in the 1980s, and attempts were made to introduce the CIAT variety ‘Mantiqueira’ at that time because it produced acceptable yields even with high levels of root-knot nematode infestation. The range of local genotypes covers a few unnamed clones that have been imported from various Caribbean basin countries. However, federal regulations prohibit further importation of cuttings or botanical seed.

Root development may occur as early as 28 days after planting, though it may take about six weeks before fibrous roots begin to thicken rapidly with starch granules. There does not appear to be any specific trigger to root thickening, but the number of roots that will eventually thicken is determined early in the life of the crop, with little change in the number of thickened roots after three months. A soil fertility analysis is conducted as a routine practice to ensure an adequate amount of potassium is maintained in the soil to improve root development for improved yield. The amount of nitrogen available to the crop is often limited because excessive nitrogen increases vegetative growth rather than root development.

For people who are able to find cuttings, follow the technique developed by scientists at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria, where one makes two-node cuttings, or ministakes, which can provide a five-fold increase in the production of propagules from each parent cassava plant. According to IITA, “[t]hese ministakes are easily moved and protected in plastic sacks until they can be grown on and hardened in individual plastic bags or nursery beds before being planted in the field.”

It takes 8–12 months for cassava roots to reach maturity. Plants are often cut back two weeks prior to harvest, resulting in increased tuber size and yields about 10% higher.

Preferences for specific varieties of cassava used for edible leaves may exist among consumers, though the ability to satisfy these requests is very limited, given the very small number of varieties currently grown in the United States.

Tannia is widely grown and used in the tropics. It has been grown since 1963 on a limited commercial scale in south Florida, where it is typically planted in the spring because the crop requires 9–10 months to reach maturity and can be injured by frosts. Tannia can be propagated by several methods: (1) plant the top (head), (2) plant the whole main tuber, (3) plant pieces of the main tuber, or (4) plant individual secondary tubers. Propagative materials should be set 3–5 in. below the surface. ‘South Dade White’ produces white-fleshed cormels; ‘Malanga Amarilla’ produces a yellow-fleshed edible corm. ‘Vinola’ produces purple-fleshed cormels.

Taro—‘Malanga Isleña’ produces one large, white-fleshed, central corm; a few unnamed Polynesian types are grown for the Asian market. The name “taro” is generally used to refer to *Colocasia esculenta*, one of several major root crops in the Araceae (Aroid) family.

There are several important crops throughout the tropical regions of the world related to taro and grown in certain Florida locations. These include the giant swamp taro, the giant taro, and cocoyam. Each of these Aroids has several other common names in different regions of the world.

Information about taro in Florida is limited due to a small acreage. However, taro can be cultivated under both wetland and dryland conditions, with the latter referred to as “dasheens” in Florida. Most will mature in 6–10 months, with corms being dug up using modified potato harvesters in commercial production. The corms are washed of soil, sorted by size, and packed. The recommended cold room temperature for prolonged storage is 45°F–50°F with a relative humidity of 85%.

Tropical sweetpotato or boniato—‘Picadito’ is the main variety grown in Miami-Dade County. Sweetpotato usually has shallow-lobed leaves and wine-colored skin with orange flesh. However, boniato, which is predominantly grown in Miami-Dade County, has deeply lobed leaves and wine-colored skin with white flesh.

It is illegal to import sweetpotato/boniato into the United States due to soil pests, such as sweetpotato weevils, and there is no program to produce disease-free planting material of ‘Picadito’ in Florida. Other sweetpotato growing states have developed red-skinned, white-fleshed sweetpotatoes, which may grow well in Florida and may be available from those plant breeders or through certified slip producers.

For other tropical root crops, such as daikon radish or turmeric, readers may refer to [chapter 5](#), “Ethnic Vegetable Production.”

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 6. Herbicides approved for managing weeds in beet. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult labels for individual product directions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with residual preemergence herbicides to lengthen control.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds and grass weeds. Apply as a preplant burndown treatment.
POSTEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. PHI 0 days.
	Clethodim 0.09–0.13 0.07–0.25	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Consult the label for necessary surfactant. PHI 30 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grass weeds. No more than 5 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 60 days.
	S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 7. Herbicides approved for managing weeds in carrot. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
	Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	A single application after planting and before crop emergence. Plant seed at least 0.5 inches deep. Preemergence and postemergence applications should not exceed 4 lb/A per season.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Apply before crop emergence. Use a nonionic surfactant.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with a residual preemergence herbicide to lengthen time of control.
	Pendimethalin 0.95	(Prowl H2O) 3.8 2.0 pt	3	Broadleaf and grass control. Apply within 2 days of planting before the emergence of the crop. PHI 60 days.
	Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. No more than 1 application. Consult label for rotational crop restrictions.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
	Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan TR-10) 5 lb	3	Annual broadleaf and grass weeds. Do not apply to muck soils. Mineral soils with 2%–5% organic material, apply 0.75 lb a.i./A. Incorporate 4 in. or less with 8 hr of application. PHI 60 days.
	Carfentrazone Up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rate. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. PHI 0 days.
POSTEMERGENCE	Clethodim 0.09–0.13 0.07–0.13	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Fluazifop 0.188	(Fusilade DX) 2 EC 12 fl oz	1	Actively growing grass weeds. No more than 48 fl oz/A per growing season. Withhold field flooding 45–60 days following application. In Palm Beach and Hendry Counties, a 60-day interval must be observed for flooding. PHI 45 days.
	Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	Apply after carrots are 3 in. tall. Repeat applications may be made but should not exceed 4 lb/A. Can be applied following Stoddard Solvent provided that the applications are at least 1 day apart. Do not tank-mix with Stoddard Solvent.
	Metribuzin 0.25	(Metribuzin, Metri, Tricor) 75 DF 0.3 lb (Metri, Tricor) 4 F 0.5 pt	5	Broadleaf and grass control. No more than 0.5 lb a.i./A per season. Apply after carrots have 5–6 true leaves and weeds are less than 1 in. tall. If needed, a second application may be made after an interval of at least 3 weeks. PHI 60 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. Apply up to 6-leaf stage of carrot. 1 application of 4 pt/A or 2 applications of 2 pt/A. For POST control of weeds, include NIS or COC. Consult label for rotational crop restrictions. PHI 30 days.
	Sethoxydim 0.28–0.38	(Poast) 1.5 EC 1.5–2.0 pt	1	Emerged grass weeds. No more than 5 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.
	S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 8. Herbicides approved for managing weeds in radish. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREPLANT/PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Glyphosate	(various formulation) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
	S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass, broadleaf weeds, and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
POSTEMERGENCE	Trifluralin 0.5–0.75	(Treflan HFP, Trifluralin) 4 EC 1.0–1.5 pt (Treflan) 4 L 1.0–1.5 pt	3	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in. within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents.
	Clethodim 0.09–0.13 0.07–0.13	(Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Emerged annual and perennial grass weeds. Reapplications at least 14 days apart. No more than 0.25 lb a.i./A per season. PHI 15 days.
	Sethoxydim 0.47	(Poast) 1.5 EC 2.5 pt	1	Emerged grass weeds. No more than 3.0 pt/A per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 days.

Table 9. Herbicides approved for managing weeds in sweetpotato. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Peter J. Dittmar, UF/IFAS Department of Horticultural Sciences, Gainesville.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PRETRANSPLANT	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Clomazone 0.49–0.75	(Command) 3 ME 1.3–2.0 pt	13	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Apply within 5 days of transplanting.
	Flumioxazin 0.096	(Valor) 51 WDG 3 oz	14	Annual broadleaf weeds. Do not use transplants that were harvested 2 days before application. Severe injury occurs if applied after transplanting. Apply 2–5 days before transplanting and minimize soil disturbance after application.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult labels for individual product directions.
	Napropamide 1.0–2.0	(Devrinol DF XT) 50 DF 2.0–4.0 lb	15	Annual broadleaf and grass weeds. Apply immediately after transplanting. If rainfall does not occur within 24 hr after application, then incorporate or irrigate 2–4 in. deep.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with residual preemergence herbicides to lengthen control.
POSTTRANSPLANT	Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds and grass weeds. Apply as a preplant burndown treatment.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. No more than 6.1 fl oz per cropping season. PHI 0 days.
	Clethodim 0.09–0.25 0.07–0.25	(Select, Arrow) 2 EC 6–16 fl oz (Select Max) 1 EC 9–16	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Consult the label for the necessary surfactant. PHI 30 days.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grass weeds. No more than 5 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 60 days.
	S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 10. Insecticides labeled for management of arthropod pests of carrot and beet. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC (malathion)	1.5–2.0 pt	–	Beets: 12 Carrots: 24	7	No more than 3 applications for beets and 2 applications for carrots.
	1B	Malathion 8F (malathion)	1.25 pt	–	12	7	No more than 3 applications. Beets only.
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	Beets: 25.6 fl oz per year Carrots: 32 fl oz per year	12	Beets: 1 Carrots: 21	–
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	4A	Actara (thiamethoxam)	1.5–4.0 oz	8 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 5 Soil: 21	Leaves may be used for food.
	4A	Platinum 75SG (thiamethoxam)	1.7–4.0 oz	4.0 oz	12	At planting	–
	4C	Transform WG (sulfoxaflor)	Leaf production: 0.75–1.0 oz Root production: 0.75–1.5 oz	8.5 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
Beetles (includes blister beetles, cucumber beetles, flea beetles)	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz per year	12	3	–
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	–	12	7	No more than 6 applications.
	1B	Malathion 8F (malathion)	1.25 pt	–	12	7	No more than 3 applications. Beets only.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14 fl oz	12	0	Carrots only.
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	Beets: 25.6 fl oz per year Carrots: 32 fl oz per year	12	Carrots: 21 Beets: 1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (includes beet armyworm, celery leaf-tier, corn earworm, cutworms, fall armyworm, loopers)	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	4A	Actara (thiamethoxam)	1.5–4.0 oz	8 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 5 Soil: 21	Leaves may be used for food.
	4A	Platinum 75SG (thiamethoxam)	1.7–4.0 oz	4.0 oz	12	At planting	–
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	–	12	7	No more than 6 applications.
	1B	*Diazinon AG500 *Diazinon (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	AG500: 4 qt per year 50W: 8 lb per year	72	Preplant	–
	1B	Malathion 8F (malathion)	1.25 pt	–	12	7	No more than 3 applications. Beets only.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14 fl oz	12	0	Carrots only.
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	Carrots: 32 fl oz per year Beets: 25.6 fl oz per year	12	Carrots: 21 Beets: 1	–
	3A	*Fastac CS (alpha-cypermethrin)	1.3–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.28–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	5	Radiant SC (spinetoram)	Leaves: 5–10 fl oz Roots: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 28 fl oz per year (carrots) and 32 fl oz per year (beets)	4	Leaves: 3 Roots: 3 (carrots) and 7 (beets)	–
	18	Intrepid 2F (methoxyfenozide)	Leaves: 4–16 fl oz Roots: 8–16 fl oz	64 fl oz	4	Leaves: 1 Roots: 14	–
	22	Avaunt Evo (indoxacarb)	3.5–6.0 oz	24 oz	12	7	Beets only.
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	10–20.5 fl oz	0.4 lb a.i. per year	12	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Vantacor (chlorantraniliprole)	1.2–2.5 fl oz	5.1 fl oz	4	1	–
	28	Verimark (cyantraniliprole)	10–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	32	Spear-Lep (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	10 gal per year	4	0	Must be tank-mixed with a <i>Bacillus thuringiensis</i> (Bt) product.
Grasshoppers	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
Leafhoppers	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2 qt	–	12	7	No more than 6 applications.
	1B	Malathion 5EC (malathion)	1.5–2.0 pt	–	Beets: 12 Carrots: 24	7	No more than 3 applications for beets and 2 applications for carrots.
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	7	Carrots only.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14 fl oz	12	0	Carrots only.
	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	4A	Actara (thiamethoxam)	1.5–4.0 oz	8 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 5 Soil: 21	Leaves may be used for food.
	4A	Platinum 75SG (thiamethoxam)	1.7–4.0 oz	4.0 oz	12	At planting	–
	4C	Transform WG (sulfoxaflor)	1.5–2.75 oz	8.5 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
	5	Radiant SC (spinetoram)	Leaves: 5–10 fl oz Roots: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 28 fl oz per year (carrots) and 32 fl oz per year (beets)	4	Leaves: 3 Roots: 3 (carrots) and 7 (beets)	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Mole crickets and wireworms	1B	*Diazinon AG500 *50W (diazinon)	AG500: 1-4 qt 50W: 2-8 lb	AG500: 4 qt per year 50W: 8 lb per year	72	Preplant	-
Plant bugs	3A	*Fastac CS (alpha-cypermethrin)	3.2-3.8 fl oz	11.4 fl oz	12	1	-
	29	Beleaf 50 SG (flonicamid)	2.0-2.8 oz	8.4 oz per year	12	3	-
Stink bugs	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63-2.5 lb XLR, 4F: 0.5-2 qt	-	12	7	No more than 6 applications.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63-2.5 lb XLR, 4F: 0.5-2 qt	-	12	7	No more than 6 applications.
Tarnished plant bug	3A	*Mustang Maxx (zeta-cypermethrin)	3.2-4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Asana XL (esfenvalerate)	9.6 fl oz	96 fl oz	12	7	Carrots only.
Weevils	3A	*Baythroid XL (beta-cyfluthrin)	1.6-2.8 fl oz	14 fl oz	12	0	Carrots only.
	3A	*Fastac CS (alpha-cypermethrin)	1.8-3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76-4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions.

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

*Restricted use insecticide.

Table 11. Insecticides labeled for management of arthropod pests of radish. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5 pt 8F: 1.0 pt	-	12	7	No more than 3 applications per year.
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	32 fl oz per year	12	21	-
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	-
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	-
	4A	Actara (thiamethoxam)	1.5–3.0 oz	4 oz	12	7	-
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 1.2 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 21	-
	4A	Platinum 75 SG (thiamethoxam)	1.7–2.17 oz	2.17 oz	12	At planting	-
	4C	Transform WG (sulfoxaflor)	Leaf production: 0.75–1.0 oz Root production: 0.75–1.5 oz	8.5 oz per year	24	7	-
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	-
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per year	12	1	-
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz per year	12	3	-
	1A	Sevin 4F, XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	7	-
	1B	Malathion 8F (malathion)	1.0 pt	-	12	7	No more than 3 applications per year. Flea beetles only.
Beetles (includes cucumber beetle, flea beetles) and weevils	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	19.2 fl oz	12	7	-
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14.0 fl oz	12	0	-
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	32 fl oz	12	21	-
	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	4 oz	12	7	Flea beetles only.
	4A	Admire Pro (imidacloprid)	1.2 fl oz	1.2 fl oz	12	7	–
	4A	Platinum 75 SG (thiamethoxam)	1.7–2.17 oz	2.17 oz	12	At planting	–
Caterpillars (includes cutworms, armyworms, corn earworm, hornworm, loopers, webworms, saltmarsh caterpillar)	1A	*Lannate SP, *LV (methomyl)	SP: 0.5 lb LV: 1.5 pt	SP: 4 lb LV: 12 pt	48	3	Label is a 24(c) local indemnified label for beet armyworm control in Florida, and a waiver of liability must be signed for use.
	1A	Sevin 4F, XLR Plus (carbaryl)	1–2 qt	6 qt per year	12	7	–
	1B	*Diazinon AG-500 *Diazinon 50W (diazinon)	AG500: 2–4 qt 50W: 4–8 lb	AG500: 4 qt per year 50W: 8 lb per year	72	Preplant	–
	3A	*Asana XL (esfenvalerate)	5.8–9.6 fl oz	19.2 fl oz	12	7	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14.0 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	32 fl oz per year	12	21	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.28–4.0 fl oz	24 fl oz	12	1	–
	5	Radiant SC (spinetoram)	Foliage harvest: 5–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	3	–
	18	Intrepid 2F (methoxyfenozide)	Leaves: 4–16 fl oz Roots: 8–16 fl oz	64 fl oz	4	Leaves: 1 Roots: 14	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	10.0–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Vantacor (chlorantraniliprole)	1.2–2.5 fl oz	5.1 fl oz	4	1	–
	28	Verimark (cyantraniliprole)	10–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	32	Spear-Lep (GS-omega/kappa-Htx-Hv1a)	1–2 pt	10 gal per year	4	0	Must be tank-mixed with a <i>Bacillus thuringiensis</i> (Bt) product.
Grasshoppers, mole crickets	1B	*Diazinon AG-500 *Diazinon 50W (diazinon)	AG500: 1 qt 50W: 2 lb	AG500: 4 qt per year 50W: 8 lb per	72	Preplant	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	–
	1A	Sevin 4F, XLR Plus (carbaryl)	0.5–1.0 qt	6 qt per year	12	7	–
Leafhoppers	1B	Malathion 8F (malathion)	1.0 pt	–	12	7	No more than 3 applications per year.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	14.0 fl oz	12	0	Do not consume tops.
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	4 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 1.2 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.7–2.17 oz	2.17 oz	12	At planting	–
	4C	Transform WG (sulfoxaflor)	1.5–2.75 oz	8.5 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
	5	Radiant SC (spinetoram)	Foliage harvest: 6–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	3	–
	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	32 fl oz per year	12	21	–
Stink bugs, plant bugs, meadow spittlebug	1A	Sevin 4F, XLR Plus (carbaryl)	1–2 qt	6 qt per year	12	7	–
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips (check label for species controlled)	4A	Admire Pro (imidacloprid)	Soil: 4.4–10.5 fl oz	10.5 fl oz	12	Soil: 21	–
	5	Radiant SC (spinetoram)	Foliage harvest: 6–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	3	–
Whiteflies	3A	*Brigade 2EC (bifenthrin)	5.12–6.4 fl oz	32 fl oz per year	12	21	–
	4A	Actara (thiamethoxam)	3.0–4.0 oz	4 oz	12	7	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 1.2 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 21	–
	4A	Platinum 75 SG (thiamethoxam)	1.7–2.17 oz	2.17 oz	12	At planting	–
	4C	Transform WG (sulfoxaflor)	2–2.75 oz	8.5 oz per yea	24	7	–
	4D	Sivanto Prime (flupyradifurone)	10.5–14.0 fl oz	28 fl oz per year	4	7	–
	29	Beleaf 50 SG (flonicamid)	2.8 oz	8.4 oz per year	12	3	–
	1B	*Diazinon AG-500 *Diazinon 50 W (diazinon)	AG500: 3–4 qt 50W: 6–8 lb	AG500: 4 qt per year 50W: 8 lb per	72	Preplant	–
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 12. Insecticides labeled for management of arthropod pests of sweetpotato. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	7	Many other brands with same active ingredient are available.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	27.0 fl oz	24	14	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	6 oz	12	14	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 125	–
	4A	Assail 30SG (acetamiprid)	2.5–4.0 oz	16 oz per year	12	7	–
	4A	Belay (clothianidin)	In-furrow or side-dress: 9–12 fl oz Foliar: 2–3 fl oz	12 fl oz per year	12	Foliar: 14	–
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting	–
	4C	Transform WG (sulfoxaflor)	Leaf production: 0.75–1.0 oz Root production: 0.75–1.5 oz	8.5 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
	9B	Fulfill (pymetrozine)	2.75–5.5 oz	11 oz	12	14	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	9.6 fl oz	12	7	–
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	7	–
	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz per year	12	7	–

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Beetles (including cucumber beetle, Japanese beetle, tortoise beetle, flea beetle, whitefringed beetle)	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 1.25–2.5 lb XLR, 4F: 1–2 qt	80S: 10 lb XLR, 4F: 8 qt	12	7	–
	1B	Imidan 70 W (phosmet)	1.3 lb	–	Seedbed treatment: 4 days Foliar: 5 days	7	No more than 5 applications per season. Do not apply through irrigation system. Crop must be mechanically harvested.
	1B	*Mocap 15 G, *EC (ethoprop)	15G: 1.6–2.1 lb/1000 row ft EC: 5.1–6.9 fl oz/1000 row ft	–	48	Preplant	No more than 1 application 2–3 weeks before planting.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	Soil: At plant: 9.6–19.2 fl oz At lay-by: 3.2–9.6 fl oz Foliar: 2.1–6.4 fl oz	32 fl oz per year	12	21	–
	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Many other brands with same active ingredient are available.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	27.0 fl oz	24	14	–
	4A	Actara (thiamethoxam)	1.5–3.0 oz	6 oz	12	14	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 125	–
	4A	Assail 30SG (acetamiprid)	1.5–4.0 oz	16 oz per year	12	7	–
	4A	Belay (clothianidin)	In-furrow or side-dress: 9–12 fl oz Foliar: 2–3 fl oz	12 fl oz per year	12	Foliar: 14	Flea beetles only.
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting	Flea beetles only.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (including armyworms, loopers, corn earworms, hornworms, webworms, saltmarsh caterpillars)	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2.0–2.75 fl oz Soil: 11.5–13.25 fl oz	Foliar: 8 fl oz Soil: 13.25 fl oz	12	Foliar: 7 Soil: apply preplant, preemergence or at ground crack	Flea beetles only.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4 oz	8 oz	12	14	–
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 1.25–2.5 lb XLR, 4F: 1–2 qt	80S: 10 lb XLR, 4F: 8 qt	12	7	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2 EC (bifenthrin)	Soil: At plant: 9.6–19.2 fl oz At lay-by: 3.2–9.6 fl oz Foliar: 2.1–6.4 fl oz	32 fl oz per year	12	21	–
	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Many other brands with same active ingredient are available.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	27.0 fl oz	24	14	–
	5	Radiant SC (spinetoram)	Foliage harvest: 5–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	Leaves: 3 Roots: 7	–
	15	Rimon 0.83 EC (novaluron)	6–12 fl oz	24 fl oz	12	14	–
	18	Intrepid 2F (methoxyfenozide)	6–10 fl oz	64 fl oz per year	4	7	–
	22	Avaunt eVo (indoxacarb)	2.5–6.0 oz	24 oz	12	7	–
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz	4	1	–
	28	Exirel (cyantraniliprole)	10–20.5 fl oz	0.4 lb a.i. per year	12	1	–
	28	Vantacor (chlorantraniliprole)	1.2–2.5 fl oz	5.1 fl oz	4	1	–

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafhoppers	28	Verimark (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz at planting or 0.4 lb a.i. per year	4	At planting	–
	32	Spear-Lep (GS-omega/kappa-Htx-Hv1a)	1–2 pt	10 gal per year	4	0	–
	1B	Malathion 5EC (malathion)	1.5–2.5 pt	–	12	0	No more than 2 applications per year.
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Fastac CS (alpha-cypermethrin)	1.8–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	1.76–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	27.0 fl oz	24	14	--
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 125	–
	4A	Assail 30SG (acetamiprid)	1.5–4.0 oz	16 oz per year	12	7	–
	4A	Platinum 75SG (thiamethoxam)	1.66–2.67 oz	2.67 oz	12	Applied at planting	–
	4A	Scorpion 35 SL (dinotefuran)	Foliar: 2.0–2.75 fl oz Soil: 11.5–13.25 fl oz	Foliar: 8 fl oz Soil: 13.25 fl oz	12	Foliar: 7 Soil: apply preplant, preemergence, or at ground crack	–
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4 oz	8 oz	12	14	–
	4C	Transform WG (sulfoxaflor)	1.5–2.75 oz	8.5 oz per year	24	7	–

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Leafminers	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	7	–
	1B	Malathion 5EC (malathion)	1.5–2.5 pt	–	12	0	No more than 2 applications per year.
	4A	Actara (thiamethoxam)	1.5–3.0 oz	6 oz	12	14	–
Mites	5	Radiant SC (spinetoram)	Foliage harvest: 5–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	Leaves: 3 Roots: 7	–
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz per year	12	14	–
	15	Rimon 0.83 EC (novaluron)	6–12 fl oz	24 fl oz	12	14	–
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz per year	12	14	–
Stink bugs, plant bugs	23	Oberon 2SC (spiromesifen)	8–16 fl oz	32 fl oz	12	7	–
	3A	*Fastac CS (alpha-cypermethrin)	3.2–3.8 fl oz	11.4 fl oz	12	1	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	Leaves cannot be used for food or feed.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	7	Many other brands with same active ingredient are available.
Sweetpotato weevil	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	27.0 fl oz	24	14	–
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz per year	12	7	–
	1B	Imidan 70 W (phosmet)	1.3 lb	–	Seedbed treatment: 4 days Foliar: 5 days	7	No more than 5 applications. Crop must be mechanically harvested.

