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Use of Glyphosate and Herbicide Alternatives for Weed Control in Florida Landscape Planting Beds[1]

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Introduction

There is a growing controversy over potential health risks associated with the herbicide glyphosate, the active ingredient in RoundUp®. Following extensive study, the United States Environmental Protection Agency (EPA), along with many other agencies, has maintained its findings that "glyphosate poses no risks to public health when used in accordance with its current label instructions" (US EPA 2019). Despite these findings, many people are concerned over possible health or environmental risks. These concerns have led to bans on glyphosate use on public property in several Florida counties and customers or homeowners becoming hesitant to have it applied on their property. This article is written for landscape professionals and those maintaining landscape areas to guide them in selecting alternatives to glyphosate for postemergence weed control in Florida. Information is also included on preemergence herbicides and integrated weed management (use of chemical and non-chemical controls), which should be the basis of a weed management program.

Glyphosate Advantages

Glyphosate is currently the most commonly applied postemergence herbicide in planting beds and other nonturf areas of residential and commercial landscapes in Florida. Glyphosate is so commonly used for many reasons, but primarily because it is effective. Glyphosate is a systemic/translocated herbicide, meaning that it moves within the plant tissues from the treated leaves, stems, and so on down to the roots. Because glyphosate is translocated throughout the weed, it is effective on most annual and perennial weeds. With one herbicide, an applicator can control almost all common broadleaf, grass, and sedge weeds in Florida landscapes.

Additionally, glyphosate is ideal for planting beds because it is not soil-active and has no residual effects. Once it is applied, it is tightly bound to soil particles, so it does not move down in the soil profile where it could be absorbed by the roots of trees or shrubs. This also minimizes potential environmental contamination from leaching or runoff. Glyphosate is also not volatile, meaning that it will not turn into vapor, move off the treated site, and damage nearby ornamentals. The fact that glyphosate has no soil activity and is not volatile allows it to be used safely around ornamentals as long as the ornamental plant itself is not contacted. Glyphosate can be absorbed through leaves, green stems, root suckers, and even exposed lateral roots, so care must be taken when making directed applications around desirable plants.

Glyphosate is odorless, which can be important for customers and applicators alike because there is no foul odor during mixing or application. Glyphosate is manufactured by multiple companies, and this highly competitive business environment results in it being one of the most affordable herbicides available. Finally, glyphosate has very low toxicity to humans and the environment when used according to label directions.

Glyphosate Disadvantages

While glyphosate offers many advantages, it has disadvantages as well; it can potentially injure landscape plants, it is relatively slow acting, and it does not control certain common weeds well . While glyphosate is very effective at low doses on weeds, it has potential to damage ornamental plants at these low doses if accidental contact is made. A small amount of overspray or misapplication can cause significant injury or death to many different ornamental plants, even if contacting only suckers, low-growing stems, or the

trunks of thin-barked trees (Figure 1). Care should be taken when applying glyphosate around ornamentals by using coarser sprays at lower pressures to prevent spray drift from contacting the foliage, stems, or other tissues of ornamental plants.



Figure 1. Typical glyphosate injury on Knockout rose. Even a small amount of spray drift can cause the injuries seen here, including chlorosis (yellowing), witches' brooming, and deformed new growth. Plants may or may not recover depending upon growth stage and amount applied.
Credit: Chris Marble, UF/IFAS

Another key consideration is speed of herbicidal action. Glyphosate works slowly, and the speed of symptom development (or lack thereof) may be considered a disadvantage when aesthetics are especially important. Glyphosate works to kill weeds by inhibiting an enzyme in plants that is not found in humans or animals. This enzyme inhibition and its effects require some time, and symptoms are usually not evident for 7 or more days, depending upon weather conditions. While this provides thorough weed control, many customers or homeowners want immediate results. For this reason, many contact-action herbicides, such as diquat or pelargonic acid, which cause symptoms to develop rapidly, are often mixed with glyphosate at low concentrations to speed results

While glyphosate is considered to be nonselective and controls most weeds, it is not effective on a few of the most common weeds in Florida landscapes, such as artillery weed (*Pilea microphylla*) (Figure 2). This glyphosate-tolerant weed may spread if glyphosate is repeatedly used. Widespread use of glyphosate without rotating to herbicides with a different mode of action has also led to the prevalence of many glyphosate-resistant weeds, such as horseweed (*Conyza canadensis*) and parthenium ragweed (*Parthenium hysterophorous*) (Figure 4), which are both common in Florida.



Figure 2. Artillery weed (*Pilea microphylla*) is not well controlled with glyphosate.
Credit: Annette Chandler, UF/IFAS



Figure 3. Parthenium ragweed (*Parthenium hysterophorous*) has developed resistance to glyphosate.
Credit: Annette Chandler