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	16.8 fl oz	12	0	–
	4A	Belay (clothianidin)	9–12 fl oz	12 fl oz per year			–
Thrips (check label for species controlled)	5	Radiant SC (spinetoram)	Foliage harvest: 5–10 fl oz Root harvest: 6–8 fl oz	Leaves: 34 fl oz per year Roots: 24 fl oz per year	4	Leaves: 3 Roots: 7	–
Whitefly	1B	Malathion 5EC (malathion)	1.5–2.5 pt	–	12	0	No more than 2 applications per year.
	3A	*Brigade 2EC (bifenthrin)	2.1–6.4 fl oz	32 fl oz per year	12	21	–
	3A	*Warrior II (lambda-cyhalothrin)	2.1–6.4 fl oz	7.68 fl oz	24	7	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	10 fl oz	24	14	–
	4A	Admire Pro (imidacloprid)	Foliar: 1.2 fl oz Soil: 4.4–10.5 fl oz	Foliar: 3.7 fl oz Soil: 10.5 fl oz	12	Foliar: 7 Soil: 125	–
	4C	Transform WG (sulfoxaflor)	2–2.75 oz	8.5 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7–14 fl oz	28 fl oz per year	4	7	–
	15	Rimon 0.83 EC (novaluron)	6–12 fl oz	24 fl oz	12	14	–
	23	Movento (spirotetramat)	4.0–5.0 fl oz	10 fl oz	24	7	–
	23	Oberon 2SC (spiromesifen)	8–16 fl oz	32 fl oz	12	7	–

Insects	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Wireworms	1B	*Mocap 15 G, *EC (ethoprop)	15G: 1.6–2.1 lb/1000 row ft EC: 5.1–6.9 fl oz/1000 row ft	-	48	Preplant	No more than 1 application 2–3 weeks before planting.
	3A	*Brigade 2 EC (bifenthrin)	Foliar: 2.1 – 6.4 fl oz At plant: 9.6–19.2 fl oz At lay-by: 3.2–9.6 fl oz	32 fl oz per year	12	21	-
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 13. Beet fungicides ordered by disease and then FRAC group according to their mode of action. Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production. Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria, powdery mildew	7	Fontelis SC (penthioopyrad)	30 fl oz	61 fl oz	0	0.5	No more than 2 sequential applications before alternating to dissimilar chemistry.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	No more than 2 sequential applications before alternating to dissimilar chemistry.
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	19	OSO 5% SC (polyoxin D zinc salts)	13 fl oz	84 fl oz	0	4 hr	-
Cercospora	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Top Cop w/Sulfur	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
	M2	(sulfur) Many brands available: Kumulus DF, Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur, Wettable Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	(propiconazole) Many brands available: Bumper 41.8EC, Propiconazole 3.6 EC, Propicure 3.6 F, Propi-Star EC, Tilt	See individual label	See individual label	7	0.5	No more than 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	(tebuconazole) Many brands available: Folicur 3.6F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6L, Tebustar 3.6L, Tebuzol 3.6F, Toledo	7.2 fl oz	28.8 fl oz	7	0.5	No more than 4 applications per season.
	7	Fontelis (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	No more than 2 sequential applications before alternating to dissimilar chemistry.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	No more than 2 sequential applications before alternating to dissimilar chemistry.
	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	0.5	No more than 3 applications per crop. Alternate chemistry.
	11	Flint Extra (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	3.75 qt	0	4 hr	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	M3	Defiant 75WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.
	M3	Signet (thiram)	5.0 oz/100 lb of seed	-	-	1	Seed treatment only.
Damping-off	33	(mono- and dipotassium salts of phosphorous acids) Many brands available: Confine Xtra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Rampart	3 qt	-	0	4 hr	See label for details.
Downy mildew	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	7	0.5	No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pythium seedling blight	4	Apron XL LS (mefenoxam)	0.64 fl oz/100 lb seed	-	-	2	Seed treatment only.
	4	(metalaxyl) Various brands available: Acquire, Allegiance FL, Dynashield, Metalaxyl 318 FS	0.75 fl oz/100 lb seed	-	-	0.5	Seed treatment only.
	4	Metastar 2E (metalaxyl)	8 pt	-	-	1	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
Pythium seedling diseases	4	Sebring (metalaxyl)	0.7 fl oz/100 lb seed	-	-	1	Seed treatment only.
	4	Ridomil Gold EC (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ridomil Gold GR (mefenoxam)	40 lb	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	Ultra Flourish (mefenoxam)	4 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	Uniform SC (mefenoxam + azoxystrobin)	0.34 fl oz/1000 row ft	-	-	0	Soil incorporated. No more than 1 application.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	12	Spirato 480 FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
Various diseases	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 14. Carrot fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria blight	M1	(copper compounds) Many labels available: Badge SC, Badge X2, Basic Copper 53, Champ, Champ DP, Champ Formula 2, Champ WG, COC DF, COCS WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide, Kocide 2000, Kocide 3000, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop HB, Previsto, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur (chlorothalonil)	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
	M5	Many labels available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	See individual label	See individual label	7	0.5	-
	M5 + 33	Catamaran (chlorothalonil + phosphite)	4 pt	50 pt	0	0.5	-
	2	(iprodione) Many labels available: Enclosure 4F, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4F	2 pt	8 pt	0	1	-
	3	(propiconazole) Many labels available: Amcide, Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt, Topaz, Willowood Azoxy	4 fl oz	16 fl oz	14	0.5	No more than 4 total applications.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	Ridomil Gold Bravo (mefenoxam + chlorothalonil)	2 lb	-	7	2	-
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	-	7	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Endura (boscalid)	7.8 oz	22.5 oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7	Fontelis (penthioopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Amistar or other QoI fungicides. See label for soil application.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti, and rotate with non-QoI fungicides.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	7	Endura (boscalid)	7.8 oz	22.4 oz	0	0.5	See label for additional instructions.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	-	7	0.5	See label for additional instructions.
Botrytis rot, sclerotinia white mold	29	Omega (fluzazinam)	1 pt	-	7	0.5	White mold only.
	M5	(chlorothalonil) Many labels available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	See individual label	See individual label	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4	Metastar 2E (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
	4	Ridomil Gold Ultra Flourish (mefenoxam)	2 pt	-	7	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	-
	4 + M5	Ridomil Gold Bravo (mefenoxam + chlorothalonil)	2 lb	-	7	2	-
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	-	7	2	-
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	21	Ranman (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be applied with a fungicide of different mode of action.
	M1	(copper compounds) Many labels available: Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, COC DF, COCS WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kocide DF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Nu-Cop XLR, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	(propiconazole) Many labels available: Amcide Propiconazole, Bumper 41.8EC, Fitness, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	No more than 4 total applications.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	Ridomil Gold Bravo (mefenoxam + chlorothalonil)	2 lb	-	7	2	-
	4 + M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	-	7	2	-
	7	Fontelis (penthioopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	230 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Amistar or other QoI fungicides. See label for soil application.
	M3	Defiant 75WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.
	M2	(sulfur compounds) Many brands available: Dusting Sulfur – Crusade, IAP, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	(propiconazole) Many labels available: Amcide Propiconazole, Bumper 41.8EC, Fitness, Propimax, Propi-Star EC, Shar-Shield PPZ, Tilt	4 fl oz	16 fl oz	14	0.5	No more than 4 total applications.
Damping-off Powdery mildew	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Fontelis (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Merivon SC (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti, and rotate with non-Qol fungicides.
	11 + 3	Avaris Quilt Willowood Azoxy (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Pythium	11 + 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	33 + M2	Sanction (potassium phosphate + sulfur)	6 pt	-	-	2	-
	21	Ranman (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
Pythium damping-off	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be applied with a fungicide of different mode of action.
	4	Acquire, Sebring 318FS, Sebring 480FS, Metalaxyl 4.0 ST (metalaxyl)	0.7 fl oz/100 lb of seed	-	-	1	Seed treatment only.
Pythium seedling blight	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb of seed	-	-	2	Seed treatment only.
	4	Metastar 2E (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
	4	Ridomil Gold (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4	Ridomil Gold SL Ultra Flourish (mefenoxam)	2 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Various (see label)	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	23 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Pristine (boscalid + pyraclostrobin)	10.5 oz	63 oz	0	0.5	No more than 6 applications crop and alternate chemistry.
	11	(azoxystrobin) Many labels available: Azoxystar, Azoxyzone, Equation SC, Quadris, Satori, Trevo, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/ 1000 ft	3.75 qt	0	4 hr	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Heritage (azoxystrobin)	10.5 oz	4 lb	0	4 hr	No more than 3 sequential applications before alternating to a fungicide of dissimilar mode of action.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	No more than 2 sequential applications and 6 total applications of Quadris Opti, and rotate with non-Qol fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	7	0.5	No more than 1 sequential application and 4 total applications of Quadris Top.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	-
	29	Omega (fluzinam)	1 pt	4 pt	7	0.5	For southern blight, apply 45 days prior to harvest.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart	3 qt	-	0	4 hr	-
	12	Maxim 4FS Spirato 480 FS (fludioxonil)	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
Various seedling diseases							

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 15. Radish fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria leaf spot	7	Fontelis (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	–
	11	(azoxystrobin) Various brands available: Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides.
	3	Tilt (propiconazole)	4 fl oz	16 fl oz	14	0.5	–
Cercospora leaf spot	3 + 11	Quilt (propiconazole + azoxystrobin)	14 fl oz	56 fl oz	14	0.5	Alternate with fungicides of dissimilar modes of action.
	7	Fontelis (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	–
	11	(azoxystrobin) Many brands available: Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Damping-off	11	Flint Extra (trifloxystrobin)	3 oz	12 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	M3	Defiant 75WP (thiram)	5.3 oz/100 lb of seed	-	-	1	Seed treatment only.
Downy mildew	4 + M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	-
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Confine Extra, Fosphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Rampart	3 qt	-	0	4 hr	See label for details.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.
	M2	(sulfur compounds) Many brands available: Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7	Fontelis (penthioopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	11	(azoxystrobin) Many brands available: Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.
	21	Presidio (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pythium damping-off	4	Acquire Sebring 318FS Sebring 480FS (metalaxyl)	0.7 fl oz/100 lb of seed	-	-	1	Seed treatment only.
	4	Apron XL (mefenoxam)	0.64 fl oz/100 lb of seed	-	-	2	Seed treatment only.
Pythium seedling blight	4	Metastar 2E (metalaxyl)	8 pt	-	-	2	Apply as a broadcast soil application and incorporate into top 2 in. See label for directions.
	4	Ridomil Gold (mefenoxam)	2 pt	-	-	2	Apply at seeding in a 7 to 12 in. band on soil over seed furrow.
	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
White rust	11	(azoxystrobin) Many brands available: Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.
Various (see label)	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications before rotating to a fungicide of dissimilar mode of action.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	(azoxystrobin) Many brands available: Quadris, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	62 fl oz	0	0.5	No more than 1 sequential application and 4 total applications of Qol fungicides. See label for soil application.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Confine Extra, Fosiphite, Fungi-phite, K-Phite 7LP, Oxiphos, Rampart	3 qt	-	0	4 hr	See label for details.
Various seedling diseases	12	(fludioxonil) Many brands available: Dynashield, Maxim 4FS, Spirato 480 FS	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 16. Sweetpotato fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Alternaria leaf blight	BM01 + 3	Regev (tea tree oil, difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	32.4 fl oz	14	0.5	-
	9	Vango WG (cyprodinil)	7 oz	28 oz	14	0.5	-
	9 + 12	Alterity 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	9 + 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Alternate with another labeled non-Group 9 or 12 fungicide for 2 applications after 2 applications of Switch WG.
	9 + 12	Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	-
	11	Acadia LFC (azoxystrobin)	25.6 fl oz	155 fl oz	14	4 hr	-
	11	Aframe (azoxystrobin)	15.5 fl oz	123 fl oz	0	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11	(azoxystrobin) Many brands available: Arius 250, Atticus Acadia 2 SC, A-Zox 25SC, Azoxystar, GCS Azoxy 25C, Tetraban Fungicide, Trevo	20 fl oz	123 fl oz	14	4 hr	No more than 2 sequential applications, including other Group 11 fungicides, before alternating with another group.
	11	Azoxystrobin SC (azoxystrobin)	20.3 fl oz	123 fl oz	14	4 hr	-
	11	AZteroid FC 3.3 (azoxystrobin)	12.8 fl oz	77.6 fl oz	14	4 hr	-
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	No more than 1 consecutive application.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Ascochyta leaf spot	11	Headline Fungicide (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	No more than 2 sequential applications, including other Group 11 fungicides.
	11	Quadris Flowable (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	No more than 1 consecutive application.
	11	Satori (azoxystrobin)	20 fl oz	120 fl oz	14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	12	Palladium (fludioxonil)	14 fl oz	56 fl oz	7	0.5	-
	3 + 7	Miravis Top (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates. Reapplications at least 7 days apart.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 containing fungicides.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	11	Acadia LFC (azoxystrobin)	25.6 fl oz	155 fl oz	0 or 14	4 hr	-
	11	Aframe Quadris Flowable (azoxystrobin)	15.5 fl oz	120 fl oz	0 or 14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11	(azoxystrobin) Many brands available: Arius 250, Atticus Acadia 2 SC, A-Zox 25SC, Azoxystar, GCS Azoxystar 25C, Satori Fungicide, Tetraban Fungicide, Trevo	20 fl oz	123 fl oz	0 or 14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11	Azoxystrobin SC (azoxystrobin)	20.3 fl oz	123 fl oz	0 or 14	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Black dot	11	AZteroid FC 3.3 (azoxystrobin)	12.8 fl oz	77.6 fl oz	0 or 14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11 + 3	Acadia ESQ Quadris Top Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 consecutive applications; addition of a spreading/penetrating adjuvant (nonionic surfactant or crop oil concentrate) is recommended.
	3	Provysol Fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	-
	3	Quash Fungicide (metconazole)	4 oz	16 oz	1	0.5	-
	3 + 11	Veltyma Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	-
	3 + 29	Orbus ESQ (difenoconazole + fluazinam)	14.5 fl oz	64 fl oz	14	2	-
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	-
	7	Velum Prime (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	-
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	-
	7 + 3	Aprovia Top Fungicide (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	-
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 containing fungicides.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	11	Aftershock Evito 480 SC (fluoxastrobin)	0.24 fl oz/1000 row ft	22.8 fl oz	7	0.5	No more than 1 application of seed treatment or in-furrow or banded application in conjunction with foliar application.
	11	Reason 500 SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	No more than 1 consecutive application.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Botrytis	11 + 3	Acadia ESQ Fungicide Quadris Top Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 consecutive applications; addition of a spreading/penetrating adjuvant (nonionic surfactant or crop oil concentrate) is recommended.
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl	34 fl oz	14	0.5	-
	3	Quash Fungicide (metconazole)	4.0 oz	16 oz	1	0.5	-
	7	Vertisan (penthioopyrad)	24 fl oz	72 fl oz	7	0.5	-
Cercospora leaf spot	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 fungicides.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	See label.
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	No more than 2 consecutive applications of Miravis Prime or other Group 7 fungicide before alternation with a fungicide that is not in Group 7.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	155 fl oz	0	4 hr	-
	11	Many brands available: Aframe, Arius 250, Atticus Acadia™ 2 SC, A-Zox 255C, AzoxyStar, Azoxystrobin SC, GCS Azoxy 25C, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	123 fl oz	14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Early blight	11	AZteroid FC 3.3 (azoxystrobin)	9.7 fl oz	77.6 fl oz	14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	-
	11	Headline Fungicide Headline SC Fungicide (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	-
	11	Quadris Flowable (azoxystrobin)	15.5 fl oz	120 fl oz	0	4 hr	-
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	No more than 1 postharvest application to the tubers.
	3	Provysoil Fungicide (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	-
	3	Quash Fungicide (metconazole)	4 oz	16 oz	1	0.5	-
	3 + 7	Miravis Top (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates. Reapplications at least 7 days apart.
	3 + 11	Veltyrna Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	-
	3 + 29	Orbus ESQ (difenoconazole + fluazinam)	14.5 fl oz	64 fl oz	14	2	-
	7	Bonafide (boscalid)	4.5 oz	20 oz	10	0.5	-
	7	Endura Fungicide (boscalid)	10 oz	20 oz	10	0.5	-
	7	Velum Prime (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	No more than 2 sequential applications or with Group 7 fungicides. Postplant drench or hill drench.
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Aprovia Top Fungicide (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. No more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications or with Group 7 or 9 fungicides.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	6.8 fl oz	20.4 fl oz	7	0.5	An adjuvant may be added at recommended rates.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	See label.
	9	Vango WG (cyprodinil)	7 oz	28 oz	14	0.5	-
	9 + 12	Alterity 62.5WG Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	14	0.5	-
	11	Aftershock Evito 480 SC (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	See label.
	11	Aproach (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	-
	11	Flint Extra (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	-
	11	Reason 500 SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	-
	11 + 3	Acadia ESQ Fungicide Quadris TOP Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Addition of nonionic surfactant or crop oil concentrate or blend is recommended.
	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6 pt	14	0.5	Tank-mix with chlorothalonil, maneb, or mancozeb for better control.
Phytophthora	4	ReCon 4 F (metalaxyl)	4 pt	-	-	2	Preplant incorporated or surface application to soil.
	4	Orondis Gold B (mefenoxam)	2 pt	1.5 lb a.i.	-	2	No more than 3 applications per crop.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pink rot	4	ReCon Bold SL (mefenoxam)	2 pt	1.5	-	2	-
	4	Ridomil Gold SL (mefenoxam)	2 pt	1.5 lb a.i.	-	2	Preplant incorporated broadcast or band application, soil spray.
	4	Thrive 4M (mefenoxam)	31.4 fl oz	-	-	2	Preplant incorporated or surface application to soil.
	4	Ultra Flourish (mefenoxam)	4 pt	1.5 lb a.i.	-	2	Preplant incorporated broadcast or band application, surface application.
	4	Xylar FC (metalaxyl)	2.9 qt	2.9 qt	-	-	Preplant incorporated broadcast or band application, surface application.
	43	Presidio Fungicide (fluopicolide)	4 fl oz	12 fl oz	7	0.5	-
	11	(azoxystrobin) Many brands available: Atticus Acadia 25C, A-Zox 25SC, Azoxystar, Azoxystrobin SC, GCS Azoxy 25C	0.6 fl oz/ton tubers	-	-	4 hr	No more than 1 postharvest application to the tubers.
	11	Satori Fungicide Tetraban Fungicide (azoxystrobin)	0.6 fl oz/ton tubers	-	-	-	-
	21	Ranman 400SC RenaZ SC (cyazofamid)	At planting: 0.42 fl oz/1000 linear ft Lay-by/hilling: 2.75 fl oz	27.5 fl oz	7	0.5	-
	22	Elumin (ethaboxam)	8 fl oz	16 fl oz	-	0.5	-
Powdery mildew	49	Orondis Gold 200 (oxathiapiprolin)	9.6 fl oz	9.6 fl oz	5	4 hr	Apply as an in-furrow application at planting.
	49 + 4	Orondis Gold (Premix) (oxathiapiprolin + mefenoxam)	Soil: 27.8 fl oz Foliar: 12 fl oz	27.8 fl oz	14	2	-
	BM 01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	M2	Microthiol Disperss (sulfur)	10 lb	-	-	1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M2	Thiolux (sulfur)	10 lb	-	-	1	OMRI listed. ³
	M2	Suffa (sulfur)	0.6 gal	2.8 gal	0	1	Apply at 14-day intervals or as needed.
	M2	Sulfur 80 WDG (sulfur)	10 lb	-	-	1	OMRI-listed. ³ Apply at early leaf stage; repeat every 14 days or as needed.
	M2	Sulfur 90W (sulfur)	20 lb	-	-	1	For greenhouse use.
	3	Quash Fungicide (metconazole)	4 oz	16 oz	1	0.5	No more than 2 sequential applications.
	3 + 7	Miravis Top (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates. Reapplications at least 7 days apart.
	3 + 11	Veltyma Fungicide (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	-
	7	Vertisan (penthioopyrad)	24 fl oz	72 fl oz	7	0.5	May be used with adjuvants; other crops cannot be planted until 120 days after the last application of Vertisan.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	7	0.5	Make no more than 2 sequential applications of Fontelis before switching to a fungicide with a different mode of action.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. No more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	-
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9	Vango WG (cyprodinil)	7 oz	28 oz	14	0.5	-
	9 + 12	Alterity 62.5WG Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	Leaves of root and tuber subgroup: 7 Tuberous and corm subgroup: 14	0.5	-
	9 + 12	Switch 62.5WG Palladium (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Alternate with another labeled fungicide for 2 applications after 2 applications of Switch WG.
	11	Acadia LFC (azoxystrobin)	19.5 fl oz	155 fl oz	14	4 hr	-
	11	Many brands available: Aframe, Arius 250, A-Zox 25SC, AzoxyStar, GCS Azoxy 2SC, Quadris Flowable, Satori Fungicide, Tetraban Fungicide, Trevo	15.5 fl oz	123 fl oz	0	4 hr	-
	11	Atticus Acadia 2SC (azoxystrobin)	20 fl oz	123 fl oz	0	4 hr	No more than 1 sequential application or with other Group 11 fungicides.
	11	Azteroid FC 3.3 (azoxystrobin)	9.7 fl oz	77.6 fl oz	Leaves of root and tuber subgroup: 0 Tuberous and corm subgroup: 14	4 hr	-
	11	Azoxystrobin SC (azoxystrobin)	15.3 fl oz	123 fl oz	0 or 14	4 hr	-
	11	Cabrio EG Fungicide (pyraclostrobin)	12 oz	48 oz	0	0.5	-
	11	Headline Fungicide Headline SC Fungicide (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	No more than 2 sequential applications or with other Group 11 fungicides.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Quadris Top Acadia ESQ Fungicide Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 sequential applications or with other Group 11 fungicides. Adding adjuvant may enhance the efficacy.
Pythium damping-off	4	Orondis Gold B (mefenoxam)	2 pt	1.5 lb a.i.	-	2	Preplant incorporated application or soil spray.
	4	ReCon 4 F (metalaxyl)	4 pt	-	-	2	-
	4	ReCon Bold SL (mefenoxam)	2 pt	2 pt	-	-	Preplant incorporated application or soil spray.
	4	Ridomil Gold SL (mefenoxam)	2 pt	-	-	2	-
	4	StartUp MEFEN (mefenoxam)	0.47 fl oz/100 lb seed	1 lb a.i.	-	-	-
	4	Thrive 4M (mefenoxam)	31.4 fl oz	-	-	2	-
	4	Ultra Flourish (mefenoxam)	4 pt	-	-	2	Preplant incorporated broadcast or band application, surface application.
	4	Xyler FC Fungicide (metalaxyl)	2.9 qt	-	-	2	-
	11	Acadia LFC (azoxystrobin)	1.0 fl oz/1000 row ft	155 fl oz	0 or 14	4 hr	-
	11	Aframe Satori Fungicide (azoxystrobin)	0.8 fl oz/1000 row ft	120 fl oz	14	4 hr	-
	11	(azoxystrobin) Many brands available: Atticus Acadia 2 SC, Arius 250, A-Zox 25SC, AzoxyStar, GCS Azoxy 25C, Azoxystrobin SC	0.8 fl oz/1000 row ft	123 fl oz	0 or 14	4 hr	In-furrow and banded applications over the row shortly after plant or during herbicide applications or cultivation.
	11	AZteroid FC 3.3 (azoxystrobin)	0.48 fl oz/1000 row ft	77.6 fl oz	14	4 hr	-
	11	Quadris Flowable (azoxystrobin)	0.8 fl oz/1000 row ft	120 fl oz	14	4 hr	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Tetran Fungicide (azoxystrobin)	0.8 fl oz/1000 row ft	123 fl oz	14	4 hr	-
	11 + 4	Uniform (azoxystrobin + mefenoxam)	0.34 fl oz/1000 ft row	-	-	0	No more than 1 application per crop season as an in-furrow spray.
	21	Ranman 400SC Fungicide Renaz SC (cyazofamid)	0.42 fl oz/1000 linear ft	27.5 fl oz	7	0.5	To avoid development of resistant strains, do not apply at reduced rate; rotate with other fungicides of a different group.
	22	Elumin Fungicide (ethaboxam)	8 fl oz	16 fl oz	-	0.5	Reapplications at least 25 days apart.
	43	Presidio Fungicide (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be tank-mixed with another fungicide of different group. No more than 2 sequential applications.
Rhizopus rot	49 + 9	Orondis Gold (Premix) Fungicide (oxathiapiprolin + mefenoxam)	In furrow: 27.8 fl oz Foliar: 12 fl oz	27.8 fl oz	14	2	-
	12	Scholar SC Pilato SC (fludioxonil)	Postharvest dip: 32 fl oz/100 gal water Spray: 16 fl oz/ 200,000 lb sweet potatoes	-	-	-	No more than 1 postharvest application.
	14	Botran 5F (DCNA dicloran)	0.6 qt in 100 gal water for postharvest or for root dip 5-10 seconds	-	-	0.5	See label.
	11 + 12	Archive (azoxystrobin + fludioxonil)	1.0 fl oz/2000 lb tubers	-	-	-	In-line spray.
Rust/white rust	BM01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. No more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Acadia LFC (azoxystrobin)	25.6 fl oz	155 fl oz	14	4 hr	-
	11	Aframe Satori Fungicide (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	No more than 1 sequential application, including other Group 11 fungicides.
	11	Azoxystrobin SC (azoxystrobin)	20.3 fl oz	123 fl oz	14	4 hr	-
	11	(azoxystrobin) Many brands available: Arius 250, Atticus Acadia 2 SC, A-Zox 25SC, AzoxyStar, GCS Azoxy 25C, Tetraban Fungicide, Trevo	20 fl oz	123 fl oz	14	4 hr	-
	11	AZteroid FC 3.3 (azoxystrobin)	12.8 fl oz	77.6 fl oz	14	4 hr	-
	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	0.5	Alternate with other labeled fungicides after each application.
	11	Headline Fungicide Headline SC Fungicide (pyraclostrobin)	12 fl oz	48 fl oz	3	0.5	Alternate with other labeled fungicides after each application.
	11	Quadris Flowable (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	No more than 1 application before alternating with a different mode of action.
	11	Reason 500SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	-
	11 + 3	Acadia ESQ Quadris Top Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 consecutive applications; adding adjuvant may enhance the efficacy.
	BM01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	3	Quash Fungicide (metconazole)	4 oz	16 oz	1	0.5	No more than 2 sequential applications.
Sclerotinia white mold	3 + 7	Miravis Top (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	Apply at early flowering, followed by a second application 14 days later. Reapplications at least 7 days apart.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3 + 29	Orbus ESQ (difenoconazole + fluazinam)	12.5 fl oz	64 fl oz	14	2	-
	7	Bonañide Endura (boscalid)	10 oz	20 oz	10	0.5	No more than 2 sequential applications or with other Group 7 fungicides.
	7	Velum Prime (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	-
	7	Fontelis Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	-
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	No more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 fungicides.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	32.4 fl oz	14	0.5	Apply at or before row closure, followed by a second application 14 days later; an adjuvant may be added at recommended rates.
	11	Aproach (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	-
	29	Omavo Omega 500F Orbus 4F Vantana (fluazinam)	8 fl oz	56 fl oz	14	0.5	-
	BM01 + 3	Regev (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	-
	7	Fontelis Vertisan (penthiopyrad)	1.6 fl oz/1000 row ft	24 fl oz	7	0.5	No more than 2 sequential applications.
	11	(azoxystrobin) Many brands available: Atticus Acadia 2SC, AzoxyStar, A-Zox 25SC, Azoxystrobin SC, GCS Azoxy 2SC, Tetraban Fungicide, Satori Fungicide	0.6 fl oz/ton tubers	-	-	4 hr	No more than 1 postharvest application to tubers.
Scurf							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Aftershock Evito 480 SC (fluoxastrobin)	0.24 fl oz/1000 row ft 9.2 fl oz	22.8 fl oz	7	0.5	No more than 1 application of seed treatment or in-furrow or banded application in conjunction with foliar application.
	11 + 12	Archive (azoxystrobin + fludioxonil)	1.0 fl oz/2000 lb tubers	-	-	-	In-line spray.
	11 + 12 + 3	Stadium (azoxystrobin + fludioxonil + difenoconazole)	0.5 fl oz/1000 lb tubers	-	-	-	-
	12	Pilato SC (fludioxonil)	0.6 fl oz/ton tubers	-	-	-	-
	14	Botran 5F (DCNA dicloran)	Seed dip: 0.6 qt/ 7.5 gal water Plant bed spray: 5.73 oz/1000 linear ft bed (42 in)	3.2 qt	-	0.5	Do not plant tomatoes as a follow-up crop.
	M2	Sulfur 80 WDG (sulfur)	5 lb/treated acre 10 lb	-	0	1	Do not use within 2 weeks of an oil spray treatment. OMRI-listed. ³ Apply at early leaf stage; repeat every 14 days or as needed.
Septoria leaf spot	3 + 7	Miravis Top (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates. Reapplications at least 7 days apart.
	3 + 29	Orbus ESQ (difenoconazole + fluazinam)	14.5 fl oz	64 fl oz	14	2	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. No more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	9	Vango WG (cyprodonil)	7 oz	28 oz	14	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9 + 12	Alterity 62.5WG Xuvia (cyprodinil + fludioxonil)	14 oz	56 oz	14	0.5	-
	11 + 3	Acadia ESQ Quadris Top Trevo DCZ (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	No more than 2 consecutive applications. Adding adjuvant may enhance the efficacy.
	11	Acadia LFC (azoxystrobin)	1.0 fl oz/1000 row ft	155 fl oz	0	4 hr	-
	11	Aframe Satori (azoxystrobin)	0.80 fl oz/1000 row ft	120 fl oz	14	4 hr	-
Southern blight (<i>Sclerotium rolfsii</i>)	11	(azoxystrobin) Many brands available: Atticus Acadia 2 SC, Arius 250, A-Zox 25SC, Azoxystar, Azoxystrobin SC, GCS Azoxystar 25SC, Tetraban, Trevo	0.80 fl oz/1000 row feet	123 fl oz	Tuberous and corm subgroup: 14	4 hr	-
	11	AZteroid FC3.3 (azoxystrobin)	0.48 fl oz/1000 row feet	77.6 fl oz	-	4 hr	-
	11	Quadris Flowable (azoxystrobin)	0.80 fl oz/1000 row feet	120 fl oz	-	4 hr	-
Various soilborne diseases	11	Many brands (azoxystrobin)	Various; see label	See label	4 hr	See label	-

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

Table 17. Nonfumigant nematicides for carrot, beet, and radish in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl) (carrot only)	Apply within 1 week before planting or before emergence if postplant, either broadcast (2 gal/A, incorporate 2 in. at least), in the seed furrow (1–2 gal/A), or via chemigation (1 gal/A). No more than 4 gal/A per season. Reapplications at least 14 days apart. No more than 8 applications per season. Last application at least 14 days to harvest.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop, and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Salibro (a.i. fluazaindolizine) (only for carrots)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated. Apply at 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year and no more than 30.7 fl oz/A applied by drip. No more than 2 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 14 days apart. Preharvest interval: Do not apply within 65 days of harvest.
Vydate is an insecticide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how best to apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 18. Nonfumigant nematicides for sweetpotato in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	When to Apply	Application Pattern	Incorporation Depth	Rate
Mocap 15G (a.i. ethoprop)	2–3 weeks preplant	Row, 12"–15" band	2"–4" with rotary hoe, tiller, etc., or by bedding over the band	20–26 lb/A or 1.6–2.1/1000 row ft (min. row spacing of 42")
Mocap EC (a.i. ethoprop)	2–3 weeks preplant	Row, 12"–15" band	2"–4" deep	5.1–6.9 fl oz/1000 ft row
Vydate L* (a.i. oxamyl)	Within 1 week before planting	Broadcast, band, or in-furrow transplant drench	4"–6" deep	2 gal/A broadcast or 1–2 gal/A in-furrow (Consult table for specific instructions and other uses.)
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop, and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.			
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A as an in-furrow spray during planting directed on or below seed, by using overhead chemigation equipment, or for transplanted crops, as a postplanting drench or hill drench. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). Do not apply Velum within 7 days of harvest. For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group. The grazing of livestock in treated areas within 7 days of application is prohibited.			
Salibro (a.i. fluazaindolizine)	Apply 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated. Apply 15.6–61.4 fl oz/A for in-furrow soil treatment. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year. No more than 30.7 fl oz/A applied post-emergence. No more than 2 applications per calendar year. Re-entry interval is 12 hr. Reapplications at least 14 days apart. Pre-harvest interval: Do not apply within 40 days of harvest.			
Biological nematicides	See chapter 19.			
Mocap and Vydate are insecticide/nematicides; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how best to apply them (see specific label recommendations). When nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants. *Vydate L has registration for nematode control on sweetpotatoes only as a broadcast or in-furrow treatment. Foliar applications are registered for insect control only. For broadcast or in-furrow treatments, Vydate L should be applied in a minimum of 20 gal of water. As a broadcast treatment thoroughly incorporate to a soil depth of 4–6 in.				

Table 19. Fumigant nematicides for carrot and sweetpotato in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other use and rate-modifying recommendations.

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 16. Strawberry Production¹

Vance M. Whitaker, Nathan S. Boyd, Natalia A. Peres, Johan Desaegeer, Sriyanka Lahiri, and Shinsuke Agehara²

Botany and Planting

Strawberry—*Fragaria* × *ananassa*, Rosaceae.

Table 1. Planting dates for strawberries.

Planting Region	Dates
North Florida	Sept 20–Oct 15
Central Florida	Sept 25–Oct 25
South Florida	Oct 1–Nov 1

Table 2. Planting information for strawberries.

Planting Parameters	Measurements
Number of plant rows per bed	2
Distance between beds (in)	48–60
Distance between plants within a row (in)	12–16
Distance between plant rows (in)	12–14
Days to first ripe fruit	35–50
Plant populations (acre)	16,000–20,000

Cultivars

These sections arrange cultivars in order from most to least utilized in Florida.

Main Cultivars

Florida Ember™ ‘FL 20.80-4’. Released in 2024. Medium to large fruit size; uniform conic fruit; bright red external color and light red to white internal color; low acid and high Brix similar to Florida Medallion™ ‘FL 16.30-128’; moderately resistant to rain damage; robust plant with medium vigor; N rates similar to ‘Florida Brilliance’. Recommended planting dates October 1–15. Resistant to moderately susceptible to most diseases with no high susceptibilities; excellent choice for organic production; of the UF varieties the least susceptible to *Pestalotia* caused by *Neopestalotiopsis rosae*.

Florida Encore™ ‘FL 20.34-183’. Released in 2024. Large fruit size; glossy surface with even red external color and medium red internal color; moderate acid and Brix; firm flesh with excellent shelf life and shipping quality; resistant to rain damage. Plant is vigorous with

recommended planting dates from October 12–22; moderate N rates similar to or lower than for ‘Florida Brilliance’. Moderately susceptible to *Colletotrichum* crown rot and charcoal rot. Moderately resistant to anthracnose fruit rot and phytophthora crown rot.

‘Florida Brilliance’. Released in 2017. High early yield; medium fruit size; uniform conic to broad-conic shape; very firm with excellent shelf life; externally very glossy red; light red internally; moderately resistant to rain damage; balanced flavor. The plant is robust but not overly vigorous; is upright with long stems, allowing ease of harvest; and does not require high N applications as Florida Medallion™ ‘FL 16.30-128’ does. Fruit can develop weak skin during hot periods in mid-late season, and both N rates and irrigation volumes should be reduced to counteract this possible problem. Recommended planting dates in central Florida are October 5–15. Resistant to anthracnose fruit rot and *Colletotrichum* crown rot; moderately to powdery mildew and charcoal rot; moderately susceptible to *Botrytis* fruit rot, angular leaf spot, and *Colletotrichum* crown rot; susceptible to *Phytophthora* root rot.

Florida Medallion™ ‘FL 16.30-128’. Released in 2020. Medium size; extremely uniform, conic fruit with glossy appearance; glossy-red external color and medium-red internal color; moderately acidic and high Brix; moderately firm with good shipping quality. Low to medium plant vigor with upright canopy; N rates higher than for ‘Florida Brilliance’ will be required for optimum plant growth. Recommended planting dates in central Florida are October 1–10 due to a compact plant. Moderately susceptible to *Colletotrichum* crown rot and angular leaf spot; susceptible to *Botrytis* fruit rot, powdery mildew, and *Phytophthora* root rot; highly susceptible to charcoal rot and anthracnose fruit and root rots.

Minor Cultivars

Sweet Sensation® ‘Florida127’. Released in 2013. Large fruit size; moderately uniform conic to broad-conic fruit; bright red with lighter color than other cultivars. Exceptional flavor throughout season; 1.0–1.5°Brix higher and slightly lower acidity than ‘Florida Brilliance’; susceptible to rain damage. The plant is vigorous, which may be an advantage in north Florida but in central Florida it will require reduced nutrient applications early in the season and/or later planting dates to maintain a small plant size. Recommended N rates are lower than for ‘Florida Brilliance’. Recommended planting dates in central Florida are October 15–25. Resistant to anthracnose fruit rot and *Colletotrichum* crown rot; moderately resistant to charcoal rot; moderately susceptible to angular leaf spot; susceptible to *Botrytis* fruit rot and powdery mildew; highly susceptible to *Phytophthora* root rot. Ridomil and phosphite applications are highly recommended.

Florida Pearl® ‘66’ and ‘220’. This variety produces white strawberries, also called “pineberries.” It is the result of hybridization between descendants of Japanese white strawberries, the source of its unique color, and red Florida strawberries, the source of its yield, disease resistance, and other commercial production qualities. The fruit has pure white internal color and a white external base color with red seeds and a pink blush when ripe. Fertilization rates for ‘66’ should be similar to those of ‘Florida Brilliance’, while ‘220’ will need higher fertility rates due to a more compact and less vigorous plant. Recommended planting dates in central Florida are October 10–20 for ‘66’ and October 1–15 for ‘220’. The cultivar ‘66’ also has the best disease resistance profile with few weaknesses and is moderately resistant to *Pestalotia* caused by *Neopestalotiopsis rosae*.

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 3. Herbicides approved for managing weeds in strawberry. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

	Active Ingredient	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PRETRANSPLANT	Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles. PHI 60 days.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Broadleaves. Apply as a preplant burndown for emerged broadleaves up to 4 in. tall or rosettes less than 3 in. across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
	Flumioxazin 0.1	(Chateau) EZ 3 oz	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles before weed emergence. 30-day pretransplant interval if applied under the plastic mulch. No more than 1 application per year.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaves and grasses. Apply preplant or in row middles with a shielded applicator; PHI 14 days. Consult label for individual product directions.
	Napropamide 4.0	(Devrinol) 2-XT 1–2 gal (Devrinol DF XT) 4–8 lb	15	Annual broadleaves and grasses. Apply under the plastic and in row middles. Mechanically incorporate in the row middle to a 1–2 in. depth within 24 hr of application. When applied under plastic, incorporate mechanically or with irrigation. Do not apply between bloom and harvest.
	Oxyfluorfen 0.25–0.5	(Galigan H2O, GoalTender) 4 EC 0.5–1.0 pt (Collide, Goal 2XL) 2 EC 1–2 pt	14	Broadleaves. Apply pretransplant just prior to installation of plastic mulch. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or post-transplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.
	Pendimethalin 0.72	(Prowl H20) 3.8 1.5 pt	3	Broadleaves and grasses in row middles. Do not apply under the plastic. In systems that use irrigation at planting, delay application until after irrigation regime. PHI 35 days.
	S-metolachlor 0.64–1.27	Dual Magnum 0.67–1.33 pt	15	Broadleaves, grasses, and nutsedge suppression. Apply to row middles using a shielded applicator pre- and posttransplant. Label is a 24(C) local indemnified label, and a waiver of liability must be signed for use. PHI 30 days.
	Sulfentrazone 0.125	(Spartan FL) 4F 4 oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
POSTTRANSPLANT	Terbacil 0.2	(Sinbar WDG) 80 WDG 4 oz	3	Broadleaves, grasses, and some sedges. No more than 1 application per crop of 4 oz/A after bedding but prior to transplanting. Rainfall or irrigation required. Do not apply to soils with less than 0.5% organic matter. PHI 110 days.
	Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt	14	Broadleaves. Apply directed to the row middles with a shielded or hooded sprayer. Do not allow to contact strawberry plants. PHI 60 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Broadleaves. Apply with hooded applicator directed to the row middles for control of emerged broadleaves up to 4 in. tall or rosettes less than 3 in. across. Good coverage is essential. A nonionic surfactant, methylated seed oil or crop oil concentrate is recommended. PHI 0 days.
	Clethodim 0.09–0.13 0.07–0.13	(Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. PHI 4 days.
	Clopyralid 0.125–0.25	(Stinger) 3 EC 0.33–0.66 pt	4	Broadleaves. No more than 2 applications of 0.33 pt/A per year. Do not include a surfactant. PHI 7 days.
	Fluazifop-P-butyl 0.25	Fusilade DX 16 fl oz	1	Supplemental label. Emerged annual and perennial grasses. Most effective on young, actively growing grasses. No more than 1 application per year. PHI 14 days.
	Flumioxazin 0.1	(Chateau) EZ 3 oz	14	Broadleaves. May be applied with a shielded or hooded spray directed to row middles before weed emergence. Do not apply after fruit set.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply directed to the row middles. Injury has been observed from translocation from daughter plants in the row middle to the mother plants. PHI 14 days. Spot treatment has 7-day PHI.
	Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Apply as a directed spray to row middles only. Do not allow spray to contact plants. No more than 3 applications per season. Nonionic surfactant recommended. PHI 21 days. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or posttransplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.
	Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grasses. No more than 2.5 pt/A per season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. PHI 7 days.
	S-metolachlor 0.64–1.27	Dual Magnum 0.67–1.33 pt	15	Broadleaves, grasses, and nutsedge suppression. Apply to row middles using a shielded applicator posttransplant. Label is a 24(C) local indemnified label, and a waiver of liability must be signed for use. PHI 30 days.
POSTHARVEST	Paraquat 0.49	(Gramoxone) 2 SL 1.95 pt	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended. Consult label for new restrictions.

Table 4. Selected insecticides approved for managing insect pests of strawberry. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
Contact: Sriyanka Lahiri, UF/IFAS Gulf Coast Research and Education Center.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Ants	7A	Extinguish Professional Fire Ant Bait (S-methoprene)	Mound treatments: 3–5 tablespoons/mound Broadcast: 1.0–1.5 lb	–	4	0	Do not apply during a hot day or when rain is expected within 6 hr.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	0.134 lb	12	1	Avoid if rain is expected within 4–6 hr.
Aphids	1B	Diazinon 50W, AG600 WBC (diazinon)	50W: 1 lb AG600 WBC: 12.75 fl oz	50W: 1 lb AG600 WBC: 12.75 fl oz	3	5	Highly toxic to bees.
	1B	Dibrom 8-E* (naled)	1 pt	5 pt	48	1	Reapplications at least 7 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5 pt 8F: 1.5–2.0 pt	5EC: 4 8F: 8 pt per year	12	3	Reapplications at least 7 days apart.
	3A	*Brigade WSB (bifenthrin)	6.4–32.0 oz	80 oz	12	0	–
	3A + 4A	*Brigadier (bifenthrin + imidacloprid)	5.1–6.14 fl oz	17.92 fl oz	12	7	Reapplications at least 5 days apart.
	4A	Actara (thiamethoxam)	1.5–4.0 oz	12 oz	12	3	Reapplications at least 10 days apart.
	4A	Admire Pro (imidacloprid)	Soil: 7.0–10.5 fl oz Foliar: 1.3 fl oz	Soil: 14.0 fl oz Foliar: 3.9 fl oz	12	Soil: 14 Foliar: 7	Foliar: Reapplications at least 5 days apart.
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9–6.9 oz 70 WP: 0.8–3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A	Platinum 75 SG (thiamethoxam)	1.7–4.01 oz	4.01 oz	12	50	–
	4A + 15	Cormoran (acetamiprid + novaluron)	9.0–12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	2.0–5.0 oz	15.0 oz	12	3	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz	4	0	Reapplications at least 10 days apart.
	6	Timectin 0.15 EC Ag (abamectin)	16.0 fl oz	64.0 fl oz	12	3	Reapplications at least 7–10 days apart.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Armyworms (see also caterpillars)	29	Beleaf 50 SG (flonicamid)	2.8 oz	8.4 oz per year	12	0	Reapplications at least 7 days apart.
	1A	Carbaryl 4 L (carbaryl)	1-2 qt	10 qt per year	12	7	Bee restriction: Do not apply to target crops in bloom.
	1A	Sevin 4F, 80 Solupak (carbaryl)	4F: 1-2 qt 80 Solupak: 1.25-2.5 lb	4F: 10 qt per year 80 Solupak: 12.5 qt per year	12	7	-
	3A	*Brigade WSB (bifenthrin)	6.4-32.0 oz	80 oz	12	0	-
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-21.33 fl oz	42.67 fl oz per year	24	2	-
	3A + 4A	*Brigadier (bifenthrin + imidacloprid)	5.1-6.14 fl oz	17.92 fl oz	12	7	Reapplications at least 5 days apart.
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9-6.9 oz 70 WP: 0.8-3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	2.0-5.0 oz	15.0 oz	12	3	-
	5	Radiant SC (spinetoram)	6.0-10.0 fl oz	39 fl oz per year	4	1	-
Beetles and weevils (including sap beetles) (see also grubs)	15	Rimon 0.83EC (novaluron)	9.0-12.0 fl oz	36 oz	12	1	Reapplications at least 7 days apart.
	18	Intrepid 2F (methoxyfenozide)	6.0-12.0 fl oz	64 fl oz per year	4	3	-
	28	Coragen (chlorantraniliprole)	3.5-7.5 fl oz	15.4 fl oz	4	1	Reapplications at least 7 days apart.
	28	Harvanta 50SL (cyclaniliprole)	10.9-16.4 fl oz	49.2 fl oz per year	4	1	Reapplications at least 5 days apart.
	1B	Lorsban 75WG (chlorpyrifos)	1.33-2.67 lb	2.67 lb per year	24	21	-
	3A	*Brigade WSB (bifenthrin)	6.4-32.0 oz	80 oz	12	0	-
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-21.33 fl oz	42.67 fl oz per year	24	2	-

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Caterpillars (including budworms, earworms, leafrollers, leaf tiers, borers, and loopers) (see also armyworms)	3A + 4A	*Brigadier (bifenthrin + imidacloprid)	5.1–6.14 fl oz	17.92 fl oz	12	7	Reapplications at least 5 days apart.
	4A	Admire Pro (imidacloprid)	Soil: 10.5–14 fl oz Foliar: 1.3 fl oz	Soil: 14.0 fl oz Foliar: 3.9 fl oz	12	Soil: 14 Foliar: 5	–
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9–6.9 oz 70 WP: 0.8–3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 oz	12	1	Reapplications at least 7 days apart.
	28	Harvanta 50SL (cyclaniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	Reapplications at least 5 days apart.
	1A	Carbaryl 4 L (carbaryl)	1–2 qt	10 qt per year	12	7	Bee restriction: do not apply to target crops in bloom.
	1A	Sevin 4F, 80 Solupak (carbaryl)	4F: 1–2 qt 80 Solupak: 1.25–2.5 lb	4F: 10 qt per year 80 Solupak: 12.5 qt per year	12	7	–
	1B	Diazinon 50W, AG600 WBC (diazinon)	50W: 1–2 lb AG600 WBC: 12.75–25.5 fl oz	–	3	5	No more than 1 foliar application per crop and 1 soil application per crop per season.
	1B	Dibrom 8-E* (naled)	1 pt	5 pt	48	1	–
Crickets and cockroaches	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–3.2 pt 8F: 1.5–2.0 pt	8F: 8 pt per year	12	3	Reapplications at least 7 days apart.
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9–6.9 oz 70 WP: 0.8–3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	5	Radiant SC (spinetoram)	6.0–10.0 fl oz	39 fl oz per year	4	1	–
	28	Harvanta 50SL (cyclaniliprole)	10.9–16.4 fl oz	49.2 fl oz per year	4	1	Reapplications at least 5 days apart.
	1A	Carbaryl 4 L (carbaryl)	1–2 qt	10 qt per year	12	7	Bee restriction: Do not apply to target crops in bloom.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Fruit fly (vinegar fly) and spotted wing drosophila	1B	Diazinon 50W, AG600 WBC (diazinon)	50W: 1-2 lb AG600 WBC: 12.75-25.5 fl oz	-	3	5	No more than 1 foliar application per crop and 1 soil application per crop per season.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5-3.2 pt 8F: 1.5-2.0 pt	8F: 8 pt per year	12	3	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	9.0-12.0 fl oz	36 oz	12	1	Reapplications at least 7 days apart.
	3A	*Brigade WSB (bifenthrin)	6.4-32.0 oz	80 oz	12	0	-
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-21.33 fl oz	42.67 fl oz per year	24	2	-
	3A	BioMagnet Ruby (deltamethrin)	60 devices	-	0	0	No more than 1-2 applications per year.
	4A	Actara (thiamethoxam)	1.5-4.0 oz	12 oz	12	3	Reapplications at least 10 days apart.
	4A	Admire Pro (imidacloprid)	Soil: 10.5-14 fl oz Foliar: 1.3 fl oz	Soil: 14.0 fl oz Foliar: 3.9 fl oz	12	Soil: 14 Foliar: 5	-
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9-6.9 oz 70 WP: 0.8-3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
Grubs (see also beetles)	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i.	12	1	Reapplications at least 5 days apart.
	1B	Lorsban 75WG (chlorpyrifos)	1.33-2.67 lb	2.67 lb per year	24	21	No more than 1 preplant or 2 foliar applications per year.
	4A	Admire Pro (imidacloprid)	Soil: 7.0-10.5 fl oz	Soil: 14.0 fl oz	12	Soil: 14	Avoid when bees are present.
	4A	Platinum 75 SG (thiamethoxam)	1.7-4.01 oz	4.01 oz	12	50	-
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Mites (including twospotted spider mite, strawberry spider mite, carmine spider mite, cyclamen mite, broad mite)	1B	Diazinon 50W, AG600 WBC (diazinon)	50W: 1-2 lb AG600 WBC: 12.75-25.5 fl oz	-	3	5	No more than 1 foliar application per crop and 1 soil application per crop per season.
	1B	Dibrom 8-E* (naled)	1 pt	5 pt	48	1	Reapplications at least 7 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5-3.2 pt 8F: 1.5-2.0 pt	8F: 8 pt per year	12	3	Reapplications at least 7-10 days apart.
	3A	*Brigade WSB (bifenthrin)	16-32.0 oz	80 oz	12	0	Reapplications at least 7 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	16.0-21.33 fl oz	42.67 fl oz per year	24	2	Reapplications at least 30 days apart.
	6	Agri-Mek 0.15 EC*, SC* (abamectin)	0.15 EC: 16 oz SC: 3.5 fl oz	0.15 EC: 64 fl oz SC: 14 fl oz	12	3	Reapplications at least 7-10 days apart.
	10A	Onager Optek (hexythiazox)	12-32 oz	32 oz per year	12	3	No more than 1 application per season.
	10B	Zeal (etoxazole)	2-3 oz	3.0 oz	12	1	-
	12B	*Vendex 50 WP (fenbutatin oxide)	1.5-2.0 lb	4 lb	48	1	Reapplications at least 21 days apart.
	20B	Kanemite 15 SC (acequinocyl)	21.0-31.0 fl oz	62 fl oz	12	1	Reapplications at least 14 days apart.
	20D	Acramite 50 WS (bifenazate)	0.75-1.0 lb	2.0 lb	12	1	Reapplications at least 21 days apart.
	21A	Magister (fenazaquin)	24-36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Nexter (pyridaben)	4.4-10.67 oz	-	12	1	No more than 2 applications per year. Reapplications at least 30 days apart.
	21A	Portal (fenpyroximate)	2 pt	4.0 pt per crop cycle	12	1	Reapplications at least 14 days apart.
	23	Oberon 2 SC (spiromesifen)	16.0 fl oz	16.0 fl oz	12	3	-
	25	Nealta (cyflumetofen)	13.7 fl oz	27.4 fl oz	12	1	Reapplications at least 14 days apart.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Plant bugs, including <i>Lygus</i>	1A	Carbaryl 4 L (carbaryl)	1-2 qt	10 qt per year	12	7	-
	1A	Sevin 4F, 80 Solupak (carbaryl)	4F: 1-2 qt 80 Solupak: 1.25-2.5 lb	4F: 10 qt per year 80 Solupak: 12.5 qt per year	12	7	Reapplications at least 7 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5-3.2 pt 8F: 1.5-2.0 pt	8F: 8 pt per year	12	3	Reapplications at least 7-10 days apart.
	3A	*Brigade WSB (bifenthrin)	6.4-32.0 oz	80 oz	12	0	Reapplications at least 5 days apart.
	3A	*Danitol 2.4 EC (fenpropathrin)	10.67-21.33 fl oz	42.67 fl oz per year	24	2	-
	3A + 4A	*Brigadier (bifenthrin + imidacloprid)	5.1-6.14 fl oz	17.92 fl oz	12	7	-
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 1.9-6.9 oz 70 WP: 0.8-3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	4C	Transform WG (sulfoxafloflor)	1.5-2.25 oz	8.5 oz	24	1	-
	15	Rimon 0.83EC (novaluron)	9-12 fl oz	36 oz	12	1	Reapplications at least 7 days apart.
Thrips (including flower thrips, chilli thrips)	29	Beleaf 50 SG (flonicamid)	2.8 oz	8.4 oz per year	12	0	-
	1B	Dibrom 8-E* (naled)	1 pt	5 pt	48	1	Reapplications at least 7 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5-3.2 pt 8F: 1.5-2.0 pt	8F: 8 pt per year	12	3	-
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 4.0-6.9 oz 70 WP: 1.7-3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	4C	Closer SC (sulfoxafloflor)	4.5 oz	17.0 oz per year	12	1	Reapplications at least 7 days apart.
	4C	Transform WG (sulfoxafloflor)	2.25 oz	8.5 oz	24	1	-
	4D	Sivanto Prime (flupyradifurone)	14.0 fl oz	28 oz per year	4	0	Reapplications at least 10 days apart.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	5	Radiant SC (spinetoram)	6.0–10.0 fl oz	30 fl oz per year	4	1	Reapplications at least 3 days apart.
	6	Timectin 0.15 EC Ag (abamectin)	16.0 fl oz	64 fl oz	12	3	Reapplications at least 7 days apart.
	6 + 28	Minecto Pro (abamectin + cyantraniliprole)	10.0 fl oz	40 fl oz per year	12	3	Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	6.0–12.0 fl oz	36 fl oz per year	12	1	Reapplications at least 7 days apart.
	21A	Apta (tolfenpyrad)	27.0 fl oz	81.0 fl oz per year	12	1	Reapplications at least 7 days apart.
	9D	Sefina Inscalis (afidopyropen)	For chilli thrips: 14 fl oz	28 fl oz	12	0	Reapplications at least 7 days apart.
	7C	Knack (pyriproxyfen)	For chilli thrips: 10 fl oz	20 fl oz	12	2	Reapplications at least 30 days apart.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	61.4 fl oz	12	1	Reapplications at least 5 days apart.
	1B	Malathion 5EC, 8F (malathion)	5EC: 1.5–3.2 pt 8F: 1.5–2.0 pt	8F: 8 pt per year	12	3	Reapplications 7 days apart.
	3A + 4A	*Brigadier (bifenthrin + imidacloprid)	5.1–6.14 fl oz	17.92 fl oz	12	7	–
Whiteflies	4A	Actara (thiamethoxam)	3.0–4.0 oz	12 oz	12	3	Risk to bees and other insect pollinators
	4A	Admire Pro (imidacloprid)	Soil: 10.5–14 fl oz Foliar: 1.3 fl oz	Soil: 14.0 fl oz Foliar: 3.9 fl oz	12	Soil: 14 Foliar: 5	Reapplications at least 7 days apart.
	4A	Assail 30 SG, 70 WP (acetamiprid)	30 SG: 4.0–6.9 oz 70 WP: 1.7–3.0 oz	30 SG: 13.8 oz 70 WP: 6.0 oz	12	1	Reapplications at least 7 days apart.
	4A	Platinum 75 SG (thiamethoxam)	1.7–4.01 oz	4.01 oz	12	50	Risk to bees and other insect pollinators
	4A + 15	Cormoran (acetamiprid + novaluron)	12.0 fl oz	35.0 fl oz	12	1	Reapplications at least 7 days apart.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	2.0–5.0 oz	15.0 oz	12	3	Reapplications at least 10 days apart.
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz	4	0	Reapplications at least 7 days apart.

Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	7D	Esteem 0.86 EC (pyriproxyfen)	10.0 fl oz	20 fl oz	12	2	Reapplications at least 10 days apart.
	16	Courier SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	3	Reapplications at least 10 days apart.
	21A	Magister SC (fenazaquin)	32–36 fl oz	36 fl oz	12	1	Do not apply until petal fall.
	21A	Portal (fenpyroximate)	2 pt	4.0 pt	12	1	Reapplications at least 14 days apart.
	23	Oberon 2 SC (spiromesifen)	16.0 fl oz	16 fl oz	12	3	–
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 5. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Natalia Peres, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to Reentry		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Angular leaf spot	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 Flowable, Champ WG, COC DF, C-O-C-S WDG, COC WP, Copper Count-N, CS 2005 Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Cuproxat Flowable, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Mastercop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50 DF, Nu Cop 50 WP, Nu Cop HB, and many others	See individual label	See individual label	1–2	Varies by product from 4 hr to 2 days	Frequent use of copper fungicides may cause foliar phytotoxicity.
	21	Actigard 50 WG (acibenzolar-s-methyl)	0.75 oz	6 oz	0	0.5	Do not apply to plants that are stressed due to drought, excessive moisture, cold weather, herbicide injury, etc.
Anthracnose fruit rot	M4	(captan) Many brands available: Captan Captan 80 WDG, Captan 4L, Captan Gold 80 WDG, Captan Gold 4L, Drexel Captan 80 WDG, Drexel Captan 4L	See individual label	See individual label	1	1	Begin applications at emergence of flower buds. Repeat at 7-day intervals through harvest.
	M4 + 17	Captevat 68 WDG (captan + fenhexamid)	5.25 lb	21 lb	0	1	No more than 2 consecutive applications.
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	No more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	3	Inspire (difenoconazole)	7 fl oz	28 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide with a different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	(propiconazole) Many brands available: Amcide, Propiconazole EC, Bumper 41.8 EC, Fitness, Orbit, Proti-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	No more than 2 consecutive applications.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3 + 11	Quadris Top (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide group. No more than 4 applications per crop per year.
	3 + 11	Quilt Xcel (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	No more than 2 consecutive applications. No more than 4 applications per crop.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	No more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	No more than 2 consecutive applications. No more than 5 applications per crop.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	26.8 fl oz	0	0.5	No more than 2 consecutive applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.
	9 + 12	Switch 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application. See special label for instructions on dipping transplants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	No more than 2 sequential applications. No more than 4 applications per season. Reapplications at least 14 days apart.
	11	(azoxystrobin) Many brands available: Abound, Aframe, Azaka, Azoxy 25C, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	No more than 2 sequential applications. No more than 4 applications per crop year. See label for instructions on dipping transplants.
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	No more than 2 sequential applications. No more than 5 applications per crop year.
	11	Flint (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	No more than 2 sequential applications of Flint or other Group 11 fungicides. No more than 6 total applications of Group 11 fungicides per season.
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	See individual label	See individual label	0	4 hr	Use in alternation with fungicides that have different modes of action. No more than 3 applications per season.
	21	Actigard 50 WG (acibenzolar-S-methyl)	0.75 oz	6 oz	0	0.5	Apply in combination with an approved efficacious fungicide when disease first appears and continue on a 7- to 14- day interval. Do not apply within 5 days of transplanting.
	48	Zivion (natamycin)	See individual label	See individual label	N/A	4 hr	For use as preplant dip of transplants.
	M3	Thiram Granuflo Thiram SC (thiram)	See individual label	See individual label	-	1	Do not rotate treated crops with other crops for which Thiram is not registered.
	M4	(captan) Many brands available: Captan 80 WDG, Captan 4L, Captan Gold 80 WDG, Captan Gold 4L	See individual label	See individual label	1	1	Begin applications at emergence of flower buds. Repeat at 7-day intervals through harvest.
	M4 + 17	Captevate 68 WDG (captan + fenhexamid)	5.25 lb	21 lb	0	1	No more than 2 consecutive applications.
Botrytis fruit rot							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M12	Fracture (banda de lupinus albus doce—BLAD)	36.6 fl oz	183 fl oz	1	4 hr	No more than 2 sequential applications.
	1	(thiophanate-methyl) Many brands available: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	See individual label	See individual label	1	1	Fungicides from different chemical groups should be rotated in spray program for disease resistance management.
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	No more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	No more than 1 application per season. Do not apply after first fruiting flower.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a fungicide from a different group.
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	No more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	No more than 2 consecutive applications. No more than 5 applications per crop.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	13.4 fl oz	26.8 fl oz	0	0.5	No more than 2 consecutive applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	1	0.5	No more than 2 consecutive applications. No more than 2 of 6 applications per season.
	9 + 12	Switch 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	No more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application. See special label for instructions on dipping transplants.
	17	Elevate 50 WDG (fenhexamid)	1.5 lb	6 lb	0	0.5	No more than 2 consecutive applications.
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	See individual label	See individual label	0	4 hr	Use in alternation with fungicides that have different modes of action. No more than 3 applications per season.
	3 + 11	Topguard (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per year.
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	No more than 2 sequential applications. No more than 4 applications per season. Reapplications at least 14 days apart.
	11	(azoxystrobin) Many brands available: Abound, Aframe, Azaka, Azoxy 25C, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	No more than 2 sequential applications. No more than 4 applications per crop year. See label for instructions on dipping transplants.
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	No more than 2 sequential applications. No more than 5 applications per crop year.
Botrytis (suppression only)							

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Flint (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	No more than 2 sequential applications of Flint or other Group 11 fungicides. No more than 6 total applications of Group 11 fungicides per season.
	11	Intuity (mandestrobin)	6 fl oz	12 fl oz	0	0.5	No more than 2 applications per year. Reapplications at least 14 days apart.
	1	Topsin 4.5FL Topsin M WSB (thiophanate methyl)	See individual label	See individual label	1	1	Apply through buried drip irrigation (chemigation) to the root zone. Apply at 14-day intervals beginning at transplant.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	Product is to be applied through drip irrigation (see label for chemigation directions).
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	Apply via chemigation into the root zone through low-pressure drip.
	48	Zivion (natamycin)	See individual label	See individual label	N/A	4 hr	For use as preplant dip of transplants.
	1	(thiophanate-methyl) Many brands available: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	See individual label	See individual label	1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	3 + 11	Topguard (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per year.
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.
	1	(thiophanate-methyl) Many brands available: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB,	See individual label	See individual label	1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	1 + 3	Protocol, Talaris XL (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	No more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
Leaf spot	M4	(captan) Many brands available: Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	See individual label	See individual label	1	1	Begin applications when new growth starts.
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	No more than 1 application per season. Do not apply after first fruiting flower.
	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Reapplications at least 14 days apart. No more than 4 applications per season.
	3	Rally 40WSP Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	(propiconazole) Many brands available: Amcide Propiconazole EC, Bumper 41.8 EC, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	No more than 2 consecutive applications.
	3 + 11	Quadris Top (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide group. No more than 4 applications per crop per year.
	3 + 11	Quilt Xcel (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	No more than 2 consecutive applications. No more than 4 applications per crop.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group. Suppression only.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group. Suppression only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	No more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	No more than 2 consecutive applications. No more than 5 applications per crop.
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	No more than 2 sequential applications. No more than 5 applications per crop year.
	3 + 11	Topguard (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per year.
	4	Metalaxy/ 2E AG MetaStar 2E AG (metalaxy)	2 qt	6 qt	0	2	See label for use in drip irrigation.
	4	Ridomil Gold EC Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt/treated acre	1.5 qt/treated acre	0	2	See label for use in drip irrigation.
Leather rot	11	(azoxystrobin) Many brands available: Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	No more than 2 sequential applications. No more than 4 applications per crop year. See label for instructions on dipping transplants.
	33	Aliette WDG Legion 80WDG Linebacker WDG (fosetyl-Al)	5 lb	30 lb	0.5	0.5	Do not tank-mix with copper fungicides, adjuvants, or foliar fertilizers.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phorcephite, Phostrol, Rampart	See individual label	See individual label	0	4 hr	Avoid mixing with strongly acidic or alkaline materials. Test the compatibility of spray adjuvants (i.e., stickers, spreaders, wetting agents) before use.
Phomopsis leaf blight	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Reapplications at least 14 days apart. No more than 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Rally 40WSP Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group. Suppression only.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	11	Flint (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	No more than 2 sequential applications of Flint or other Group 11 fungicides. No more than 6 total applications of Group 11 fungicides per season. Suppression only.
	2	(iprodione) Many brands available: Enclosure 4, Iprodione 4L AG, Meteor, Nevada 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	No more than 1 application per season. Do not apply after first fruiting flower.
Phomopsis soft rot	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group. Suppression only.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	4	Metalaxyl 2E AG MetaStar 2E AG (metalaxyl)	2 qt	6 qt	0	2	See label for use in drip irrigation.
Phytophthora crown rot	4	Ridomil Gold EC Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt/treated acre	1.5 qt/treated acre	0	2	See label for use in drip irrigation.
	4 + 49	Orondis Gold (mefenoxam + oxathiapiprolin)	62 fl oz	124 fl oz	28	2	No more than 2 sequential applications before rotating to a fungicide with a different mode of action.
	21	Actigard 50 WG (acibenzolar-s-methyl)	0.75 oz	6 oz	0	0.5	Do not apply to plants that are stressed due to drought, excessive moisture, cold weather, herbicide injury, etc.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phorcephite, Phostrol, Rampart	See individual label	See individual label	0	4 hr	Avoid mixing with strongly acidic or alkaline materials.
Powdery mildew	M2	(sulfur) Many brands available: Acoidal, Cosavet DF, Crusade DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Rebel DF, Sulfur 90W, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Do not apply with temperatures above 90°F. Do not use within 2 weeks of an oil spray treatment.
	M2 + 33	Sanction (potassium phosphate + sulfur)	6 pt	24 pt	N/A	1	Do not apply during hot weather. May cause injury during certain climatic conditions.
	M12	Fracture (banda de lupinus albus doce—BLAD)	24.4 fl oz	122 fl oz	1	4 hr	No more than 2 sequential applications.
	1	(thiophanate-methyl) Many brands available: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	See individual label	See individual label	1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	No more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	3	Inspire (difenoconazole)	7 fl oz	28 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Reapplications at least 14 days apart. No more than 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	Rally 40WSP Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	Procure 480 SC (triflumizole)	8 oz	32 oz	1	0.5	Do not plant leafy vegetables within 30 days, root vegetables within 60 days, or rotational crops not on label for 1 year after application.
	3	(propiconazole) Many brands available: Amcide Propiconazole EC, Bumper 41.8 EC, Bumper ES, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	No more than 2 consecutive applications.
	3	Rally 40WSP Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per year.
	3 + 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3 + 11	Quadris Top (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	No more than 2 sequential applications before alternating to another fungicide group. No more than 4 applications per crop per year.
	3 + 11	Quilt Xcel (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	No more than 2 consecutive applications. No more than 4 applications per crop.
	3 + 11	Topguard (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per year.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a fungicide from a different group.
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Luna Privilege (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	Apply through drip irrigation system preventatively. No more than 2 sequential applications before alternating to a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	No more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	No more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	No more than 2 consecutive applications. No more than 5 applications per crop.
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	No more than 2 sequential applications. No more than 4 applications per season. Reapplications at least 14 days apart.
	11	(azoxystrobin) Many brands available: Abound, Aframe, Azaka, Azoxy 25C, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	No more than 2 sequential applications. No more than 4 applications per crop year. See label for instructions on dipping transplants.
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	No more than 2 sequential applications. No more than 5 applications per crop year.
	11	Flint (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	No more than 2 sequential applications of Flint or other Group 11 fungicides. No more than 6 total applications of Group 11 fungicides per season.
	11	Intuity (mandestrobin)	6 fl oz	12 fl oz	0	0.5	No more than 2 applications per year. Reapplications at least 14 days apart.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	13	Quintec (quinoxifen)	6 fl oz	24 fl oz	1	0.5	No more than 2 consecutive applications. No more than 4 applications per crop.
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	See individual label	See individual label	0	4 hr	Use in alternation with fungicides that have different modes of action. No more than 3 applications per season.
	U6	Torino (cyflufenamid)	3.4 oz	6.8 oz	0	4 hr	No more than 2 applications per year. Reapplications at least 14 days apart.
	50	Prolivo (pyriofenone)	5 fl oz	16 fl oz	0	4 hr	No more than 2 sequential applications of Group 50 fungicides before rotating to a fungicide with a different mode of action.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 6. Nonfumigant nematicides for strawberry in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Application Rates and Procedures	
Product	
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop, and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Reapplications at least 7 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Biological nematicides	See chapter 19.
Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 7. Fumigant nematicides for strawberry in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II ^{2,3} Telone EC ^{2,3}	27–35	79–102	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2,3}	32.4–42	95–123	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	39–50	114–146	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine ^{2,3}	29–56	–	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60 ^{2,3}	19.5–31.5	57–90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC ^{2,3}	19.5–31.5	–	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75	–	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 17. Sweet Corn Production¹

Katia Viana Xavier, Ramdas Kanissery, Craig Frey, Anna Mészáros, Nicholas S. Dufault, Johan Desaeger, Jawwad Qureshi, and Julien Beuzelin²

Botany and Planting

Sweet corn— *Zea mays* var. *rugosa*, Poaceae (Gramineae).

Table 1. Planting dates for sweet corn.

Planting Region	Dates
North Florida	Feb–Apr
Central Florida	Jan–Apr
South Florida	Sep–Mar

Table 2. Planting information for sweet corn.

Planting Parameters	Measurements
Distance between rows (in)	28–36
Distance between plants (in)	6–8
Seeding depth (in)	1.0–1.5
Seed per acre (lb)	6–15
Days to maturity from seed	64–90
Plant population (acre)	24,000–32,000

Cultivars

Table 3. Description of major sweet corn cultivars currently available.

Type	Genes Controlling Sweetness	Storage Life (Days)	Relative Sugar Content
Sugary	Full complement of sugary	1–3	Normal
Sugary Enhanced, also “Modified” and “EH”	Full complement of sugary (su) and half or full complement of sugary enhancer (se)	3–5	Slight to moderate or even high levels
Supersweet, also “Ultra,” “Extra” sweet	No sugary (su); full complement of shrunken-2 (sh2)	5–10	High
Synergistic, also “Sweet-Gene Hybrid”	Full complement of sugary (su) and half complement of shrunken-2 (sh2)	3–5	Moderate
Improved Supersweet	Half complement of sugary (su) and full complement of shrunken-2 (sh2)	5–10	Very high
ADX	No sugary (su) or shrunken-2 (sh2) genes; full complement of ae, du, and wx genes.	5–10	Moderate to high

Table 4. Supersweet (shrunk-2) sweet corn cultivars arranged by kernel color.

Corn	Cultivars
Yellow	Accentuate, Alliance, Astronaut, Gallant MXR, GSS 1170, Hercules, Passion, Primetime, Seminole Gold, SV 1077, SV 1446
White	Coronado, Devotion, Glacial, Platinum XR, 3174 XTH, 3380 XTH
Bicolor	Affection, Awesome XR, Battalion, BSS 1075, Coastal, Courage MXR, Honor XR, Obsession, Salute XR, Seminole Sweet, Starship, 7143

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension county offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 5. Herbicides approved for managing weeds in sweet corn. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREEMERGENCE	Atrazine Mineral Soil 1.0–2.0 Muck Soil 2.0–3.0	(Aatrex) 4 L Mineral: 2–4 pt Muck: 4–6 pt (Aatrex Nine-0) 90 WDG Mineral: 1.1–2.2 lb Muck: 2.2–3.3 lb	5	Germinating broadleaf and grass weeds. Apply to moist soil. No more than 2.5 lb a.i./A per calendar year. Consult labels for plant-back restrictions on rotational crops.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. No more than 0.096 lb a.i./A per season. No pretransplant interval.
	Dimethenamid-P 0.56–0.84	(Outlook) 6 EC 12–18 fl oz	15	Annual broadleaf and grass weeds. After application, incorporate into soil by rainfall, sprinkler irrigation, or mechanical tillage. Consult label for rate based on soil texture.
	EPTC 4.0–6.0	(Eradicane) 6.7 E 4.75–7.33 pt	8	Annual broadleaf, grass weeds, and nutsedge. Use lower rates on lighter soils (sand). Control of perennial weeds such as bermudagrass or nutsedge is increased through incorporation.
	Flufenacet 0.49–0.68	(Define DF) 60 DF 13–18 oz (Define SC) 4 SC 15–19 fl oz	15	Annual broadleaf and grass weeds. Rainfall, irrigation, or light cultivation is required within 7–10 days of application. Consult label for rate based on soil texture.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Tank-mix with a residual herbicide to broaden spectrum of weed control. Consult label for individual product directions.
	Mesotrione 0.188–0.24	(Callisto) 4 SC 6.0–7.7 fl oz	28	Annual broadleaf weeds. Tank-mix with a preemergence grass herbicide for grass control. No more than 7.7 fl oz/A per season.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Gramoxone) 3 SL 1.3–2.7 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown. No more than 3 applications per year. Tank-mix with a residual preemergence herbicide to broaden the spectrum of weed control. Consult label for new restrictions.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
	Pendimethalin Mineral Soil 0.75–1.0 Muck Soil 1.0–2.0	(Acumen, Prowl) 3.3 EC Mineral: 1.8–2.4 pt Muck: 2.4–4.8 pt (Prowl H20) 3.8 Mineral: 2.0–3.0 pt Muck: 2.0–4.0 pt	3	Broadleaf and grass weeds. Overhead irrigation or rainfall is required within 7 days of application.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
	Simazine 2.0	(Princep, Simazine) 4 L 2.0 qt (Princep, Simazine) 90 WDG 2.2 lb	5	Broadleaf and grass weeds. If a second application is required, do not exceed 2.5 lb a.i./A per calendar year. Simazine 4 L and Simazine 90 DF can be applied to muck soils at 2.5 lb a.i./A. PHI 45 days.
	S-metolachlor 1.0–1.6	(Brawl, Dual Magnum) 7.62 EC 1.0–1.67 pt (Cinch, Dual II Magnum) 7.64 EC 1.0–1.67 pt	15	Annual broadleaf and grass weeds. Use a lower rate on lighter soils. Weed control is increased with 0.5–1 in. of rainfall or irrigation. No more than 3.9 pt/A per crop year depending on soil texture.
POSTEMERGENCE	Atrazine Mineral Soil 1.0–2.0 Muck Soil 2.0–3.0	(AAtrex) 4 L Mineral: 2–4 pt Muck: 4–6 pt (AAtrex Nine-0) 90 WDG Mineral: 1.1–2.2 lb Muck: 2.2–3.3 lb	5	Broadleaf and some grass weeds. Apply before weeds exceed 1.5 in. tall and before corn exceeds 12 in. tall. No more than 2.5 lb a.i./A per calendar year. Consult label for plant-back restrictions on rotational crops.
	Bentazon 0.75–1.0	(Basagran) 4 L 1.5–2.0 pt (Basagran) 5 L 1.2–1.6 pt	6	Certain broadleaf and sedge weeds. Consult label for weeds controlled/weed size table. No more than 4 pt/A per season.
	Carfentrazone 0.008–0.016	(Aim) 2 EC 0.5–1.0 fl oz	14	Emerged broadleaf weeds. Apply up to the 14-leaf stage of corn growth. After the V8 stage of growth, apply as a directed application. No more than 2.0 fl oz/A per season including preplant burndown and crop application. PHI 3 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Halosulfuron 0.03–0.05	(Sandeia) 75 DF 0.6–1.0 oz	2	Broadleaf weeds and nutsedge. Apply over the top or with drop nozzles from the spike stage through the layby stage of corn. A sequential application of 0.66 oz/A may be made using drop nozzles to avoid spraying into the plant whorl. No more than 2 applications per year.
	Mesotrione 0.094	(Callisto) 4 SC 3 fl oz	28	Broadleaf weeds. Treat up to 30 in. tall or up to the 8-leaf stage. Include a crop oil concentrate or nonionic surfactant in the spray solution. Slight leaf bleaching may occur. No more than 7.7 fl oz/A per season.
	Nicosulfuron 0.03–0.06	(Accent) 75 WDG 0.6–1.3 oz (Accent Q) 54.5 WDG 0.9–1.8 oz	2	Broadleaf and grass weeds. Sensitivity to sweet corn varieties is variable. Do not apply to 'Merit' sweet corn. Do not apply to corn that has previously been treated with Counter or Thimet insecticides because this may result in injury. Consult label for acceptable insecticides. Apply as broadcast to corn plants less than 12 in. tall. Use drop nozzles to direct the spray to corn plants that are 12–18 in. tall.
	Pendimethalin Mineral Soil 0.7–1.0 Muck Soil 1.0–2.0	(Acumen, Prowl) 3.3 EC Mineral: 1.8–2.4 pt Muck: 2.4–4.8 pt (Prowl H20) 3.8 Mineral: 2.0–3.0 pt Muck: 2.0–4.0 pt	3	Broadleaf and grass weeds. Apply after 4 in. tall until corn is 20–24 in. tall or the V8 growth stage. Direct the spray to the base of the plants.
	S-metolachlor up to 1.9	(Brawl, Dual Magnum) 7.62 EC up to 2.0 pt (Cinch, Dual II Magnum) 7.64 EC up to 2.0 pt	15	Annual broadleaf and grass weeds. Apply after crop emergence up to 40 in. tall. Direct spray to the base of the plants when plants are taller than 5 in. Use a lower rate on lighter soils. Weed control is increased with 0.5–1 in. of rainfall or irrigation. No more than 3.9 pt/A per crop year depending on soil texture. PHI 30 days.
	Tembotrione 0.08	(Laudis) 3.5 EC 3 fl oz	27	Annual broadleaf and grass weeds. Crop tolerance is dependent on variety, so apply to a small area if tolerance is unknown. Do not use it on 'Merit' or 'Shogun'. May be applied from corn emergence through the V7 stage of growth. No more than 3 fl oz/A per season.
	Topramezone 0.020–0.022	(Armezon, Impact) 2.8 0.75–1.0 fl oz	27	Broadleaf and grass weeds. Consult label for maximum size of certain weed species for control. PHI 45 days.

Table 6. Insecticides labeled for management of arthropod pests of sweet corn. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
 Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids	1A	*Lannate LV *Lannate SP (methomyl)	LV: 0.75–1.5 pt SP: 0.25–0.50 lb	LV: 21 pt SP: 7 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1B	Fyfanon 57% EC (malathion)	1.5 pt	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.
	3A	*Asana XL Insecticide (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	1	–
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.
	3A	*Capture LFR (bifenthrin)	At plant: 3.4–17.0 fl oz	17.0 fl oz	12	At planting	For mixing with liquid fertilizer.
	3A	*Delta Gold (deltamethrin)	1.5–2.4 fl oz	38.4 fl oz	12	Ears and forage: 1 Stover: 21	–
	3A	*Fastac CS (alpha-cypermethrin)	2.8–3.8 fl oz	11.4 fl oz	12	3	–
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	See label when using more than 1 product containing bifenthrin or zeta-cypermethrin.
	3A	*Mustang Maxx (zeta-cypermethrin)	2.8–4.0 fl oz	24 fl oz	12	3	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	30.72 fl oz	24	Ears (foliar): 1 For feeding livestock or at-plant applications: 21	Many other brands with same active ingredient available.
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.
	4A	Assail 30 SG Assail 70 WP (acetamiprid)	30 SG: 2.1–2.9 oz 70 WP: 0.9–1.2 oz	30 SG: 11.2 oz per year 70 WP: 4.8 oz per year	12	1	Other brands available with same active ingredient.
	4A + 15	Cormoran (acetamiprid + novaluron)	9–12 fl oz	40 fl oz	12	7	–
	4C	Transform WG (sulfoxaflor)	0.75–1.5 oz	3.0 oz per year	24	7	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz per year	4	Ears and forage: 7 Stover: 21	–
	1A	*Lannate LV *Lannate SP (methomyl)	LV: 0.75–1.5 pt SP: 0.25–0.50 lb	LV: 21 pt SP: 7 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	16 qt per year	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	–
	1B	*Counter 15G Lock 'N Load (terbufos)	Banded or in furrow: 6.0–8.0 oz/1000 row ft Postemergence incorporated: 8 oz/1000 row ft at cultivation	–	48	60	No more than 1 application.
	1B	Fyfanon 57% EC Fyfanon ULV AG (malathion)	57% EC: 1.5 pt ULV AG: 4–8 fl oz	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.
	1B	*Thimet 20-G (phorate)	4.5–6.0 oz/1000 row ft	–	48	At planting	No more than 1 application.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Asana XL Insecticide (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	28 fl oz	12	0	–
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.
	3A	*Capture LFR (bifenthrin)	Preplant incorporated: 4.0–5.3 fl oz At plant: 3.4–17.0 fl oz Preemergence: 3.4 fl oz	17.0 fl oz	12	Preplant incorporated, at planting, preemergence application	For mixing with liquid fertilizer.
	3A	*Delta Gold (deltamethrin)	1.0–2.4 fl oz	38.4 fl oz	12	Ears and forage: 1 Stover: 21	–
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	3	–
	3A	*Force 3G (tefluthrin)	4–5 oz/1000 row ft	–	48	At planting or cultivation within 30 days of seedling emergence	No more than 1 application.
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	3	–
	3A	*Warrior II (lambda-cyhalothrin)	At plant: 0.33 fl oz/ 1000 row ft Foliar: 1.28–1.92 fl oz	30.72 fl oz	24	Ears (foliar): 1 Feeding livestock or at-plant applications: 21	Many other brands available with same active ingredient.
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Assail 30 SG Assail 70 WP (acetamiprid)	30 SG: 4.0–5.3 oz 70 WP: 1.7–2.3 oz	30 SG: 11.2 oz per year 70 WP: 4.8 oz per year	12	7	Other brands available with same active ingredient.
	4A + 15	Cormoran (acetamiprid + novaluron)	9–12 fl oz	40 fl oz	12	7	–
	15	Rimon 0.83EC (novaluron)	6–12 fl oz	60 fl oz	12	1	–
Caterpillars (includes beet armyworm, corn borer, corn earworm, cutworms, fall armyworm, webworms)	1A	*Lannate LV *Lannate SP (methomyl)	LV: 0.75–1.5 pt SP: 0.25–0.50 lb	LV: 21 pt SP: 7 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	*Methomyl 5G (methomyl)	1.5–3.0 lb	30 lb	48	Forage: 3 Ears: 21	For corn earworm and fall armyworm control. Apply as a banded application, directing granules to the whorl of the plants. Apply from the 4th leaf stage until tasseling.
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	16 qt per year	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	–
	1B	*Counter 15G Lock 'n Load (terbufos)	Banded or in furrow: 6.0–8.0 oz/1000 row ft Postemergence incorporated: 8 oz/1000 row ft at cultivation	–	48	60	No more than 1 application.
	1B	Fyfanon 57% EC (malathion)	1.5 pt	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	1B	*Mocap 15G (ethoprop)	Broadcast: 20 lb	-	48	At planting	No more than 1 application, spread out over 3 days before planting and at planting.
	3A	*Asana XL Insecticide (esfenvalerate)	5.8-9.6 fl oz	96 fl oz	12	1	-
	3A	*Baythroid XL (beta-cyfluthrin)	0.8-2.8 fl oz	28 fl oz	12	0	-
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	In-furrow T-band at plant: 0.15-0.30 fl oz/1000 row ft Foliar: 2.1-6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.
	3A	*Capture LFR (bifenthrin)	Preplant incorporated: 4.0-5.3 fl oz At plant: 3.4-17.0 fl oz Preemergence: 3.4 fl oz	17.0 fl oz	12	Preplant incorporated, at planting, preemergence application	For mixing with liquid fertilizer.
	3A	*Delta Gold (deltamethrin)	1.0-2.4 fl oz	38.4 fl oz	12	Ears and forage: 1 Stover: 21	-
	3A	*Fastac CS (alpha-cypermethrin)	2.2-3.8 fl oz	11.4 fl oz	12	3	-
	3A	*Force 3G (tefluthrin)	3-4 oz/1000 row ft	-	48	At planting	No more than 1 application.
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0-10.3 fl oz	27.39 fl oz	12	3	-
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24-4.0 fl oz	24 fl oz	12	3	-
	3A	*Warrior II (lambda-cyhalothrin)	At plant: 0.33 fl oz/1000 row ft Foliar: 1.28-1.92 fl oz	30.72 fl oz	24	Ears (foliar): 1 Feeding livestock or at-plant applications: 21	Many other brands with same active ingredient available.
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5-13.8 fl oz	27.6 fl oz per year	24	7	-
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6-10 fl oz	31 fl oz per year	24	1	-

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.
	4A + 15	Cormoran (acetamiprid + novaluron)	9–12 fl oz	40 fl oz	12	7	–
	5	Radiant SC (spinetoram)	3–6 fl oz	36 fl oz per year	4	Ears: 1 Forage or fodder: 3	–
	5 + 18	Intrepid Edge (spinetoram + methoxyfenozide)	4–12 fl oz	51 fl oz per year	4	Ears and fodder: 3 Dry fodder: 21	–
	15	Rimon 0.83EC (novaluron)	6–12 fl oz	60 fl oz	12	1	–
	18	Intrepid 2F (methoxyfenozide)	4–16 fl oz	64 fl oz per year	4	Ears and forage: 3 Dry fodder: 21	Other brands available with same active ingredient.
	22	Avaunt Avaunt eVo (indoxacarb)	2.5–3.5 oz	14 oz	12 (14 days for hand harvesting)	Ears: 3 Fodder and stover: 35	Whorl stage through tassel push applications only.
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz per year	4	1	–
	28	Vantacor (chlorantraniliprole)	In-furrow at plant: 1.7–2.5 fl oz Foliar: 1.2–2.5 fl oz	5.1 fl oz per year	4	1	Can be applied by overhead sprinkler chemigation system.
	32	Spear-Lep (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	10 gal per year	4	0	Must be tank-mixed with a <i>Bacillus thuringiensis</i> (Bt) product.
Chinch bugs	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	16 qt per year	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	–
	1B	*Counter 15G Lock 'n Load (terbufos)	Banded or in furrow: 6.0–8.0 oz/1000 row ft Postemergence incorporated: 8 oz/1000 row ft at cultivation	–	48	60	No more than 1 application.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Asana XL Insecticide (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	28 fl oz	12	0	–
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.
	3A	*Delta Gold (deltamethrin)	1.5–2.4 fl oz	38.4 fl oz	12	Ears and forage: 1 Stover: 21	–
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	3	–
	3A	*Force 3G (tefluthrin)	4–5 oz/1000 row ft	–	48	At planting or cultivation within 30 days of seedling emergence	No more than 1 application.
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	3	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	30.72 fl oz	24	Ears: 1 Feeding livestock: 21	–
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.
Corn silk flies	1B	Fyfanon ULV AG (malathion)	6–8 fl oz	–	12	5	No more than 2 applications per year.
	3A	*Asana XL Insecticide (esfenvalerate)	9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	28 fl oz	12	0	–
	3A	*Fastac CS (alpha-cypermethrin)	2.8–3.8 fl oz	11.4 fl oz	12	3	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	3	–
	3A	*Warrior II (lambda-cyhalothrin)	1.92 fl oz	30.72 fl oz	24	Ears: 1 Feeding livestock: 21	–
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	10 fl oz	31 fl oz per year	24	1	–
	4A	Assail 30 SG Assail 70 WP (acetamiprid)	30 SG: 5.3 oz 70 WP: 2.3 oz	30 SG: 11.2 oz per year 70 WP: 4.8 oz per year	12	7	Other brands available with same active ingredient.
	4A + 15	Cormoran (acetamiprid + novaluron)	12 fl oz	40 fl oz	12	7	–
	1B	Fyfanon 57% EC Fyfanon ULV AG (malathion)	57% EC: 1.5 pt ULV AG: 8 fl oz	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.
Grasshoppers	3A	*Asana XL Insecticide (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	28 fl oz	12	0	–
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.
	3A	*Delta Gold (deltamethrin)	1.0–1.5 fl oz	38.4 fl oz	12	Ears and forage: 1 Stover: 21	–
	3A	*Fastac CS (alpha-cypermethrin)	2.8–3.8 fl oz	11.4 fl oz	12	3	–
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Mustang Maxx (zeta-cypermethrin)	2.8–4.0 fl oz	24 fl oz	12	3	–
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	30.72 fl oz	24	Ears: 1 Feeding livestock: 21	–
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.
	4A + 15	Cormoran (acetamiprid + novaluron)	9–12 fl oz	40 fl oz	12	7	–
	15	Rimon 0.83EC (novaluron)	6–12 fl oz	60 fl oz	12	1	–
	28	Coragen (chlorantraniliprole)	2.0–5.0 fl oz	15.4 fl oz per year	4	1	–
	28	Vantacor (chlorantraniliprole)	1.2–2.5 fl oz	5.1 fl oz per year	4	1	Foliar only. Can be applied by overhead sprinkler chemigation system.
Leafhoppers	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	16 qt per year	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	–
	1B	Fyfanon 57% EC (malathion)	1.5 pt	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.
	3A	*Fastac CS (alpha-cypermethrin)	2.2–3.8 fl oz	11.4 fl oz	12	3	–
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	27.39 fl oz	12	3	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	3	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Warrior II (lambda-cyhalothrin)	1.28–1.92 fl oz	30.72 fl oz	24	Ears: 1 Feeding livestock: 21	Many other brands with same active ingredient available.
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz per year	24	7	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28 fl oz per year	4	Ear and forage: 7 Stover: 21	–
Soil pests (includes corn rootworms, seed corn maggot, white grubs, wireworms)	1A	*Lannate LV *Lannate SP (methomyl)	LV: 0.75–1.5 pt SP: 0.25–0.50 lb	LV: 21 pt SP: 7 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	Sevin 4F Sevin XLR Plus (carbaryl)	1–2 qt	16 qt per year	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	–
	1B	*Counter 15G Lock 'n Load (terbufos)	Banded or in furrow: 6.0–8.0 oz/1000 row ft Postemergence incorporated: 8 oz/1000 row ft at cultivation	–	48	60	No more than 1 application.
	1B	*Mocap 15G (ethoprop)	At planting: 8 oz/1000 row ft	–	48	At planting	No more than 1 application.
	1B	*Thimet 20-G (phorate)	At planting or cultivation: 4.5–6.0 oz/1000 row ft	–	48	Ears, forage: 30	No more than 1 application.
	3A	*Asana XL Insecticide (esfenvalerate)	5.8–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	0.8–2.8 fl oz	28 fl oz	12	0	–
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	In-furrow T-band at plant: 0.15–0.30 fl oz/1000 row ft Foliar: 2.1–6.4 fl oz	12.8 fl oz	12	1	Many other brands available with same active ingredient.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Capture LFR (bifenthrin)	Preplant incorporated: 4.0–5.3 fl oz At plant: 3.4–17.0 fl oz Preemergence: 3.4 fl oz	17.0 fl oz	12	Preplant incorporated at planting, preemergence application	For mixing with liquid fertilizer.
	3A	*Force 3G (tefluthrin)	4–5 oz/1000 row ft	–	48	At planting or cultivation within 30 days of seeding emergence	No more than 1 application.
	3A	*Warrior II (lambda-cyhalothrin)	At plant: 0.33 fl oz/1000 row ft Foliar: 1.28–1.92 fl oz	30.72 fl oz	24	Ears (foliar): 1 Feeding livestock or at-plant applications: 21	Many other brands available with same active ingredient.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz per year	24	1	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	–	12	1	No more than 2 applications per year.
	3A	*Brigade 2EC Insecticide/Miticide (bifenthrin)	5.12–6.4 fl oz	12.8 fl oz	12	1	Many other brands with same active ingredient available.
	3A	*Hero Insecticide (bifenthrin + zeta-cypermethrin)	10.3 fl oz	27.39 fl oz	12	3	–
	3A + 4C	Ridgeback (bifenthrin + sulfoxaflo ^r)	4.5–13.8 fl oz	27.6 fl oz	24	7	–
	3A + 28	*Elevest (bifenthrin + chlorantraniliprole)	7.7–9.6 fl oz	–	12	1	No more than 2 applications per year.
	6	*Agri-Mek SC (abamectin)	1.75–3.50 fl oz	7 fl oz per year	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant.
	23	Oberon 2SC (spiromesifen)	5.7–16 fl oz	17 fl oz	12	Ears, green forage, silage: 5 Grain or stover: 30	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips (check label for species controlled)	1B	*Counter 15G Lock 'n Load (terbufos)	Banded or in furrow: 6.0–8.0 oz/1000 row ft Postemergence incorporated: 8 oz/1000 row ft at cultivation	–	48	60	No more than 1 application.
	1B	Fyfanon 57% EC (malathion)	1.5 pt	–	12	5	No more than 2 applications per year. Crop injury may occur in the whorl to silking stages.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. *Restricted use insecticide.							

Table 7. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to Harvest	Reentry	Remarks ³
			Appl.	Season ²			
Bacterial stalk rot	M1	(copper compounds) Many brands available: AmeriCop 40 DF, Badge SC, Badge X2, ChampION++, Copper Count N, Cueva, Kocide 2000, Kocide 3000, Mastercop, Nu-Cop 50 DF, Top Cop w/Sulfur	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
Damping-off	M3	Signet 480FS (thiram)	5.0 oz/100 lb of seed	-	-	1	Seed treatment only.
Damping-off seedling blight	3	Vortex (ipconazole)	0.085 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	4 + 3	Dividend Extreme (mefenoxam + difenoconazole)	5 fl oz/100 lb of seed	-	-	2	Seed treatment only.
	11	Dynasty (azoxystrobin)	0.153 fl oz/100 lb of seed	-	-	4	Seed treatment only.
	11	Trilex (trifloxystrobin)	0.32-0.96 fl oz/100 lb of seed	-	-	-	Seed treatment only.
Eye spot	3	(propiconazole) Many brands available: Amcide Propiconazole 41.8, Bumper 41.8EC, Fitness, Propiconazole E-AG 41.8EC, Propimax EC, Tilt	4 fl oz	16 fl oz	14	0.5-1	No more than 4 total applications.
	3 + 7 + 11	Miravis Neo (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	No more than 2 sequential applications.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	Forage and ears: 0 Fodder: 14	0.5	No more than 2 sequential applications.
	7	Vertisan (penthiopyrad)	24 fl oz	48 fl oz	7	0.5	Soil and foliar treatments. See label for details.
	7 + 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Aftershock (fluoxastrobin)	Foliar: 3.8 fl oz	15.27 fl oz	7	0.5	Soil and foliar treatments. See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Evito 480SC (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	No more than 2 sequential and 4 total applications.
	11	Headline (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	No more than 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	Headline SC (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	No more than 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	Quadris (azoxystrobin)	15.5 fl oz	120 fl oz	7	4 hr	No more than 1 sequential and 4 total applications of Quadris or other QoI fungicides. See label for soil applications.
	11 + 3	Avaris (azoxystrobin + propiconazole)	14 fl oz	28 fl oz	14	0.5	See label for details.
	11 + 3	Evito T (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	No more than 2 sequential and 4 total applications.
	11 + 3	Headline AMP (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz	7	0.5	No more than 2 sequential and 4 total applications.
	11 + 3	Helmstar Plus (azoxystrobin + tebuconazole)	10.8 fl oz	43.2 fl oz	7	19	Do not spray after V8 growth stage.
	11 + 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	Stratego (trifloxystrobin + propiconazole)	12 fl oz	24 fl oz	14	0.5	No more than 2 sequential applications.
	11 + 3	Stratego YLD (trifloxystrobin + propiconazole)	5 fl oz	20 fl oz	14	0.5	No more than 2 sequential applications.
	11 + 3	Topguard EQ (flutriafol + azoxystrobin)	7 fl oz	14 fl oz	-	3	No more than 2 applications per season.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Gray leaf spot	3	(tebuconazole) Many brands available: Folicur 3.6F, Monsoon 3.6F, Orius 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	-
	3	Topguard (flutriafol)	14 fl oz	28 fl oz	7	3	No more than 2 applications per year.
	3	Xyway LFR (flutriafol)	5.8–15.2 fl oz	15.2 fl oz	-	0.5	Apply to corn in-furrow at planting or postemergence directed to the soil.
	3 + M2	Unicorn (tebuconazole + sulfur)	3.75 lb	15.0 lb	14	19	See label for details and rotational restrictions.
	3 + 7	Revyllok (mefenfluproconazole + fluxapyroxad)	15 fl oz	30 fl oz	21	0.5	No more than 2 applications per season.
	3 + 7 + 11	Miravis Neo (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	No more than 2 sequential applications.
	3 + 7 + 11	Revytek (mefenfluproconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 33	Viathon (tebuconazole + potassium phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7 + 11	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	Alternate with a fungicide of dissimilar mode of action.
	3 + 11	Veltyma (mefenfluproconazole + pyraclostrobin)	10 fl oz	30 fl oz	21	0.5	-
	M3	(mancozeb) Many brands available: Dithane F45 Rainshield, Dithane M45, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF, Roper DF Rainshield (chlorothalonil)	1.5 lb	24 lb	7	1	Start applications at the first sign of disease.
Northern corn leaf blight, southern corn leaf blight, common rust, northern corn leaf spot	M5	Many brands available: Bravo Ultrex, Bravo Weather Stik, Chlorothalonil 720, Echo 720, Echo 90DF, Echo ZN, Equus 720 SST, Initiate 720, Initiate ZN	See individual label	See individual label	7	0.5–1	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3	(propiconazole) Many brands available: Bumper 41.8 EC, Fitness, Propimax EC, Propi-Star EC, Tilt, Topaz, Willowood Propicon 3.6EC	4 fl oz	16 fl oz	14	0.5	No more than 4 total applications.
	3	Prosaro® 421 SC (tebuconazole + prothioconazole)	8.2 fl oz	26 fl oz	21	0.5	See label for adjuvant information and rotational restrictions.
	3	(tebuconazole) Many brands available: Monsoon, Onset 3.6L, Orius 3.6F, Tebu-Crop, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	-
	3	Topguard (flutriafol)	14 fl oz	28 fl oz	7	3	No more than 2 applications per year.
	3	Xyway LFR (flutriafol)	15.2 fl oz	5.8-15.2 fl oz	-	0.5	Apply to corn in-furrow at planting or postemergence directed to the soil.
	3 + M2	Unicorn (tebuconazole + sulfur)	3.75 lb	15 lb	14	19	See label for details and rotational restrictions.
	3 + 7	Revyllok (mefentrifluconazole + fluxapyroxad)	15 fl oz	30 fl oz	21	0.5	No more than 2 applications per season.
	3 + 7	Propulse (prothioconazole + fluopyram)	13.7 fl oz	27.4 fl oz	0	1	No more than 2 sequential applications.
	3 + 7 + 11	Miravis Neo (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	No more than 2 sequential applications.
	3 + 7 + 11	Revytek (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	13.7 fl oz	54.8 fl oz	14	0.5	No more than 2 sequential applications before alternating with a fungicide of dissimilar mode of action.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	0	0.5	No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	3 + 11	Veltyma (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	21	0.5	No more than 3 applications of 10 fl oz/A or 4 applications of 7 fl oz/A.
	3 + 33	Viathon (tebuconazole + potassium phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7	Vertisan (penthiopyrad)	24 fl oz	48 fl oz	7	0.5	Soil and foliar treatments.
	7 + 11	Elatus (benzovindiflupyr + azoxystrobin)	7.3 oz	14.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Aftershock (fluoxastrobin)	3.8 fl oz	15.27 fl oz	7	0.5	Foliar treatments.
	11	Aproach (picoxystrobin)	12 fl oz	36 fl oz	7	0.5	See label for details.
	11	Evito 480SC (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	No more than 2 sequential applications and 4 total applications.
	11	Headline (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications and 6 total applications of Headline or other Qol fungicides.
	11	Headline SC (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	No more than 2 sequential applications and 6 total applications of Headline or other Qol fungicides.
	11	Quadris (azoxystrobin)	15.5 fl oz	120 fl oz	7	4 hr	No more than 2 sequential applications and 4 total applications of Quadris or other Qol fungicides. See label for soil applications.
	11	Willowood Azoxy 2 SC (azoxystrobin)	15.5 fl oz	62 fl oz	7	4 hr	No more than 2 sequential applications.
	11 + 3	Avaris (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	See label for details.
	11 + 3	Custodia (azoxystrobin + tebuconazole)	12.9 fl oz	51.7 fl oz	21	0.5	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Evito T (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	No more than 2 sequential applications and 4 total applications.
	11 + 3	Headline AMP (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz	7	0.5	No more than 2 sequential applications and 4 total applications.
	11 + 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	Stratego (trifloxystrobin + propiconazole)	12 fl oz	24 fl oz	0	0.5	No more than 2 sequential applications.
	11 + 3	Stratego YLD (trifloxystrobin + propiconazole)	5 fl oz	20 fl oz	0	0.5	No more than 2 sequential applications.
	11 + 3	Topguard EQ (flutriafol + azoxystrobin)	7 fl oz	14 fl oz	7	3	No more than 2 applications per season.
	11 + 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	See label for details.
	M2	(sulfur) Many brands available: Microfine Sulfur, Sulfur 90W, Top Cop with Sulfur, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
Pythium seedling blight, systemic downy mildew	4	(metalaxyl) Various brands available: Acceleron, Acquire, Allegiance, Sebring 2.65ST	3 fl oz/100 lb seed	-	-	1	Seed treatment only.
	4	Apron XL (mefenoxam)	2.2 fl oz/100 lb seed	-	-	2	Seed treatment only.
	33	(mono- and dipotassium salts of phosphorous acid) Various brands available: Confine Extra, K-white	3 qt	-	0	4 hr	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Rhizoctonia root and stalk rot diseases Tar spot	11	Aftershock (fluoxastrobin)	Soil: 0.24 fl oz/ 1000 row ft	15.2 fl oz	7	0.5	Soil and foliar treatments. See label for details.
	3 + 7	Revylak (mefentrifluconazole + fluxapyroxad)	15 fl oz	30 fl oz	21	0.5	No more than 2 applications per season.
	3 + 7 + 11	Delaro Complete (prothioconazole + fluopyram + trifloxystrobin)	8 fl oz	32 fl oz	Forage and ears: 0 Fodder: 14	0.5	No more than 2 sequential applications.
	3 + 7 + 11	Miravis Neo (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	No more than 2 sequential applications.
	3 + 7 + 11	Revytek (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 7 + 11	Trivapro (propiconazole + benzovindiflupyr + azoxystrobin)	13.7 fl oz	54.8 fl oz	14	0.5	No more than 2 sequential applications before alternating with a fungicide of dissimilar mode of action.
	3 + 11	Delaro (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	Forage and ears: 0 Fodder: 14	0.5	No more than 2 sequential applications
	3 + 11	Veltyma (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	21	0.5	No more than 3 applications of 10 fl oz/A or 4 applications of 7 fl oz/A.
	1	Thiabendazole 4L ST (thiabendazole)	0.41 fl oz/80,000 kernel count	-	-	0.5	-
	1 + 4 + 11 + 12	Maxim Quattro (thiabendazole + mefenoxam + azoxystrobin + fludioxonil)	-	-	-	0.5	Seed treatment only.
Various seedling diseases	3	Difenoconazole 3L ST (difenoconazole)	1.25 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	3 + 4	EverGol Energy (metalaxyl + prothioconazole)	2 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	4 + 14 + NC	System 3 (mefenoxam + PCNB + <i>Bacillus subtilis</i> GB03)	3 oz/bu of seed	-	-	1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Kernel Guard Supreme (carboxin + permethrin)	-	-	-	0.5	Seed treatment only.
	11	Stamina (pyraclostrobin)	1.6 fl oz/100 lb of seed	-	-	-	Seed treatment only.
	12	(fludioxonil) Various brands available: Dyna-Shield, Maxim 4FS, Spirato 480 FS	0.16 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.
	14	Rizolex (tolclofos-methyl)	0.3 fl oz/100 lb of seed	-	-	0.5	Seed treatment only.

¹ FRAC code (fungicide group): Numbers and letters are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. Source: FRAC Code List; <https://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year.

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 8. Nonfumigant nematocides for sweet corn in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Broadcast or Overall Rates		Row Rates	
	Per Acre	Per 1000 sq ft	Per Acre, 36" Row Spacing	Per 1000 Row ft, Any Row Spacing
Counter 15G (terbufos)*	-	-	5.4-7.3 lb	6.0-8.0 oz
Mocap 15G (ethoprophos)**	40 lb	0.9 lb	10.8-14.8 lb	0.75-1.0 lb
Velum (fluopyram)	Apply 6.5-6.8 fl oz/A either by in-furrow spray during planting directed on or below seed, or by chemigation into root zone through low-pressure drip or trickle irrigation. No more than 6.84 fl oz/A of Velum (0.446 lb/A of fluopyram) per year, regardless of formulation or method of application (soil or foliar). Do not apply Velum within 14 days of harvest. Do not allow livestock to graze treated area for 14 days, and do not harvest for food or feed within 14 days of application.			
Biological nematocides	See chapter 19.			
*Apply banded or in the row not to exceed 8.7 lb/A. **Do not allow Mocap to come in contact with seed. Apply as a 12 to 15 in. band treatment, incorporating Mocap product according to label instructions. These products are not as consistently effective against root-knot nematodes as the fumigants but are registered as indicated.				

Table 9. Fumigant nematicides for sweet corn in Florida.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/chisel spaced 12" apart	
Telone II ^{2, 3}	9–12	26–35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 ^{2, 3}	10.8–17.1	31.8–50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2, 3}	13–20.5	38–60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19–31.5	57–90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions
¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils. ² All of the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, Fumigant Management Plans (FMP), requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations. ³ Higher application rates are possible in the presence of cyst-forming nematodes. Rates are believed to be correct for products named and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the grower has the final responsibility to see that each product is used legally; read the label of the product to be sure that you are using it properly.			

Chapter 18. Tomato Production¹

Craig Frey, Ramdas Kanissery, Jawwad Qureshi, Johan Desaegeer, and Gary E. Vallad²

Botany and Planting

Tomato—*Solanum lycopersicum*, Solanaceae

Table 1. Planting dates for tomato.

Planting Region	Dates
North Florida	July–Aug; Feb–Apr
West-central Florida	Aug–Sept; Jan–Feb
South Florida	Aug–Feb

Table 2. Planting information for tomato.

Planting Parameters	Measurements
Distance between rows (in)	48–72
Distance between plants (in)	18–32
Days to maturity	70–90
Plant population per acre	3,630–4,356

Cultivars

For more information on tomato varieties, see <https://ask.ifas.ufl.edu/topics/tomato>.

Large-Fruited and Beefsteak Types

BHN 602. Early midseason maturity. Fruit are globe-shaped and green-shouldered.

BHN 3353. Continuous yield of large to extra-large fruit on a strong, determinate plant. Great for multiple picks.

Camaro. Medium plant with limited to no pruning. Extra-large globe-shaped fruit.

Everglade. Full-season maturity with deep oblate fruit. Performs well in cool weather conditions.

Florida 47. A late midseason, determinate, jointed hybrid. Uniformly green, globe-shaped fruit.

Florida 91. Midseason variety. Uniformly green fruit borne on jointed pedicels. Determinate plant. Good fruit-setting ability under high temperatures.

Grand Marshall. Midseason vigorous plant with hot set and extra-large to large oblate fruit.

HM 1823. Determinate, round tomato, early maturing variety with a strong plant and large to extra-large round fruit.

Jolene. Early maturing, determinate variety producing large to extra-large fruit with deep, dark interiors. Suitable for mature green or vine-ripe production.

Loretta. Determinate, high-flavor variety for fresh market or gas green production. Fruit have deep, round shape and pinpoint blossom end.

Red Bounty. Medium maturity, good heat set, extra-large globe fruit.

Red Defender. Medium maturity. Vigorous vine with smooth, large, deep-red fruit with excellent firmness and shelf life.

Red Snapper. Determinate, round variety suited for mature green and vine-ripe markets. Versatile across seasons with good hot-set potential.

Skyway. Main-season variety with a strong plant. Extra-large globe-shaped fruit.

Southern Ripe. Full-season maturity with a medium plant. Deep-oblate fruit that are adapted to cooler conditions.

STM2255. Adaptable determinate variety for both mature green and vine ripe. Mid cover with firm fruit and good shelf life.

Summerhaven. Widely adaptable determinate variety with excellent plant cover and extra-large fruit that ship well.

SV 7631. Midseason variety with medium to strong plant with large to extra-large oblate fruit.

Tasti-Lee. Released for the premium tomato market. A midseason, determinate, jointed hybrid with moderate heat tolerance. Fruit are uniformly green with a high lycopene content and deep-red interior color due to the crimson gene.

Thunderbird (STM5187). Hot-set determinate variety with extra-large, very firm fruit that have good shelf life.

Winterhaven. Mature green, determinate variety adapted to withstand cooler weather.

Plum and Roma Types

BHN 685. Midseason. Large to extra-large, deep-blocky, globe-shaped fruit. Determinate, vigorous bush with no pruning recommended.

BHN 1045. Uniform large fruit and a deep-blocky shape. A strong determinate plant with an excellent disease package.

Daytona. Midseason compact plant. Blocky-elongated large to extra-large fruit.

Mariana. Midseason. Fruit are predominately extra large and extremely uniform in shape. Fruit have thick walls, very good external and internal color, and excellent firmness and shelf life. Determinate, small-to-medium-sized plant with good fruit set.

Picus. Main-season, determinate Roma tomato that is widely adapted. Fruit are large, uniform, and blocky, maturing to a deep-red color with great firmness at the red stage. Medium-to-large, vigorous plant that provides good fruit cover and sets well in hot temperatures.

Shelby. Adaptable, determinate Roma tomato that can be used in multiple seasons. Fruit are very firm, have low gel, and have a good shelf life. Can be used for mature green and vine ripe markets.

Tachi. Midseason variety with classic saladette shape. Determinate, midcompact plant. Fruit size predominately extra large, uniform, and very similar to 'Mariana'. Widely adapted and suited for concentrated harvests for vine-ripe and mature-green markets.

Villa. Mid-early season, indeterminate, extra-large Roma variety with compact growth habit and mid vigor.

Cherry Types

BHN 268. Early to midseason. Tall bush. An extra-firm cherry tomato that holds, packs, and ships well. Determinate, small-to-medium bush with high yields.

BHN 762. Early determinate variety. Globe-shaped fruit.

Sakura. Early indeterminate hybrid.

Sweet Treats. Early main season with wide adaptability. Strong, vigorous, indeterminate plant. Deep-pink, firm, globe-shaped fruit with outstanding flavor potential. Strong against cracking.

Grape Types

BHN 784. Early-midseason, determinate grape hybrid. Heat tolerant.

BHN 785. Midseason, determinate grape hybrid with a strong set of very uniformly sized and shaped fruit on a vigorous bush with good cover.

BHN 1022. Determinate "hot-set" variety.

Gold Spark. Mid-late. Indeterminate. High-yield yellow grape with consistent Brix, great firmness, and excellent shelf life.

Jolly Girl. Early season, determinate plant. Extended market life with firm, flavorful grape-shaped fruit. Average 10% Brix.

Mountain Honey. Semideterminate plant produces high yields of uniform, deep-red fruit with very good flavor and sugars.

Mountain Vineyard. Indeterminate grape with deep red color.

Ruby Crush. Mid-early, determinate plant with midcompact growth. Deep-red fruit that are very smooth, uniform, and firm with a good flavor profile.

Smarty. Early, vigorous, indeterminate bush with short internodes. Plants are 25% shorter than 'Santa'. Sweet and excellent flavor.

Sweethearts. Early to midseason, indeterminate bush with intermediate internodes. Brilliant red, firm, elongated grape-shaped fruit. Mature between 70 and 75 days. Good flavor, crack-resistant, and high Brix.

Table 3. Disease-resistance packages for tomato varieties.

	Varieties	Disease Resistance ¹
Large and Beefsteak	Amelia	R to F-R (1, 2, 3), N, S, TSW, and V (1)
	BHN 602	R to F-R (1, 2, 3), TSW, and V (1)
	BHN 3353	R to FCR, F-R (1, 2), V (1), and TSW; IR to TYLCV
	Camaro	R to ASC, F-R (1, 2, 3), and V (1); IR to S and TYLC
	Everglade	R to ASC, F-R (1, 2, 3), S, and V (1); IR to TYLCV
	Florida 47	R to F-R (1, 2), V (1), ASC, and S
	Florida 91	R to F-R (1, 2), V (1), ASC, and S
	Grand Marshall	R to ASC and F-R (1, 2); IR to S and TYLC
	HM 1823	R to FCR, F-R (1, 2), and V (1); IR to S
	Jolene	R to FCR, F-R (1, 2), and V (1); IR to TYLCV
	Laguna Red	R to ASC, FCR, F-R (1, 2), ToM, and V (1)
	Loretta	R to FCR, F-R (1, 2), S, and V (1)
	Red Bounty	R to V (1), F-R (1, 2), S, TSWV, and N
	Red Snapper	R to ASC, F-R (1, 2), and V (1); IR to S, TSW, and TYLC
	Skyway	R to F-R (1, 2); IR to N, TSW, and TYLC
	Southern Ripe	R to FCR, F-R (1, 2, 3), and TSW; IR to N
	STM2255	R to ASC, FCR, F-R (1, 2), and V (1); IR to S, TSW, and TYLCV
	Summerhaven	R to FCR, F-R (1, 2), and V (1); IR to TSW and TYLCV
	SV 7631	R to ASC, F-R (1, 2), TSW, and V (1); IR to N
	Tasti-Lee	R to F-R (1, 2, 3), V (1), and S
	Thunderbird (STM5187)	R to ASC, FCR, F-R (1, 2), and V (1); IR to S and TYLCV
	Winterhaven	R to FCR, F-R (1, 2), and V (1); IR to TSW and TYLCV
Plum	BHN 685	R to F-R (1, 2, 3), TSW, and V (1)
	BHN 1045	R to F-R (1, 2, 3), TSW, TYLCV, and V (1)
	Daytona	R to ASC, F-R (1, 2), N, and V (1); IR to TYLCV
	Mariana	R to ASC, F-R (1, 2), N, and V (1); IR to S
	Picus	R to ASC, TSW, F-R (1, 2), V (1), and CLS
	Shelby	R to ASC, FCR, F-R (1, 2), BSK, and V (1); IR to TSW and TYLCV
	Tachi	R to ASC, F-R (1, 2), N, and V (1); IR to TSW
	Villa	R to ASC, F-R (1, 2, 3), and V (1); IR to TSW
Cherry	BHN 268	R to F-R (1) and V (1)
	BHN 762	R to F-R (1) and V (1)
	Sakura	R to F-R (1, 2), CLS, and TM
	Sweet Treats	R to CLS, F-R (1, 2), and ToM; IR to FCR and S

	Varieties	Disease Resistance ¹
Grape	BHN 784	R to F-R (1)
	BHN 785	R to F-R (1)
	BHN 1022	R to F-R (1, 2, 3) and TSW
	Gold Spark	R to ToM and CLS
	Jolly Girl	R to C and V (1); IR to F-R (1, 2)
	Mountain Honey	R to F-R and V (1); IR to TSWV and Late Blight
	Mountain Vineyard	R to F-R (1, 2, 3) and TSW
	Ruby Crush	R to FCR, F-R (1, 2), and ToM; IR to S
	Smarty	R to F-R (1,2) and V (1)
	Sweethearts	R to C, CLS, F-R (1), and TM; IR to S

¹ ASC = Alternaria stem canker = *Alternaria alternata* f. sp. *lycopersici*; BSK—Bacterial speck—*Pseudomonas syringae* pv *tomato*; C—Cracking; CLS—Cladosporium leaf mold—*Cladosporium fulvum*; F-R 1, 2, 3—*Fusarium wilt* race 1, 2, 3—*Fusarium oxysporum* f. sp. *lycopersici* races 1, 2, 3; FCR—*Fusarium crown rot*—*Fusarium oxysporum* f. sp. *radicis-lycopersici*; N—Root-knot nematode—*Meloidogyne arenaria*, *M. incognita*, and *M. javanica*; S—Gray leaf spot—*Stemphylium solani*; ToM = Tomato mosaic virus; TM = Tobacco mosaic; TSW = Tomato spotted wilt; TYLC—Tomato yellow leaf curl; V (1) = *Verticillium wilt*—*Verticillium albo-atrum* and *Verticillium dahliae* race 1. R = Resistant; IR = Intermediate Resistance; T = Tolerant.

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 4. Herbicides approved for managing weeds in tomato. **Labels change frequently. Be sure to read a current product label before applying any chemical.** Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
PREPLANT/ PREEMERGENCE	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaves up to 4 in. tall or rosettes less than 3 in. across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
	EPTC 2.6	(Eptam) 7 E 3 pt	8	Annual broadleaves, annual grasses, and suppression of yellow/purple nutsedge. Labeled for transplanted tomatoes grown on low-density mulch. Do not use under high-density, VIF, TIF, or metalized mulches. Label is a 24(c) local indemnified label, and a waiver of liability must be signed for use. 14-day pretransplant interval.
	Flumioxazin up to 0.128	(Chateau EZ) up to 4 fl oz	14	Annual broadleaves and grasses. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
	Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Broadleaves and suppression of yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label, and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bareground production or to plastic-mulched beds following bed formation but prior to laying plastic. Use shields or hooded sprayers if applying to row middles and prevent contact with the plastic mulch. 7- and 0-day pretransplant interval on bare ground and plastic mulch, respectively. PHI 70 days.
	Glufosinate-ammonium 0.53–0.79	(Rely) 280 29–43 fl oz	10	For burndown of emerged broadleaved weeds, grasses, and nutsedge prior to planting. May be applied as a pre-plant burndown to pre-formed beds covered with plastic mulch. See product label for planting intervals and other restrictions when applied prior to transplanting over the top of plastic mulch. Note: Rely 280 label is still valid for use if the applicator has product on hand. Registration has since moved to the Liberty label through December 2026 for row middle weed management in tomato. PHI 30 days.
	Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply as a preplant burndown. Consult label for individual product directions.
	Halosulfuron 0.024–0.05	(Sande, Profine) 75 DF 0.5–1.0 oz	2	Broadleaf weeds and yellow/purple nutsedge. No more than 2 applications of halosulfuron per 12-month period. 7-day pretransplant interval. PHI 30 days.
	Imazosulfuron 0.19–0.3	(League) 4.0–6.4 oz	2	Broadleaves and suppression of yellow/purple nutsedge. Apply pretransplant just prior to installation of plastic mulch. 1-day pretransplant interval. PHI 21 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit may cause excessive injury. Drift of Cobra treated soil particles onto plant can cause contact injury. No more than 1 PRE and 1 POST application per growing season. PHI 30 days.
	Metribuzin 0.25–0.5	(Sencor DF, TriCor DF) 75 WDG 0.33–0.67 lb (Sencor 4, Metricor) 4 F 0.5–1.0 pt	5	Small emerged weeds less than 1 in. tall. Apply preplant in transplanted tomatoes only. Incorporate to a depth of 2–4 in. No more than 1.0 lb a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. PHI 7 days.
	Napropamide 1.0–2.0	(Devrinol DF-XT) 50 DF 2.0–4.0 lb (Devrinol 2-XT) 2–4 qt	15	Annual broadleaves and grasses. For direct-seed or transplanted tomatoes. Apply to well-worked soil that is moist enough to permit thorough incorporation to a depth of 2 in. Incorporate same day as applied.
	Oxyfluorfen 0.25–0.5	(Goal 2 XL) 2 EC 1.0–2.0 pt (GoalTender) 4 E	14	Broadleaves. Apply pretransplant just prior to installation of plastic mulch. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
	Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Gramoxone) 3 SL 1.3–2.7 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Surfactant recommended. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or posttransplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.
	Pendimethalin 0.48–0.72	(Prowl H ₂ O) 3.8 1.0–1.5 pt	3	May be applied pretransplant to bed tops just prior to laying the plastic mulch or to row middles. No more than 3.0 pt/A per year. PHI 70 days.
	Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–252.0 fl oz	14	Emerged broadleaves less than 4 in. tall or rosettes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
	Rimsulfuron 0.03–0.06	(Pruvin) 25 WDG (Matrix) SG 2.0–4.0 oz	2	Annual broadleaves and grasses. Suppression of yellow nutsedge. Requires 0.5–1 in. of rainfall or irrigation within 5 days of application for activation. May be applied as a sequential treatment with a PRE and POST application. No more than 0.06 lb a.i./A per season. PHI 45 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
POSTTRANSPLANT	S-metolachlor 1.0-1.3	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0-1.33 pt if organic matter less than 3%	15	Annual broadleaves and grasses. Suppression of yellow/purple nutsedge. Apply to bed tops pretransplant just prior to laying the plastic. May also be used in row middles. Research has shown that the 1.33 pt may be too high in some Florida soils except in row middles. PHI 30 days. 90-day PHI if rate exceeds 1.33 pt/A.
	Sulfentrazone 0.070-0.19	(Spartan) 4F 2.25-6.0 oz	14	Preemergent control of broadleaves and grasses. Applications must be made prior to transplant. No more than 12 oz/A per application or per 12-month period.
	Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan TR, Trifluralin) 10 G 5 lb	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 in. or less within 8 hr of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note that label precautions against planting "nonlisted" vegetable crops within 5 months of application. Do not apply after transplanting.
	Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Good coverage is essential. May be tank-mixed with other herbicides. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. PHI 0 days.
	Clethodim 0.09-0.25 0.07-0.25	(Arrow) 2 EC 6-16 fl oz (Select Max) 1 EC 9-32 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. PHI 20 days.
	Diquat 0.5	(Reglone Desiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. No more than 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. PHI 30 days.
	Glufosinate-ammonium 0.53-1.17	(Rely) 280 29-62 fl oz	10	For postemergence control of broadleaved weeds, grasses, and nutsedge present between the rows of established tomatoes. Make a hooded application to row middles. PHI 30 days. Note: Rely 280 label is still valid for use if the applicator has product on hand. Registration has since moved to the Liberty label through December 2026 for row middle weed management in tomato.
	Halosulfuron 0.024-0.05	(Sandea, Profine) 75 DF 0.5-1.0 oz	2	Broadleaf weeds and yellow/purple nutsedge. Apply 14 days after transplant but before first bloom. Following first bloom apply with shielded or hooded applicator. May be applied to row middles with shielded or hooded sprayer. No more than 2 oz per 12-month period. Surfactant recommended. PHI 30 days.
	Imazosulfuron 0.19-0.3	(League) 4.0-6.4 oz	2	Apply postemergence 3-5 days after transplant through early bloom. Only apply if no pretransplant application was made. Surfactant recommended. PHI 21 days.
	Lactofen 0.25-0.5	(Cobra) 2 EC 16-32 fl oz	14	Broadleaf weeds. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit can cause excessive injury. Drift of Cobra-treated soil particles onto plants can cause contact injury. No more than 1 PRE and 1 POST application per growing season. Do not apply within 18 days of transplant. Surfactant recommended. PHI 30 days.

	Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
	Metribuzin 0.25–0.5	(Sencor DF, TriCor DF) 75 WDG 0.33–0.67 lb (Sencor 4, Metricor) 4 F 0.5–1.0 pt	5	Small, emerged weeds. Apply after transplants or seedlings are well established. Apply in single or multiple applications. Reapplications at least 14 days apart. No more than 1.0 lb a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. PHI 7 days.
	Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Gramoxone) 3 SL 1.3 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaf and grass weeds. Direct spray over emerged weeds 1–6 in. tall in row middles between mulched beds. Use low pressure and shields to control drift. No more than 3 applications per season. Nonionic surfactant recommended. PHI 30 days. Consult label for new restrictions.
	Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
	Pendimethalin 0.48–0.72	(Prowl H ₂ O) 3.8 1.0–1.5 pt	3	Broadleaf and grass weeds. May be applied posttransplant to row middles if previously untreated. No more than 3.0 pt/A per year. PHI 70 days.
	Rimsulfuron 0.02–0.03	(Pruvin, Solida) 25 WDG (Matrix) SG 1.0–2.0 oz	2	Broadleaves and grasses. May be applied as a sequential treatment with a PRE and POST application. No more than 0.06 lb a.i./A per season. Requires 0.5–1.0 in. of rainfall or irrigation within 5 days of application for activation. Nonionic surfactant or crop oil concentrate recommended. PHI 45 days.
	Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Actively growing grasses. No more than 4.5 pt/A per season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. PHI 20 days.
	S-metolachlor 1.0–1.3	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0–1.33 pt	15	Annual broadleaf, grasses, and yellow/purple nutsedge. Apply to row middles. Label rates are 1.0–1.33 pt/A if organic matter is less than 3%. Use on a trial basis. Surfactant not recommended. PHI 90 days for rates above 1.33 pt/A. PHI 30 days for rates 1.33 pt/A or less.
	Trifloxysulfuron 0.005–0.009	(Envoke) 75 DG 0.1–0.2 oz	2	Broadleaves and yellow/purple nutsedge. Direct spray solution to the base of transplanted tomato plants. Apply at least 14 days after transplanting and before fruit set. PHI 45 days.
	Diquat 0.5	(Reglone Desiccant) 2.0 pt	22	No more than 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.
	Paraquat 0.62–0.94	(Gramoxone) 2 SL 2.4–3.75 pt (Gramoxone) 3 SL 1.3–2.7 pt (Firestorm) 3 SL 1.6–2.5 pt	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended. Consult label for new restrictions.
POSTHARVEST				

Table 5. Insecticides labeled for management of arthropod pests on tomato. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.**
Contact: Jawwad Qureshi, UF/IFAS Southwest Florida Research and Education Center.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Aphids (including aphids-transmitting viruses, green peach aphid, potato aphid)	1A	*Lannate LV, *SP (methomyl)	LV: 1.5–3.0 pt SP: 0.5–1.0 lb	LV: 21 pt per crop (15 pt for tomatillos) SP: 7 lb per crop (5 lb for tomatillos)	48	1	–
	1A	*Vydate L (oxamyl)	Foliar: 2.0–4.0 pt	32 pt	48	3	–
	1B	Dimethoate 4 EC (dimethoate)	0.5–1.0 pt	1 lb a.i. per year	48	7	Reapplications at least 6 days apart.
	1B	Malathion 5 (malathion)	1.0–2.5 pt	10 pt	12	1	–
	1B	Malathion 8 F (malathion)	1.5 pt	–	–	–	8F can be used in greenhouse.
	3A	*Asana XL (0.66EC) (esfenvalerate)	2.9–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Danitol 2.4 EC (fenpropathrin)	7–10.67 fl oz	42.67 fl oz	24	3	–
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.0 oz	24 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 28	*Voliam Xpress (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31.0 fl oz	24	5	–
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11.0 oz	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Reapplications at least 5 days apart.
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	Admire Pro (imidacloprid)	0.6 fl oz/1000 plants	–	12	Soil: 0	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	–	12	21	Planthouse: 1 application. See label.
	4A	Assail 70WP (acetamiprid)	0.6–1.7 oz	6.8 oz of Assail 70WP, including any pretransplant applications of acetamiprid	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	See label for application instructions. Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	12	30	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Safari 20 SG (dinotefuran)	7.0–14.0 oz	–	12	1	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use 1 method or the other.
	4A	Venom 20 SG (dinotefuran)	Foliar: 1–4 oz	1.34 lb	12	1	Toxic to honeybees.
	4A	Venom 20 SG (dinotefuran)	Soil: 5–7.5 oz	2.68 lb	12	21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Several methods of soil application—see label.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	Transform WG (sulfoxaflor)	0.75–1.0 oz	8.5 oz	24	1	–
	4D	Sivanto Prime (flupyradifurone)	Soil: 21.0–28.0 fl oz Foliar: 7.0–14.0 fl oz	28.0 fl oz per year	4	Soil: 45 Foliar: 1	Reapplications at least 7 days apart.
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz per crop	12	0	–
	9B	PQZ (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz	12	1	Reapplications at least 7 days apart.
	9D	Sefina Inscalis Insecticide (afidopyropen)	3.0 fl oz	28 fl oz	12	0	Reapplications at least 7 days apart.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz per crop cycle	12	1	Do not apply until at least 14 days after emergence.
	23	Movement MPC (spirotetramat)	7.0–8.0 fl oz	16 fl oz	24	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Beetles (including beetle larvae, blister beetles, Colorado potato beetle, cucumber beetles, flea beetles)	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per crop	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 6.75–13.5 fl oz Drip: 6.75–10 fl oz	0.4 lb a.i.	4	1	–
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels. No more than 2 applications per season. Reapplications at least 7 days apart.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season.
	1A	*Vydate L (oxamyl)	Foliar: 2.0–4.0 pt	32 pt	48	3	–
	3A	*Ambush 25W (permethrin)	3.2–12.8 oz	76.8 oz	12	Up to day of harvest	Do not use on cherry tomatoes.
	3A	*Asana XL (0.66EC) (esfenvalerate)	2.9–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 oz	24 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Pounce 25 WP (permethrin)	3.2–12.8 oz	0.6 lb a.i.	12	0	Do not apply to cherry or grape tomatoes (fruit with less than 1 in. diameter).
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 4A	*Leverage 360 (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz	–	12	0	–
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11.0 oz	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Reapplications at least 5 days apart.
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	Assail 70WP (acetamiprid)	0.6–1.7 oz	6.8 oz of Assail 70WP, including any pretransplant applications of acetamiprid	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	See label for application instructions. Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	–	–	–
	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use 1 method or the other.
	4A	Venom 20 SG (dinotefuran)	Foliar: 1–4 oz	1.34 lb	12	1	Toxic to honeybees.
	4A	Venom 20 SG (dinotefuran)	Soil: 5–7.5 oz	2.68 lb	12	21	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Several methods of soil application—see label.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz	4	1	Reapplications at least 7 days apart.
	5	Entrust (spinosad)	0.5–2.5 oz	9 oz per crop	4	1	OMRI-listed. ³ For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	28.8 oz	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 fl oz	12	1	Reapplications at least 7 days apart.
	17	Trigard (cyromazine)	2.66 oz	15.96 oz	12	0	No more than 6 applications per crop. Does not control CPB adults. Most effective against 1st and 2nd instar larvae.
	21A	Torac (tolfenpyrad)	17–21 fl oz	42 fl oz	12	1	Do not apply until at least 14 days after emergence.
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz per crop	4	1	Can be applied by drip chemigation or as a soil application at planting. See label for details.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Exirel (cyantraniliprole)	7–20.5 fl oz	0.4 lb a.i. per crop	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 6.75–13.5 fl oz Drip: 6.75–10 fl oz	0.4 lb a.i. per crop	4	1	–
	1A	*Lannate SP (methomyl)	0.5–1.0 lb	–	48	1	–
Caterpillars (including cabbage looper, corn earworm, garden webworm, hornworms, imported cabbageworm, loopers, saltmarsh caterpillar, tobacco budworm, tomato fruitworm; armyworms [beet armyworm, fall armyworm, southern armyworm, true armyworm, yellowstriped armyworm]; cutworms [black cutworm, granulate cutworm])	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 1.0–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season.
	1A	10% Sevin Granules (carbaryl)	20 lb	–	12	3	No more than 4 applications per year. Reapplications at least 7 days apart.
	1B	*Diazinon AG500 *50W (diazinon)	AG500: 1–4 qt 50W: 2–8 lb	AG500: 4 qt 50W: 8 lb	48	preplant	Incorporate into soil—see label. No more than 1 soil application per year, regardless of target pest.
	3A	*Ambush 25W (permethrin)	3.2–12.8 oz	76.8 oz	12	Up to day of harvest	Do not use on cherry tomatoes.
	3A	*Asana XL (0.66EC) (esfenvalerate)	2.9–9.6 fl oz	96 fl oz	12	1	–
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.4 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Danitol 2.4 EC (fenpropathrin)	–	–	24	3	–
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 oz	24 fl oz	12	1	Reapplications at least 7 days apart. Consult label for specific species.
	3A	*Pounce 25 WP (permethrin)	3.2–12.8 oz	0.6 lb a.i.	12	0	Do not apply to cherry or grape tomatoes (fruit with less than 1 in. diameter).

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 4A	*Leverage 360 (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz	–	12	0	–
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz per year	24	5	–
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	–	–	–
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Several methods of soil application—see label.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	Entrust (spinosad)	1.5–8.0 oz	9 oz per crop	4	1	OMRI-listed. ² For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	For thrips, if additional treatment is needed after 2 applications, switch to an alternate mode of action (not Group 5) for at least 2 applications.
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	28.8 oz	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	24	7	This label contains pollinator warnings.
	11A	Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5–2.0 lb	–	4	0	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed. ³
	11A	Biobit HP (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed. ³
	11A	Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5–2.0 lb	–	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25–1.5 lb	–	4	0	Use higher rates for armyworms. OMRI-listed. ³
	11A	DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.25–2.0 lb	–	4	0	Treat when larvae are young. Good coverage is essential. Can be used for organic production.
	11A	Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12–1.5 lb	–	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed. ³
	11A	Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5–2.0 lb	–	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production. OMRI-listed. ³
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 fl oz	12	1	Reapplications at least 7 days apart.
	18	Confirm 2F (tebufenozide)	6–16 fl oz	64 fl oz	4	7	Product is a slow-acting IGR (insect growth regulator) that will not kill larvae immediately.
	18	Intrepid 2F (methoxyfenozide)	4–16 fl oz	64 fl oz	4	1	Product is a slow-acting IGR that will not kill larvae immediately.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	22	Avaunt eVo (indoxacarb)	2.5–6.0 oz	24 oz per crop	12	3	Reapplications at least 5 days apart.
	28	Coragen (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz per crop	4	1	Can be applied by drip chemigation or as a soil application at planting. See label for details.
	28	Exirel (cyantraniliprole)	7–20.5 fl oz	0.4 lb a.i. per crop	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	5–13.5 fl oz	0.4 lb a.i. per crop	4	1	–
Fire ants	7A	Extinguish (S-methoprene)	1.0–1.5 lb	–	4	0	Slow-acting IGR.
	7C	Esteem Ant Bait (pyriproxyfen)	1.5–2.0 lb	–	12	1	Apply when ants are actively foraging.
Lace bugs	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season.
Leafhoppers	1B	Dimethoate 4 EC (dimethoate)	0.5–1.0 pt	1 lb a.i. per year	48	7	Reapplications at least 6 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 oz	24 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–

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			Appl.	Season ²			
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 28	*Voliam Xpress (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31.0 fl oz	24	5	–
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11.0 fl oz	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Reapplications at least 5 days apart.
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	See label for application instructions. Do not release irrigation water from the treated area.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	–	–	–
	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use 1 method or the other.
	4A	Venom (dinotefuran)	Foliar: 1–4 oz	1.34 lb	12	1	Use only 1 application method (soil or foliar). No more than 3 applications per season. Toxic to honeybees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Venom (dinotefuran)	Soil: 5–7.5 oz	2.68 lb	12	21	Use only 1 application method (soil or foliar).
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Several methods of soil application—see label.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	Sivanto Prime (flupyradifurone)	Soil: 21.0–28.0 fl oz Foliar: 7.0–10.5 fl oz	28.0 fl oz per year	4	Soil: 45 Foliar: 1	Reapplications at least 7 days apart.
	6	*Proclaim (emamectin benzoate)	2.4–4.8 oz	28.8 oz	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz per crop cycle	12	1	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Reapplications at least 5 days apart.
	1A	*Vydate L (oxamyl)	Foliar: 2.0–4.0 pt	32 pt	48	3	–
<i>Liriomyza</i> leafminers	4A	Venom 20 SG (dinotefuran)	Foliar: 0.44–0.895 lb	1.34 lb	12	1	Use only 1 application method (soil or foliar). No more than 3 applications per season. Toxic to honeybees.
	4A	Venom 20 SG (dinotefuran)	Soil: 1.13–1.34 lb	2.68 lb	12	21	Use only 1 application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/A.
	5	Entrust (spinosad)	6.0–10.0 oz	9 oz per crop	4	1	OMRI-listed. ³ For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	Radiant SC (spinetoram)	5–10 fl oz	34 fl oz per year	4	1	–
	6	*Agri-Mek 0.15 EC (abamectin)	8.0–16.0 fl oz	48 fl oz	12	7	No more than 2 sequential applications per season.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	24	7	This label contains pollinator warnings.
	28	Coragen (chlorantraniliprole)	Soil, drip or foliar: 5–7.5 fl oz	–	4	1	For control of larvae.
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per crop	12	1	Foliar applied. Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 6.75–13.5 fl oz Drip: 6.75–10 fl oz	0.4 lb a.i. per crop	4	1	Soil applied.
Mites (including broad mites, twospotted spider mites, tomato russet mites, carmine spider mites)	1B	Malathion 5; 8F (malathion)	5: 1.0–2.5 pt 8F: 1.5 pt	10 pt	12	1	8F can be used in greenhouse.
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Danitol 2.4 EC (fenpropathrin)	7–10.67 fl oz	42.67 fl oz	24	3	–
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRL-listed. ³ No more than 10 applications per season.
	6	*Agri-Mek 0.15 EC (abamectin)	8.0–16.0 fl oz	48 fl oz	12	7	No more than 2 sequential applications per season.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	6	*Agri-Mek SC (abamectin)	1.75–3.5 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz per year	24	7	This label contains pollinator warnings.
	20B	Kanemite 15 SC (acequinocyl)	31 fl oz	62 fl oz	12	1	Do not use less than 100 gal of water volume per acre. No more than 2 applications at least 21 days apart.
	20D	Acramite-50WS (bifenazate)	0.75–1.0 lb	–	12	3	Field grown only. Acramite-50WS is not systemic in action; therefore, complete coverage of both upper and lower leaf surfaces and of fruit is necessary for effective control. No more than 1 application.
	21A	Magister (fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt per crop cycle	12	1	No more than 2 applications per growing season. Reapplications at least 14 days apart.
	23	Movento MPC (spirotetramat)	7.0–8.0 fl oz	16 fl oz	24	1	–
	23	Oberon 25C (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz per crop	12	1	No more than 3 applications per season.
	1B	*Diazinon AG500 *50 W (diazinon)	AG500: 1–4 qt 50W: 2–8 lb	AG500: 4 qt 50W: 8 lb	48	Preplant	Incorporate into soil—see label. No more than 1 soil application per season, regardless of target pest.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt	12	3	No more than 7 applications per season.
Plant bugs and tarnished plant bugs	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Mustang Maxx (zeta-cypermethrin)	2.24–4.0 oz	24.0 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31 fl oz per year	24	5	–
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting	See label for application instructions. Do not release irrigation water from the treated area.
	4C	Transform WG (sulfoxaflor)	1.5–2.25 oz	8.5 oz	24	1	–
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 fl oz	12	1	Reapplications at least 7 days apart.
	29	Beleaf 50 SG (flonicamid)	2.0–2.8 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels. No more than 2 applications per season. Reapplications at least 7 days apart.
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz per crop cycle	12	1	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Reapplications at least 5 days apart.
Planthoppers							
Psyllids	4D	Sivanto Prime (flupyradifurone)	7.0–14.0 fl oz	28.0 fl oz per year	4	1	Reapplications at least 7 days apart.
	23	Movento MPC (spirotetramat)	7.0–8.0 fl oz	16 fl oz	24	1	–
Stink bugs (including brown stink bug and green stink bug)	1A	10% Sevin Granules (carbaryl)	20 lb	–	12	3	No more than 4 applications per year. Reapplications at least 7 days apart.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Danitol 2.4 EC (fenpropathrin)	7–10.67 fl oz	42.67 fl oz	24	3	–
	3A	*Hero (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2–4.3 oz	24.0 fl oz	12	1	Not recommended for vegetable leafminer in Florida. Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19.0 fl oz	24	5	See label for limits on each active ingredient.
	3A + 4A	*Leverage 360 (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz	–	12	0	–
	3A + 28	*Voliam Xpress (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31.0 fl oz	24	5	–
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11.0 oz	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Reapplications at least 5 days apart.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Thrips: check label for species controlled (includes melon thrips, western flower thrips, Florida flower thrips, eastern flower thrips, foliar feeding thrips, chilli thrips)	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use 1 method or the other.
	4A + 28	Voliam Flexi (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	14 oz	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 fl oz	12	1	Reapplications at least 7 days apart.
	1A	Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63–2.5 lb XLR, 4F: 0.5–2.0 qt	10 lb or 8 qt per crop	12	3	No more than 7 applications per season.
	3A	*Baythroid XL (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz	12	0	–
	3A	*Brigade 2EC (bifenthrin)	2.1–5.2 fl oz	20.8 fl oz	12	1	Reapplications at least 10 days apart. No more than 4 applications per season.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	43.26 fl oz	12	1	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A	*Mustang (zeta-cypermethrin)	3.4–4.3 oz	25.8 fl oz	12	1	Reapplications at least 7 days apart.
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92–3.84 fl oz	2.88 pt	24	5	–
3A	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5–18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz	24	5	–
	3A + 4A	*Leverage 360 (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz	–	12	0	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	3A + 28	*Voliam Xpress (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	31.0 fl oz	24	5	–
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	Assail 70WP (acetamiprid)	0.6–1.7 oz	6.8 oz of Assail 70WP including any pretransplant applications of acetamiprid	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67 oz	–	–	–
	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use 1 method or the other.
	4A	Venom 20 SG (dinotefuran)	Foliar: 1–4 oz	1.34 lb	12	1	Use only 1 application method (soil or foliar). No more than 3 applications per season. Toxic to honeybees.
	4A	Venom 20 SG (dinotefuran)	Soil: 5–7.5 oz	2.68 lb	12	21	Use only 1 application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/A.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Several methods of soil application—see label.
	4C	Transform WG (sulfoxaflor)	2.25 oz	8.5 oz	24	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	5	Entrust (spinosad)	4-8 oz	8 oz per crop	4	1	OMRI-listed. ³ For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	Radiant SC (spinetoram)	5-10 fl oz	34 fl oz per year	4	1	For thrips, if additional treatment is needed after 2 applications, switch to an alternate mode of action (not group 5) for at least 2 applications.
	6	*Agri-Mek 0.15 EC (abamectin)	8.0-16.0 fl oz	48 fl oz	12	7	No more than 2 sequential applications per season.
	6	*Agri-Mek SC (abamectin)	1.75-3.5 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.
	6 + 28	*Minecto Pro (abamectin + cyantraniliprole)	5.5-10 fl oz	20 fl oz per year	24	7	This label contains pollinator warnings.
	15	Rimon 0.83EC (novaluron)	9.0-12.0 fl oz	36 fl oz	12	1	Reapplications at least 7 days apart.
	21A	Torac (tolfenpyrad)	17-21 fl oz	42 fl oz per crop cycle	12	1	Do not apply until at least 14 days after emergence.
	23	Movento MPC (spirotetramat)	7.0-8.0 fl oz	16 fl oz	24	1	-
	28	Exirel (cyantraniliprole)	13.5-20.5 fl oz	0.4 lb a.i. per crop	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	10.0-13.5 fl oz	0.4 lb a.i. per crop	4	1	-
	29	Beleaf 50 SG (flonicamid)	4.2 oz	8.4 oz		0	Begin applications before pests reach damaging levels. No more than 2 applications per season. Reapplications at least 7 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
Weevils (vegetable weevil)	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92-3.84 fl oz	2.88 pt	24	5	-
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	23.04 fl oz	24	5	See label for limits on each active ingredient.
	3A + 4A	*Endigo ZC (lambda-cyhalothrin + thiamethoxam)	4.0-4.5 fl oz	19.0 fl oz	24	5	Antifeedant, repellent, IGR. OMRI-listed. ³
Whiteflies	1A	*Vydate L (oxamyl)	Foliar: 2.0-4.0 pt	32 pt	48	3	-
	3A	*Asana XL (0.66EC) (esfenvalerate)	2.9-9.6 fl oz	96 fl oz	12	1	-
	3A	*Baythroid XL (beta-cyfluthrin)	1.6-2.8 fl oz	16.8 fl oz	12	0	-
	3A	*Brigade 2EC (bifenthrin)	2.1-5.2 fl oz	20.8 fl oz	12	1	No more than 4 applications per season.
	3A	*Danitol 2.4 EC (fenpropathrin)	7-10.67 fl oz	42.67 fl oz	24	3	No more than 4 applications per season. Reapplications at least 10 days apart.
	3A	*Hero (bifenthrin + zeta-cypermethrin)	10.3 oz	43.26 fl oz	12	1	-
	3A	*Karate with Zeon (lambda-cyhalothrin)	0.96-1.92 fl oz	23.04 fl oz	24	5	-
	3A	*Mustang Maxx (zeta-cypermethrin)	3.2-4.0 oz	24.0 fl oz	12	1	-
	3A	*Proaxis Insecticide (gamma-cyhalothrin)	1.92-3.84 fl oz	2.88 pt	24	5	-
	3A	Pyganic Crop Protection EC 5.0 II (pyrethrins)	4.5-18.0 fl oz	11.25 pt	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. ³ No more than 10 applications per season.
	3A	*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	23.04 fl oz	24	5	-
	3A + 28	*Besiege (lambda-cyhalothrin + chlorantraniliprole)	5.0-9.0 fl oz	31.0 fl oz	24	5	Reapplications at least 10 days apart.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Actara (thiamethoxam)	2.0–5.5 oz	11.0 oz	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	Admire Pro (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	Admire Pro (imidacloprid)	0.6 fl oz/1000 plants	–	12	Soil: 0	Planthouse: 1 application. See label.
	4A	Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	–	12	21	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. No more than 4 applications per season. Reapplications at least 7 days apart.
	4A	Assail 70WP (acetamiprid)	0.6–1.7 oz	6.8 oz of Assail 70WP, including any pretransplant applications of acetamiprid	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Foliar: 1.6–2.1 oz	6.4 oz	12	7	See label for application instructions. Do not release irrigation water from the treated area.
	4A	Belay 50 WDG (clothianidin)	Soil: 4.8–6.4 oz	6.4 oz	12	Apply at planting.	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	Platinum (thiamethoxam)	5–11 fl oz	11 fl oz	12	30	–
	4A	Platinum 75 SG (thiamethoxam)	1.66–3.67 oz	3.67oz	12	30	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	Safari 20 SG (dinotefuran)	7.0–14.0 oz	–	12	1	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	Scorpion (dinotefuran)	Soil: 9–10.5 fl oz Foliar: 2–7 fl oz	Soil: 21 fl oz Foliar: 10.5 fl oz	12	21	Use only 1 application method (soil or foliar). Toxic to honeybees.

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	4A	Venom 20 SG (dinotefuran)	Foliar: 1–5 oz	1.34 lb	12	1	Use only 1 application method (soil or foliar).
	4A	Venom 20 SG (dinotefuran)	Soil: 5–7.5 oz	2.68 lb	12	21	Several methods of soil application—see label.
	4A + 28	Durivo (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz	12	30	Soil applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	Transform WG (sulfoxaflor)	2.0–2.25 oz	8.5 oz	24	1	–
	4D	Sivanto Prime (flupyradifurone)	Soil: 21.0–28.0 fl oz Foliar: 10.5–14.0 fl oz	28.0 fl oz per year	–	Soil: 45 Foliar: 1	–
	7C	Knack IGR (pyriproxyfen)	8–10 fl oz	20 fl oz	12	14	–
	9B	Fulfill (pymetrozine)	2.75 oz	5.5 oz per crop	12	0	–
	9B	PQZ (pyrifluquinazon)	2.3–3.2 fl oz	4.8 fl oz per crop cycle	12	1	–
	9D	Sefina Inscalis Insecticide (afidopyropen)	14.0 fl oz	28 fl oz	–	–	Reapplications at least 7 days apart.
	15	Rimon 0.83EC (novaluron)	9.0–12.0 fl oz	36 fl oz	12	1	Immatures only. Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Reapplications at least 5 days apart.
	16	Courier 40SC (buprofezin)	9.0–13.6 fl oz	27.2 fl oz per crop cycle	12	1	No more than 2 applications per growing season. Reapplications at least 14 days apart.
	21A	Magister (fenazaquin)	24–36 fl oz	36 fl oz	12	3	No more than 1 application per year.
	21A	Portal (fenpyroximate)	2.0 pt	4.0 pt per crop cycle	12	1	–
	23	Movento MPC (spirotetramat)	7.0–8.0 fl oz	16 fl oz	24	1	No more than 2 applications per season.
	23	Oberon 25C (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz per crop	12	1	–

Insect or Mite Pest	MOA Code ¹	Trade Name (Active Ingredient)	Max Rate/Acre		REI (Hours)	Days to Harvest	Remarks ³
			Appl.	Season ²			
	28	Exirel (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i. per crop	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Reapplications at least 5 days apart.
	28	Verimark (cyantraniliprole)	Tray drench/ transplant water: 6.75–13.5 fl oz Drip: 6.75–10.0 fl oz	0.4 lb a.i.	4	1	–
	29	Beleaf 50 SG (flonicamid)	4.2 oz	8.4 oz	–	0	–
Wireworms	1B	*Diazinon AG500 *50 W (diazinon)	AG500: 1–4 qt 50W: 2–8 lb	AG500: 4 qt 50W: 8 lb	48	Preplant	No more than 1 soil application per season, regardless of target pest.
¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. ² Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per season (or crop cycle) to a maximum rate per year. ³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production. *Restricted use insecticide.							

Table 6. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. **Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.** Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Anthracnose	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	5	1	-
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	1	Varies from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	M3	Ziram 76DF Ziram XCEL (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	No more than 3 applications per year.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	Ph-D: 6.2 oz Oso: 13 fl oz	Ph-D: 31.0 oz Oso: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide. Suppression.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	RevusTop (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
Bacterial canker	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides. Suppression.
Bacterial spot and bacterial speck	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	1	Bacterial spot control only when tank-mixed with a copper fungicide.
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	3.2 lb	12 lb	5	2	Combine with a fixed-copper fungicide. No more than 1 application before alternating to a non-FRAC group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides. Suppression.
	25	Agri-mycin 17 Agri-mycin 50 FireWall 17 FireWall 50 (streptomycin sulfate)	200 ppm	-	-	0.5	See label for details. For transplant production only. Many isolates are resistant to streptomycin.
	P	Actigard (acibenzolar-S-methyl)	0.75 oz	4.75 oz	14	0.5	Begin applications within 1 week of transplanting or emergence. No more than 8 weekly, sequential applications.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
Bacterial wilt (<i>Ralstonia solanacearum</i>)	3	Cevya ProvySol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	No more than 3 applications per year.
	3	Mentor (propiconazole)	8 oz/100 gal or 8 oz/50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. See label for details.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	3 + 12	Chairman (propiconazole + fludioxonil)	32 fl oz/100 gal or 32 fl oz/50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides; see label.
Black mold (<i>Alternaria</i> spp.)	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Tesaris (fluxapyroxad)	4.6 fl oz	13.8 fl oz	0	0.5	No more than 3 applications per year. No more than 2 sequential applications before rotating to a non FRAC-7 fungicide. See label regarding tank mixture restrictions.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per a year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: Aframe, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	No more than 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	12	Scholar SC (fludioxonil)	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	39	Magister SC (fenazaquin)	36 fl oz	36 fl oz	3	0.5	Also labeled as an acaricide. No more than 1 application per year. Foliar suppression only.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
Botrytis, Gray mold	3 + 12	Chairman (propiconazole + fludioxonil)	32 fl oz/100 gal or 32 fl oz/ 50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small-diameter fruit. See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides. Suppression.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per a year.
	7 + 11	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production. Suppression.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; has a 30-day plant-back with off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	9	Vango (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications. No more than 4 applications per year. Can be applied via chemigation.
	9 + 12	Alterity 62.5WG Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications, alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30-day plant-back with off-label crops.
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 2 sequential applications allowed. No more than 6 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group. Suppression.
	12	Scholar SC (fludioxonil)	32 fl oz/100 gal or 16 fl oz/50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.
	12	Spirato 480 FS Spirato GHN (fludioxonil)	7 fl oz	28 fl oz	0	0.5	For use in greenhouse and other enclosed structures only. No more than 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	17	Decree 50 WDG (fenhexamid)	1.5 lb	6 lb	0	0.5	Transplant and greenhouse use only. No more than 2 consecutive applications.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	Ph-D: 6.2 oz Oso: 13 fl oz	Ph-D: 31.0 oz Oso: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Buckeye rot Phytophthora fruit rot (<i>Phytophthora</i> spp.)	M1 + 4	Ridomil Gold Copper (copper hydroxide + mfenoxam)	2 lb	6 lb	14	2	No more than 3 applications per season. Tank-mix with mancozeb.
	11	(azoxystrobin) Many brands available: Aframe, Arius, Azoxystar, Azoxystrobin 100ST, Azoxystrobin, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraaban, Trevo, Willowood Azoxystrobin 25C	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 2 sequential applications allowed. No more than 6 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group; see label.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides. Suppression.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	See label.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.
Early blight	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kantan DF, Kocide 2000, Kocide 3000, Nordox DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. See label for details.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	1	-
	M3	Ziram Granuflo Ziram 76DF Ziram XCEL (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	No more than 3 applications per year.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3	Tebucon 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	8 fl oz	48 fl oz	7	0.5	No more than 6 applications per crop. Reapplications at least 7 days apart.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	4 + M5	Ridomil Gold Bravo 76.4 W (mefenoxam + chlorothalonil)	3 lb	12 lb	14	2	No more than 4 applications per crop.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	Tesaris (fluxapyroxad)	4.6 fl oz	13.8 fl oz	0	0.5	No more than 3 applications per year. No more than 2 sequential applications before rotating to a non FRAC-7 fungicide. See label regarding tank mixture restrictions.
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only. No more than 2 applications per year. The first foliar fungicide application following Velum should be from a different FRAC group.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide. Has a 30-day plant-back with off-label crops.
	9	Vango (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications. No more than 4 applications per year. Can be applied via chemigation.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.
	9 + 12	Alterity 62.5WG Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications alternate with another mode of action for the next 2 applications. No more than 5 applications per year.
	11	(azoxystrobin) Many brands available: Aframe, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 25C	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Aftershock Evito Tepera (fluoxastrobin)	5.7 fl oz Tepera: 12.6 fl oz	22.8 fl oz Tepera: 12.6 fl oz	3	0.5	No more than 4 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 2 sequential applications. No more than 6 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Flint Gem 500 SC (trifloxystrobin)	Flint: 4 oz Gem: 3 fl oz	Flint: 16 oz Gem: 16 fl oz	3	0.5	No more than 5 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
	11 + IRAC 3	Tepera Plus (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. No more than 4 applications per year. Reapplications at least 10 days apart. Not for greenhouse use.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	No more than 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	12	Spirato GHN Spirato 480SC (fludioxonil)	7 fl oz	28 fl oz	0	0.5	For use in greenhouse and other enclosed structures only. No more than 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	Ph-D: 6.2 oz Oso: 13 fl oz	Ph-D: 31.0 oz Oso: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	-
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	288 fl oz	5	0.5	No more than 8 applications per season. No more than 2 sequential applications before alternating to a different mode of action.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank-mix with chlorothalonil or mancozeb.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Fusarium wilt (<i>Fusarium</i> spp.)	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only. No more than 2 applications per year. The first foliar fungicide application following Velum should be from a different FRAC group. Suppression.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	Make first application within 7–14 days after planting and the second application 14–21 days later.
Gray leaf spot (<i>Stemphylium</i> spp.)	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kantan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fixed copper compounds.
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	1	-
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	-
	4 + M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	No more than 4 applications per crop.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per a year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.
	11	Flint Gem 500 SC (trifloxystrobin)	Flint: 4 oz Gem: 3.8 fl oz	Flint: 16 oz Gem: 16 fl oz	3	0.5	No more than 5 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	No more than 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	–
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Late blight	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kantan DF, Kocide 2000, Kocide 3000, Nordox DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	1	-
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 + M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	No more than 3 applications per crop. Tank-mix with mancozeb fungicide.
	4 + M3	Ridomil Gold MZ (mefenoxam + mancozeb)	2.5 lb	7.5 lb	5	2	No more than 3 applications per crop.
	4 + M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	No more than 4 applications per crop.
	11	Aftershock Evito Tepera (fluoxastrobin)	5.7 fl oz Tepera: 12.6 fl oz	22.8 fl oz Tepera: 12.6 fl oz	3	0.5	No more than 4 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group. Suppression.
	11 + IRAC 3	Tepera Plus (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. No more than 4 applications per year. Reapplications at least 10 days apart. No use in greenhouse. Suppression.
	11	(azoxystrobin) Many brands available: Aframe, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxystrobin, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, TetraBan, Trevo, Willowood Azoxy 2SC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 2 sequential applications allowed. No more than 6 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Flint Gem 500 SC (trifloxystrobin)	Flint: 4 oz Gem: 3.8 fl oz	Flint: 16 oz Gem: 16 fl oz	3	0.5	No more than 5 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	Veltyrna (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 + M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	No more than 3 applications per crop. Tank-mix with mancozeb fungicide.
	4 + M3	Ridomil Gold MZ (mefenoxam + mancozeb)	2.5 lb	7.5 lb	5	2	No more than 3 applications per crop.
	4 + M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	No more than 4 applications per crop.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	21	Ranman (cyazofamid)	2.75 oz	16 oz	0	0.5	No more than 6 applications per crop.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	–
	22 + M5	Zing! (zoxamide + chlorothalonil)	36 fl oz	288 fl oz	5	0.5	No more than 8 applications per season. No more than 2 sequential applications before alternating to a different mode of action.
	27	Curzate 60DF Cymbol (cymoxanil)	5 oz	30 oz per year	3	0.5	Must tank-mix with another effective product.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	27 + 28	Cymbol Balance (cymoxanil + propamocarb hydrochloride)	21 fl oz	168 fl oz	5	0.5	No more than 8 applications per season.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank-mix with chlorothalonil or mancozeb.
	33	Aliette 80 WDG (fosetyl-al)	5 lb	20 lb	14	0.5	See label for warnings concerning the use of copper compounds.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Drexel Phiticide, Phostrol, Confine Extra, Fungi-Phite, Rampart 6.8, Reliant, Sparra, Fosphite, K-Phite	See individual label	See individual label	-	4 hr	see specific label for mixing instructions and precautions.
	40	Forum (dimethomorph)	6 oz	30 oz	4	0.5	No more than 2 sequential applications. See label for details.
	40	Micora (mandipropamid)	8 fl oz/5,000 sq ft	16 fl oz/5,000 sq ft	N/A	4 hr	Micora is only labeled for transplant and retail sale to consumers.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. Rotate with another effective fungicide. See label.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants. See label.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	No more than 4 applications per season. No more than 2 sequential applications. Spray reapplications at least 10 days apart. Tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops; see label.
	45 + 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. No more than 3 applications per season.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.
Leaf mold	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	-	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	-
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	No more than 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	–
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Phytophthora crown rot Phytophthora root rot (<i>Phytophthora</i> spp.)	4	Metastar 2E ReCon 4F ReCon Bold SL Xyler FC (metalaxyl)	Metastar: 2 qt ReCon 4F: 2 qt ReCon SL: 1 pt Xyler: 2.9 qt	Metastar: 2 qt ReCon 4F: 6 qt ReCon SL: 3 pt Xyler: 4.3 qt	2	28	Must be soil applied. See labels.
	4	Ridomil Gold SL Ultra Flourish (mefenoxam)	Ridomil: 1 pt Ultra Flourish: 2 pt	Ridomil: 3 pt Ultra Flourish: 6 pt	Ridomil: 28 Ultra Flourish: 7	2*	No more than 1.5 lb/A mefenoxam per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. (<i>Phytophthora capsici</i> suppression only)
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	-	Apply to the base of plant at the time of transplanting. Make additional applications on a 7- to 10-day schedule if conditions are favorable for disease.
	28	Previcur Flex (propamocarb hydrochloride)	See individual label	See individual label	5	0.5	Greenhouse application: 6 applications per crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	33	Aliette 80 WDG Linebacker WDG (fosetyl-aluminum)	5 lb	30 lb	14	0.5	See label for warnings concerning the use of copper compounds.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Drexel Phiticide, Phostrol, Confine Extra, Fungi-Phite, Rampart 6.8, Reliant, Sparra, Fosphite, K-Phite	See individual label	See individual label	0	4 hr	See specific label for mixing instructions and precautions.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	No more than 4 applications per season. No more than 2 sequential applications. Spray reapplications at least 10 days apart. Tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops.
	45 + 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. No more than 3 applications per season.
	49 + 4	Orondis Gold (oxathiapiprolin + mfenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
	49 + 40	Orondis Ultra (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Powdery mildew	M2	(sulfur) Many brands available: Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Thiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	See individual label	See individual label	1	1	Follow label closely; may cause leaf burn if applied during high temperatures.
	3	Cevya Provysol (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	No more than 3 applications per year.
	3	Rally 40WSP Sonoma 40WSP (myclobutanil)	4 oz	1.25 lb	0	1	Note that a 30-day plant-back restriction exists.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3	Terraguard SC Trionic 4SC (triflumizole)	4 fl oz/100 gal	16 fl oz	1	0.5	Greenhouse production only. No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	Tesaris (fluxapyroxad)	4.6 fl oz	13.8 fl oz	0	0.5	No more than 3 applications per year. No more than 2 sequential applications before rotating to a non FRAC-7 fungicide. See label regarding tank mixture restrictions.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only. No more than 2 applications per year. The first foliar fungicide application following Velum should be from a different FRAC group.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9	Vango (cyprodinil)	7 oz	28 oz	0	0.5	No more than 5 applications per season with no more than rotating to a non-FRAC group 9 for at least 2 sequential applications. No more than 4 applications per year. Can be applied via chemigation.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone- or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	12	Spirato GHN Spirato 480SC (fludioxonil)	7 fl oz	28 fl oz	0	0.5	For use in greenhouse and other enclosed structures only. No more than 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	Ph-D: 6.2 oz Oso: 13 fl oz	Ph-D: 31.0 oz Oso: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	39	Torac (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	Primarily an insecticide. No more than 2 applications per season. No more than 4 applications per year. Reapplications at least 14 days apart. Suppression.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
	50	Prolivo (pyrifenone)	5 fl oz	16 fl	0	4 hr	No more than 2 sequential applications. No more than 4 applications per year.
	50	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. Do not mix with horticultural oils.
	U6	Torino (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	No more than 3 applications per season. Reapplications at least 14 days apart.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Pythium diseases (<i>Pythium</i> spp.)	4	Ridomil Gold GR Ridomil Gold SL Ultra Flourish (mefenoxam)	GR: 20 lb SL, Ultra: 2 pt	GR: 40 lb SL: 3 pt Ultra: 6 pt	GR: 28 SL, Ultra: 7	2*	No more than 1.5 lb/A mefenoxam per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4	Metastar 2E ReCon 4F ReCon Bold SL (metalaxyl)	Megastar: 4 qt ReCon 4F: 2 qt ReCon SL: 1 pt	Metastar: 6 qt ReCon 4F: 3 qt ReCon SL: 1 pt	2	28	Must be soil applied. See labels.
	21	Ranman Segway O (cyazofamid)	3 fl oz/100 gal	-	0	-	Greenhouse transplant production only; make a single application to the seedling tray 1 week prior to the time of transplanting. Do not use any surfactant.
	28	Previcur Flex (propamocarb hydrochloride)	See individual label	See individual label	5	0.5	Greenhouse application: 6 applications per crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	(Root rots and seedling diseases) Applied to lower portion of plant and soil, or as a soil drench or drip irrigation.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Drexel Phiticide, Phostrol, Confine Extra, Fungi-Phite, Rampart 6.8, Reliant, Sparra, Fosphite, K-Phite	See individual label	See individual label	-	4 hr	See specific label for mixing instructions and precautions.
	49 + 4	Orondis Gold (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
	U17	Vayantis (picarbutrazox)	0.384 fl oz/100 lb seed	-	-	-	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Rhizoctonia root rot Rhizoctonia fruit rot Rhizoctonia stem rot (<i>Rhizoctonia solani</i>)	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	7	Fontelis (penthiopyrad)	1.0–1.6 fl oz/ 1000 row ft	24 fl oz	0	0.5	Apply at plant, preplant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	11	Cabrio (pyraclostrobin)	16 oz	96 oz	0	0.5	No more than 2 sequential applications before alternating to another effective fungicide from a different FRAC group. Suppression.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Rhizopus rot	3 + 12	Chairman (propiconazole + fludioxonil)	32 fl oz/100 gal or 32 fl oz/ 50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	12	Scholar SC (fludioxonil)	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.
Septoria leaf spot	M1	(copper compounds) Many brands available: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	See individual label	See individual label	1	Varies by product from 4 hr to 2 days	-

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	M3	(mancozeb) Many brands available: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	See individual label	See individual label	5	-	-
	M3	Ziram 76DF Ziram XCEL (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 + M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	-
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 + M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	No more than 4 applications per crop.
	7	Fontelis (penthioopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	Velum (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only. No more than 2 applications per year. The first foliar fungicide application following Velum should be from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	22 + M3	Gavel 75DF (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	–
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
Sour rot (<i>Geotrichum candidum</i>)	3	Mentor (propiconazole)	8 oz/100 gal or 8 oz/50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. See label for details.
	3 + 12	Chairman (propiconazole + fludioxonil)	32 fl oz/100 gal or 32 oz/50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small-diameter fruit. See label for details.
Southern blight	7	Fontelis (penthioyprad)	1.0–1.6 fl oz/1000 row ft	24 fl oz	0	0.5	Apply at-plant, preplant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use. Suppression.
	11	Aftershock Evito Tepera (fluoxastrobin)	5.7 fl oz Tepera: 12.6 fl oz	22.8 fl oz Tepera: 12.6 fl oz	3	0.5	No more than 4 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	Cabrio (pyraclostrobin)	16 oz	96 oz	0	0.5	No more than 2 sequential applications before alternating to another effective fungicide from a different FRAC group. Suppression.
	11 + IRAC 3	Tepera Plus (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. No more than 4 applications per year. Reapplications at least 10 days apart. No use in greenhouse.
	11 + 3	Veltyma (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. Suppression.
	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide. Suppression.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	29	Omega 500F Orbus 4F (fluazinam)	24 fl oz	144 fl oz	7	0.5	Apply at or within the day of transplant as a soil directed spray, irrigate within 1 hour of application. No more than 6 foliar applications at 7- to 14-day intervals.
Target spot	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	See individual label	See individual label	0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	Rhyme (flutriafol)	7 fl oz	28 fl oz	0	0.5	No more than 4 applications per season.
	3 + BM 01	Regev (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	No more than 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	4 + M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	No more than 4 applications per crop.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	Aprovia Top (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications no shorter than a 14-day interval. No more than 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	7 + 3	Luna Flex (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	No more than 2 applications per year. No more than 2 sequential applications of any FRAC 7-containing fungicide before rotating with a fungicide from a different group.
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. No more than 5 applications per a year.
	7 + 12	Miravis Prime (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide. No more than 2 applications per year. Can be applied via chemigation in 0.1–0.25 in./A of water. Not for use in transplant or greenhouse production.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; has a 30-day plant-back with off-label crops.
	9 + 3	Inspire Super Vango ESQ (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide from another FRAC group.
	11	Aftershock Evito Tepera (fluoxastrobin)	5.7 fl oz Tepera: 12.6 fl oz	22.8 fl oz Tepera: 12.6 fl oz	3	0.5	No more than 4 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11	(azoxystrobin) Many brands available: Aframe, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraaban, Trevo, Willowood Azoxy ZSC	See individual label	See individual label	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 2 sequential applications allowed. No more than 6 applications per crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + IRAC 3	Tepera Plus (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. No more than 4 applications per year. Reapplications at least 10 days apart. No use in greenhouse.
	11 + M3	Dexter Max (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	No more than 1 application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	No more than 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	Topguard EQ (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	No more than 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 3	Veltyrna (pyraclostrobin + mefentrifluconazole)	10 fl oz	30 fl oz	0	0.5	No more than 3 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group ¹	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks ³
			Appl.	Season ²	Harvest	Reentry	
	11 + 7	Priaxor Everlon Republic (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	No more than 3 applications per season. No more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	27 + M5	Ariston Cymbol Advance (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	No more than 4 applications per season. No more than 2 sequential applications. Not labeled for transplants.
	49 + M5	Orondis Opti (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action. Reapplications at least 7 days apart. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	7 + 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
Timber rot, Sclerotinia stem rot, or white mold							

Table 7. Nonfumigant nematicides for tomatoes in Florida. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½–1 gal/A at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. No more than 3 gal/A per season. Reapplications at least 7 days apart unless a longer interval is stated. No more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5–7 pt/A (56.0–80.0 fl oz/A) a minimum of 7 days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. No more than 1 application per crop, and no more than 112 fl oz/A per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/A using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Soil reapplications at least 7 days apart. No more than 13.7 fl oz/A of Velum (0.446 lb/A fluopyram) per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Salibro (a.i. fluazaindolizine)	Apply preplant incorporated, preplant drip or at-plant drip at 30.7–61.4 fl oz/A (1–2 lb a.i./A) as preplant incorporated, via preplant drip, or at-plant drip. Apply 15.4–30.7 fl oz/A (0.5–1 lb a.i./A) for in-season drip. No more than 61.4 fl oz/A per calendar year. No more than 4 applications per calendar year. Reentry interval is 12 hr. Reapplications at least 14 days apart. Preharvest interval is 1 day.
Biological nematicides	See chapter 19
Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 8. Fumigant nematicides for tomatoes in Florida.

Nematicide	Broadcast Application ¹		In-the-Row Applications
	Gallons per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II ^{2,3}	27–35	79–102	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone EC ^{2,3}	–	–	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Telone C-17 ^{2,3}	32.4–42	95–123	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 ^{2,3}	39–50	114–146	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine ^{2,3}	29–56	–	For drip fumigation, consult the product label for overall rate, drip concentration and flow-modifying application directions.
Pic Clor 60 ^{2,3}	19.5–31.5	57–90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC ^{2,3}	19.5–31.5	–	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75	–	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60	–	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40	–	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions

¹ Gallons/acre and fl oz/1000 ft provided only for mineral soils. Higher rates may be possible for heavier textured (loam, silt, clay) or highly organic soils.

² All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).

³ Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

Chapter 19. Biopesticides and Alternative Disease and Pest Management Products¹

Natalia A. Peres, Gary E. Vallad, Johan Desaegeer, Jawwad Qureshi, and Sriyanka Lahiri²

The following tables list registered pesticides that should be integrated with other pest management methods. These pesticides are not usually crop-specific. However, check the label before use to see if any restrictions apply. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

Table 1. Biopesticides labeled for management of arthropod pests of many crops. Contact: Sriyanka Lahiri, UF/IFAS Gulf Coast Research and Education Center.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed ²	Remarks
Agree WG, Xentari (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	11A	Caterpillars	0	4	Yes	Apply when larvae are small for best control. Can be used in greenhouse.
Biobit HP, Deliver, DiPel DF, Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	11A	Caterpillars	0	4	Yes	Apply when larvae are small for best control. Can be used in greenhouse.
Aza-Direct (azadirachtin)	U	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Antifeedant, repellent, IGR (insect growth regulator).
Azaguard (azadirachtin)	U	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Use in combination with 0.25%–1.0% nonphytotoxic crop oil.
Azatin O (azadirachtin)	U	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Rate depends on targeted pest.
BoteGHA Optima ES (<i>Beauveria bassiana</i> strain GHA)	U	Thrips (chilli thrips), twospotted spider mite, whitefly, leaf feeding and stem boring lepidoptera, mealybug, aphids, weevils, leaf feeding beetles, scarab beetles, leafhoppers, planthoppers, orthoptera, plant bugs, psyllids	0	4	Yes	Apply at 5- to 10-day interval. Acts by contact.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed ²	Remarks
BotaniGard ES (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, leafhoppers, mealybugs, mites, plant bugs, planthoppers, crickets, thrips, whiteflies, cockroaches	0	4	No	Works by contact. Spores attach to insects, germinate, and penetrate insect cuticle. May be used in greenhouses.
BotaniGard Maxx (<i>Beauveria bassiana</i> strain GHA + pyrethrins)	3A + U	Aphids, leafhoppers, leafminers, plant bugs, thrips, whiteflies	0	12	No	–
Captiva (<i>Capsicum oleoresin</i> extract, garlic oil, soybean oil)	U	Leafhoppers, mites, thrips, whiteflies	0	4	No	–
Captiva Prime (<i>Capsicum oleoresin</i> extract, garlic oil, canola oil)	U	Leafhoppers, mites, thrips, whiteflies, psyllids, plant bugs, borers, mealybugs, lepidopteran larvae, whiteflies	0	4	Yes	–
Debug Turbo EC (fats and glyceridic oils margosa + azadirachtin)	U	Several pests	–	–	Yes	Repeat applications every 10–15 days.
Des-X (soap, insecticidal)	U	Aphids, mites, plant bugs, whiteflies	0			–
Entrust SC (spinosad)	5	Beetles, caterpillars, thrips, seed bugs	1	4	Yes	Highly toxic to bees and other pollinators. No more than 2 applications per crop season.
Entrust SC Naturalyte Insect Control (spinosad)	5	Thrips, armyworms	1	4	Yes	–
Evergreen EC 60-6 (pyrethrins + piperonyl butoxide)	3A	Ants, aphids, armyworms, weevils, flea beetles, fruit flies, leafhoppers, lygus, mealybugs, stink bugs, thrips	0	12	No	Reapplications at least 7 days apart.
Grandevo WDG (<i>Chromobacterium subtsugae</i> strain PR4A4-1)	U	Aphids, mites, plant bugs, whiteflies, armyworms	0	4	Yes	Can be tank-mixed with a contact insecticide for improved control of targeted pests.
JMS Stylet Oil (paraffinic oil)	U	Aphids, thrips, leafhoppers, leafminers, mites, whiteflies	0	4	No	–
Lalguard M52 OD (<i>Metarhizium brunneum</i> strain F52)	U	Mites, thrips, aphids, psyllids, weevils, whiteflies	0	12	Yes	–
Met52-EC (<i>Metarhizium anisopliae</i>)	U	Thrips, whiteflies, mites, weevils	0	0	No	Rates: 40–80 fl oz/100 gal (drench) or 8–64 fl oz/A (foliar).

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed ²	Remarks
Molt-X (Azadirachtin)	U	Aphids, beetles, caterpillars, leafminers, leafhoppers, mealybugs, thrips, whiteflies	0	4	Yes	Rates depend on the pest. Check label.
M-Pede 49% EC (potassium salts of fatty acids)	U	Aphids, leafhoppers, mites, thrips, whiteflies	0	12	Yes	Do not apply to stressed plants (high heat or drought conditions).
Mycotrol ESO (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, thrips, leafhoppers, whiteflies, crickets, cockroaches	0	4	Yes	–
Mycotrol WPO (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, leafhoppers, whiteflies	0	4	Yes	–
Neemix 4.5 (azadirachtin)	U	Aphids, leafminers, leafrollers, scales, whiteflies, worms	0	12	Yes	IGR and feeding repellent. Greenhouse and field.
Organic JMS Stylet Oil (paraffinic oil)	U	Aphids, leafhoppers, leafminers, mites, whiteflies	0	4	Yes	Use ceramic spray nozzles and apply at a pressure of no less than 400 psi.
PFR-97 20% WDG (<i>Cordyceps javanica</i> Apopka strain 97)	U	Aphids, leafminers, mites, plant bugs, psyllids, weevils, whiteflies	0	4	Yes	Can be used on vegetables grown for transplant. Do not mix with fungicides or apply within 5 days of fungicide applications other than copper. Dust/mist respirator must be used for mixing and applying.
Pyganic EC 5.0 (pyrethrins)	3A	Aphids, armyworms, beetles, leafhoppers, leafminers, mealybugs, mites, plant bugs, seed bugs, planthoppers, psyllids, stink bugs, thrips, weevils, whiteflies	0	12	Yes	Harmful to bees. Can be used in greenhouses.
Requiem Prime (<i>Chenopodium ambrosioides</i> terpenes synthetically manufactured)	U	Leafminers, leafhoppers, mites, thrips, whiteflies	0	4	No	Rate varies depending on crop.
Seduce Insect Bait (spinosad)	5	Caterpillars	See specific crops on label	4	Yes	–
Seican (Cinnamaldehyde)	U	Mites, aphids, thrips, psyllids, whiteflies	0	4	Yes	–
Suffoil-X (mineral oil)	U	Aphids, leafhoppers, thrips, whiteflies	0	4	Yes	Thorough coverage is essential.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed ²	Remarks
Surround (kaolin clay)	U	Whiteflies, thrips, psyllids	0	0	Yes	It is better not to use it too close to harvest to avoid white spots on the fruits.
Trilogy (extract of neem oil)	U	Aphids, mites, thrips, whiteflies	0	4	Yes	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
Venerate XC (heat-killed <i>Burkholderia</i> spp. strain A396 cells and spent fermentation media)	U	Corn earworms, mealybugs, mites, stink bugs, weevils, whiteflies, aphids	0	4	Yes	–

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet.

² OMRI Listed means that a product is approved for use in certified organic production under the USDA National Organic Program (NOP).

Table 2. Biopesticides and other alternative products labeled for plant disease management. **Labels change frequently. Be sure to read a current product label before applying any pesticide. Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.** Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
2-3-2 Companion (<i>Bacillus subtilis</i> strain GB03)	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	4	No	Do NOT mix with copper-based fungicides, concentrated acids such as sulfuric acid, solvents, oxidizing agents, or bactericides. Do not mix with products with a pH below 4 or above 9. Consult specific product labels for additional information or restrictions concerning tank-mixing.
Actinovate AG Actinovate SP (<i>Streptomyces lydicus</i> WYEC 108), NC	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	1	Yes	See label for specific rates and application recommendations.
Afla-guard GR (<i>Aspergillus flavus</i> NRRL 21882), NC	Sweet corn	Aspergillus	-	4	No	No more than 20 lb/A per growing season. See label for specific application instructions.
AgriPhage (bacteriophage), NC	Tomato, pepper	Bacterial spot, bacterial speck	0	0	No	Bacterial strains must be characterized periodically by the manufacturer to correctly formulate the bacteriophage mixture.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Agro Pro X Agro XP (soybean and sesame oils)	Vegetables, strawberries	Powdery mildew	0	0	Yes	See label for specific rates and application recommendations.
Aura 360 (Fig22-Bt peptide)	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	12	No	Broad-spectrum activator of disease resistance. See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Aviv Bacix Milagrums Plus (<i>Bacillus subtilis</i> strain IAB/BS03)	Vegetables, strawberries	Broad-spectrum fungicide	0	4	Yes	See label for specific rates and application recommendations.
(<i>Bacillus subtilis</i> strain QST 713), 44 Many brands available: Cease, Minuet, Rhapsody, Serenade ASO, Serenade Opti,	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	4	Yes	For foliar applications, mix with copper compounds or other effective fungicides for improved disease control. See label for details regarding specific foliar and soil applications and target diseases.
BioCover (oil, petroleum), NC	Vegetables, strawberries	Powdery mildew, rust	0	4	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Bionatrol-M (soybean oil)	Vegetables, strawberries	Powdery mildew, Botrytis, rust, sour rot	0	0	Yes	Do not apply any copper, sulfur, or others within 12 days of Bionatrol-M application. Do not spray when freezing temperatures are anticipated within 48 hours and do not apply above 95°F. Do not mix with foliar fertilizers.
BIO-TAM 2.0 Tenet WP (<i>Trichoderma asperellum</i> strain ICC 012 + <i>Trichoderma gamsii</i> strain ICC 080), NC	Vegetables, strawberries	Fusarium, <i>Phytophthora</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp., <i>Agroathelia rolfsii</i> , <i>Thielaviopsis basicola</i> spp., and <i>Verticillium</i> spp.	-	1	Yes	See label for additional rates and recommendations for transplant production and details for specific diseases. Check label for product incompatibility with certain chemical fungicides.
Botector (<i>Aureobasidium pullulans</i> strain DSM 14940, 14941)	Tomatoes, strawberries	Anthracoze, Botrytis, phomopsis, rhizopus	0	4	Yes	See label for specific rates and application recommendations. Check label for precautions regarding incompatibility with fungicides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
BotryStop WP (<i>Ulocladium oudemansii</i> U3 strain), NC	Vegetables, strawberries	Botrytis, <i>Sclerotinia</i> spp.	0	4	No	See label for specific rates, application recommendations, and precautions regarding fungicide compatibility.
CHR-1WP (<i>Bacillus subtilis</i> strain CH3000 and <i>Bacillus paralicheniformis</i> strain CH2970), NC	Vegetables, strawberries	<i>Rhizoctonia</i> spp., <i>Fusarium</i> , <i>Pythium</i> spp., <i>Verticillium</i> spp., <i>Botrytis</i> spp., and <i>Sclerotinia</i> spp.	0	4	No	See label for specific rates and application recommendations. Also labelled for several parasitic nematode species.
Cinnaction Cinnerate EMP Barrier (cinnamon oil), NC	Vegetables, strawberries	Powdery mildew, Botrytis, rusts	0	0	Yes	See label for specific rates and application recommendations.
Contans WG (<i>Coniothyrium minitans</i> strain CON/M/91-08)	Vegetables, strawberries	<i>Sclerotinia sclerotiorum</i> and <i>Sclerotinia minor</i>	0	4	Yes	See label for specific rates and application recommendations.
Cyclops (olive and cinnamon oils), NC	Vegetables, strawberries	Broad-spectrum fungicide	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
DART Fungicide EC (capric acid, caprylic acid)	Vegetables, strawberries	Broad-spectrum fungicide	0	24	Yes	See label for specific rates and application recommendations.
Debug ON Debug Optimo Debug Tres Debug Turbo (fats and glyceridic oils Mongosa, Azadirachtin), NC	Vegetables, strawberries	Powdery mildew, rust, <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp., <i>Sclerotium rolfsii</i>	0	4	Yes	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides.
Double Nickel 55 Double Nickel LC Triathlon BA (<i>Bacillus amyloliquefaciens</i> strain D747), 44	Vegetables, strawberries	<i>Alternaria</i> spp., anthracnose, bacterial diseases, Botrytis, early blight, <i>Fusarium</i> , late blight, <i>Phytophthora</i> spp., powdery mildew, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp.	0	4	Yes	See label for additional rates and recommendations for foliar and soil application rates and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment. See label for details.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
EcoSwing (extract of <i>Swinglea glutinosa</i>), NC	Vegetables, strawberries	<i>Alternaria alternata</i> , <i>Monilinia fructicola</i> , <i>Monilinia laxa</i> , <i>Botrytis cinerea</i> , <i>Erysiphaceae</i> spp., <i>Erwinia carotovora</i> subspp., <i>Aspergillus niger</i> , <i>Alternaria tenuis</i> , <i>Cladosporium herbarum</i> , <i>Rhizopus arrhizus</i> , <i>Penicillium</i> spp.	0	4	Yes	See label for specific rates, application recommendations, and greenhouse use.
EcoWorks EC Rango Socoro (cold pressed neem oil)	Vegetables, strawberries	Broad-spectrum fungicide, insecticide, miticide, and nematocide	0	4	Yes	See label for specific rates, application recommendations, and greenhouse use.
Ethos (bifenthrin, <i>Bacillus velezensis</i> strain RTI301, and <i>Bacillus subtilis</i> strain RTI477)	Vegetables	Damping off, seedling blights, and root or crown rot caused by <i>Phythium</i> spp., <i>Rhizoctonia</i> spp., <i>Fusarium</i> , and <i>Phytophthora</i> spp.	-	12	No	For at-plant disease suppression, must be applied in-furrow with the seed or with transplant water at transplant.
Flower Pharm (potassium chloride, sodium bicarbonate, soy oil, and rosemary oil)	Vegetables, strawberries	Broad-spectrum fungicide, insecticide, and miticide	0	0	Yes	See label for specific rates, application recommendations.
FungOUT (citric acid)	Vegetables, stone fruits, blueberries, greenhouse vegetables	Downy mildew, target spot, bacterial canker, powdery mildew, bitter rot, fire blight, and anthracnose	0	4	Yes	For disease suppression, obtain excellent coverage on both sides of leaf, do not apply within 24 hr of rainfall.
Fungus Pharm (soybean oil, cinnamon oil, and rosemary oil)	Vegetables, strawberries	Broad-spectrum fungicide, insecticide, and miticide	0	0	Yes	See label for specific rates, application recommendations.
Gargoil (cinnamon oil and garlic)	Vegetables, small fruit	Broad-spectrum contact fungicide/insecticide/miticide	0	0	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Glacial Spray Fluid (oil, petroleum), NC	Vegetables, strawberries	Powdery mildew, rust	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
GreenClean PRO PerCarb (sodium carbonate peroxyhydrate), NC	Vegetables, strawberries	Broad-spectrum fungicide/bactericide	0	-	No	See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Howler (<i>Pseudomonas chlororaphis</i> strain AFS009), NC	Vegetables, strawberries	<i>Rhizoctonia</i> spp., <i>Pythium</i> spp., <i>Fusarium</i> , <i>Phytophthora</i> spp., <i>Sclerotinia</i> spp., <i>Colletotrichum</i> spp., and <i>Botrytis</i> spp.	0	4	Yes	See label for specific rates and application recommendations.
(Hydrogen peroxide + peroxyacetic acid), NC Many brands available: GreenClean Liquid, Jet-Ag, OxiDate, Purpose Plus, Rendition, SaniDate, SporeQuell, StorOx, TerraClean, TerraStart, ZeroTol	Vegetables, strawberries	Broad-spectrum fungicide	0	1 for enclosed areas; until spray dries in open-field areas.	No	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides. Some formulations can be used as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment or for postharvest treatments.
JMS Stylet-Oil Organic JMS Stylet-Oil (paraffinic oil), NC	Vegetables, strawberries	Potato virus Y, tobacco etch virus, cucumber mosaic virus	0	4	Yes, but only for 1 label	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
LEAPES (<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> , strain ABTS-351 and methyl salicylate)	Tomatoes, peppers	<i>Xanthomonas</i> spp.	0	12	No	Apply before disease is observed in the field; should be used as part of a plant pathogen control program. See label for details regarding insecticidal activity.
LifeGard (<i>Bacillus mycooides</i> isolate J)	Vegetables	Broad-spectrum fungicide	-	4	Yes	See label for specific rates and application recommendations.
Mildew Cure (cotton, corn, and garlic oils), NC	Vegetables, strawberries	Powdery mildew	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
(mineral oil), NC Many brands: 440 Superior Spray Oil, BioCover, Glacial Spray Oil, Omni Supreme Oil, PureSpray Green, SuffOil-X, TriTek, Ultra-Pure Oil	Vegetables, strawberries	Powdery mildew	0	4	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Mycostop LALSTOP K61 SP (<i>Streptomyces</i> sp. strain K61)	Vegetables, strawberries	Broad-spectrum fungicide	0	4	No	See label for specific rates and application recommendations.
Nutrol (potassium phosphate), NC	Cucurbits, peppers, tomatoes	Powdery mildew	0	0	No	Do not mix with copper fungicides or other products affected by low pH (<5.5). See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Obrona (PDHP 25279)	Vegetables, small fruit	Broad-spectrum fungicide	0	4	No	See label for specific rates and application recommendations.
OxiPhos (mono- and dipotassium salts of phosphorus acid + hydrogen peroxide), 33 & NC	Vegetables, strawberries	<i>Alternaria</i> spp., anthracnose, bacterial diseases, Botrytis, early blight, Fusarium, late blight, <i>Phytophthora</i> spp., powdery mildew, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp.	0	1 for enclosed areas; until spray dries in open-field areas.	No	See label for additional rates and recommendations for transplant production and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment.
PlantShield HC RootShield WP Trianum-G (<i>Trichoderma harzianum</i> Rifai strain KRL-AG2), NC	Vegetables, strawberries	<i>Cylindrocladium</i> spp., Fusarium, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	PlantShield: 4 RootShield: 0 if soil-applied; until spray dries	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
(potassium bicarbonate), NC Many brands available: Armicarb 100, Armicarb "O", Carb-O-Nator, Eco-mate, Kaligreen, Milstop	Vegetables, strawberries	Broad-spectrum fungicide	0	4	Yes	See label for specific rates and application recommendations.
(potassium phosphite; mono- and dipotassium salts of phosphorous acid), 33 Many brands available: Alude, Appeal, Confine Extra T&O, Fosphite, Fungi-Phite, Helena Prophyt, K-Phite 7LP AG, Phiticide, Phorcephite, Phostrol, Rampart, Reveille	Vegetables, strawberries	<i>Alternaria</i> spp., anthracnose, bacterial diseases, downy mildew, Fusarium, late blight, leaf blights caused by <i>Cercospora</i> and <i>Septoria</i> spp., <i>Phytophthora</i> spp., powdery mildew, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., root rots	0	4	No	See label for details, specific recommendations, and precautions for tank mixing with copper-based fungicides.
Prev-Am (sodium tetraborohydrate decahydrate), NC	Vegetables, strawberries	Downy mildew, Botrytis, powdery mildew, late blight, white rust, white mold	0	12	No	See label for details, crop-specific recommendations, and precautions.
ProBlad Verde Fracture (Banda de Lupinus albus doce [BLAD])	Vegetables, strawberries	Anthracnose, Botrytis, powdery mildew, southern blight, white mold	24 24	4 4	Yes No	See label for details, crop specific recommendations, and precautions.
Procidic BerryCare FungOUT (citric acid), NC	Vegetables, strawberries (labels vary)	Broad-spectrum fungicide and bactericide	0 0 0	0 4 4	No Yes Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
PureCrop1	Vegetables, strawberries	Botrytis, fusarium wilt, downy mildew, powdery mildew	0	0	Yes	See label for specific rates, application recommendations, and precautions.
Purespray Green (oil, petroleum), NC	Vegetables, strawberries	Powdery mildew, rust	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use.
Pvent LALSTOP G46 WG (<i>Clonostachys rosea</i> strain J1446), NC	Vegetables, strawberries	Broad-spectrum fungicide	0	4	Yes	See label for details, crop specific recommendations, and precautions.
Regalia Regalia Rx Pacesetter (extract of <i>Reynoutria sachalinensis</i>), P	Vegetables, strawberries	Bacterial canker, bacterial speck, bacterial spot, <i>Botrytis</i> spp., early blight, late blight, <i>Phytophthora</i> spp., powdery mildew, target spot	0	4	Yes	Tank-mix with other effective fungicides for improved disease control under heavy pressure. See label for details.
Romeo (Cerevisane; cell walls of <i>Saccharomyces</i> <i>cerevisiae</i> strain LAS117)	Vegetables, strawberries	<i>Alternaria</i> leaf spot, anthracnose, <i>Botrytis</i> spp., downy mildew, Fusarium, late blight, <i>Phytophthora</i> , powdery mildew, <i>Rhizoctonia</i> spp., scab, sour rot	0	4	Yes	See label for details, crop specific recommendations, and precautions.
RootShield Granular RootShield WP Triatum WG (<i>Trichoderma harzianum</i> Rifai strain T- 22), NC	Vegetables, strawberries	<i>Cylindrocladium</i> spp., Fusarium, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	0	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
RootShield Plus Granular RootShield Plus WP (<i>Trichoderma harzianum</i> Rifai strain T-22 and <i>Trichoderma virens</i> strain G-41), NC	Vegetables, strawberries	<i>Cylindrocladium</i> spp., Fusarium, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	4	Yes	See label for specific rates, application recommendations, and precautions.
Seican (cinnamaldehyde)	Vegetables, strawberries	Botrytis, powdery mildew, rusts	0	4	No	See label for details, crop specific recommendations, and precautions.
Serifel Biofungicide Serifel NG Biological Fungicide Subtilex NG (<i>Bacillus amyloliquefaciens</i> strain MBI 600), NC	Vegetables, strawberries	Broad-spectrum fungicide	0	4	Yes	See label for details, crop specific recommendations, and precautions.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to Reentry		OMRI- Listed ²	Remarks ³
			Harvest			
Sil-Matrix (potassium silicate), NC	Vegetables, strawberries	Broad-spectrum fungicide	0	4	No	Must be used in a rotational program with other fungicides when conditions are conducive for disease development. See label for details.
Soilgard (<i>Gliricladium virens</i> GI-21), NC	Vegetables, strawberries	Fusarium root and crown rot, <i>Phytophthora capsici</i> , <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp., <i>Sclerotium</i> spp.	0	0	Yes	For best results, apply to transplants or as a drench during transplanting. Subsequent applications can be made as drench, directed spray, or by chemigation. See label for precautions regarding use and fungicide compatibility.
Sonata (<i>Bacillus pumilus</i> QST 2808), NC	Vegetables, strawberries	Early blight, downy mildew, late blight, powdery mildew, rust	0	4	Yes	Mix or alternate with other effective fungicides for improved disease control. See label for details.
Soyote (soybean oil and sodium lauryl sulfate)	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	0	Yes	See label for specific rates and application recommendations.
Sporan (oils of clove, peppermint, rosemary, and thyme)	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	0	Yes	See label for specific rates and application recommendations.
Sporatec (oils of clove, rosemary, and thyme), NC	Vegetables, strawberries	Bacterial spot, <i>Botrytis</i> , early blight, gray mold, late blight, powdery mildew	0	0	Yes	Exercise care when applying. Begin applications once disease is observed. Use of a spreader and/or penetrant adjuvant recommended for improved performance. Do not apply when temps are above 90°F. See label for details. Ingredients are exempt from FIFRA.
Stargus (<i>Bacillus amyloliquefaciens</i> strain F727 cells and spent fermentation media)	Vegetables, strawberries	Broad-spectrum fungicide and bactericide	0	4	Yes	See label for specific rates and application recommendations.
Taegro 2 (<i>Bacillus subtilis</i> var. <i>amyloliquefaciens</i> strain FZB24), NC	Vegetables	Foliar diseases: Downy mildew, powdery mildew, <i>Pseudomonas</i> spp., <i>Xanthomonas</i> spp. Soilborne diseases: Fusarium, <i>Phytophthora</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp.	-	24	No	See label for specific instructions regarding soil injected, spray, or incorporated applications. No more than 12 applications per season. For best efficacy, product should be applied prior to disease or disease establishment. May be applied to greenhouse-produced crops.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Thyme Guard (thyme oil extract), NC	Vegetables, strawberries	Broad-spectrum bactericide and fungicide	0	0	-	See label for specific rates, application recommendations, and precautions regarding use with other pesticides. Ingredients are exempt from FIFRA.
Guarda Huma Gro Promax Huma Gro Proud 3 JUDGEMENT PathoCURB RECKONING SPORICIDE Slam Org THYME GUARD Thymic Thymox Control (thyme oil)	Vegetables, strawberries	Broad-spectrum fungicide	0	0	Check label	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA. Not all labels are OMRI listed.
Timorex ACT (tea tree oil), BM 01	Vegetables, strawberries	Broad-spectrum fungicide	48	4	Yes	See label for specific rates and application recommendations.
Timorex Gold (tea tree oil), BM 01	Vegetables, strawberries	Broad-spectrum fungicide	48	12	No	See label for specific rates and application recommendations.
Trilogy (clarified hydrophobic extract of neem oil), NC	Vegetables, strawberries	<i>Alternaria</i> spp., anthracnose, <i>Botrytis</i> , early blight, powdery mildew	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Ultra-Pure Oil (mineral oil), NC	Vegetables, strawberries	Powdery mildew	0	4	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Vacciplant (laminarin), P	Vegetables, strawberries	Anthracnose, bacterial speck, bacterial spot, early blight, phytophthora blight, powdery mildew	0	4	No	Start applications preventatively when weather conditions are favorable for disease development. Repeat applications until disease conditions end. Add a labeled copper product to Vacciplant if the disease symptoms appear.
Vectorite with CR-7 (<i>Clonostachys rosea</i> strain CR-7)	Vegetables, strawberries	Broad-spectrum fungicide	0	0	Yes	Biofungicide is dispensed using commercially reared bumble or honey bees using Bee Vectoring Technology- approved hive dispensers.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Min. Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Veggie Pharm (oils of soybean, garlic, rosemary, and peppermint)	Vegetables, strawberries	Broad-spectrum bactericide and fungicide	0	0	Yes	See label for specific rates and application recommendations and precautions.
Veg'Lys, Brandt (garlic oil), NC	Vegetables, strawberries	Broad-spectrum bactericide and fungicide	0	0	Yes	See label for specific rates and application recommendations and precautions. Do not apply when temps are above 90°F. Ingredients are exempt from FIFRA.
Gleam Kitogard WarHammer (chitosan)	Vegetables, strawberries	Broad-spectrum bactericide and fungicide	0	0	No	See label for specific rates and application recommendations and precautions. Ingredients are exempt from FIFRA.
Vegalab Mildew Control Zayin Zealous (geraniol)	Vegetables, strawberries (labels vary)	Broad-spectrum fungicide	0	0	Yes No	See label for specific rates and application recommendations.
Zivion S (natamycin)	Strawberries	Anthrachnose, <i>Verticillium</i> spp., charcoal rot	0	4	No	Apply prior to plant as a preplant transplant root or whole-plant dip treatment. Do not apply after or to harvestable commodities.
ZONIX (rhamnolipid biosurfactant)	Vegetables, strawberries	Broad-spectrum fungicide (see label)	0	4	Yes	See label for specific rates and application recommendations.

¹ FRAC code (fungicide group): Letters (BM, NC, and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same letter and number) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. However, products with BM, NC, or P are considered low risk and don't require any rotation unless specifically directed on the label. BM = Biologicals with multiple modes of action; NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; P = host plant defense inducers. Source: FRAC Code List <http://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² OMRI Listed means that a product is approved for use in certified organic production under the USDA National Organic Program (NOP).

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 3. Biopesticides labeled for management of nematode pests of many crops. Contact: Johan Desaegeer, UF/IFAS Gulf Coast Research and Education Center.

Pest	Active Ingredient	Product(s)	Rate Product/Acre	Days to Harvest	REI (Hours)	Remarks ¹
Nematodes	Azadirachtin	Aza-Guard, Ecozine Plus, Molt-X, Neemix	See label	0	4	OMRI-listed. ¹
	<i>Burkholderia rinojensis</i> heat-killed	Majestene	4–8 qt	0	4	OMRI-listed. ¹
	Mustard oil + capsaicin	Dazitol	6.25 gal	0	4	OMRI-listed. ¹ Apply 3–5 days preplant or 1/4 rate postplant.
	<i>Purpureocillium lilicanum</i> PL-251	LALNIX ACT DC	10.25 fl oz	0	4	OMRI-listed. ¹
	<i>Purpureocillium lilicanum</i> PL-11	NemaClean 10% WP	1–2 lb	0	12	OMRI-listed. ¹
	Saponins of <i>Quillaja saponaria</i>	Nema-Q	See label	0	4	OMRI-listed. ¹
	Thyme oil	Nemakill, Promax, Thyme Guard	See label	0	4	OMRI-listed. ¹
¹ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.						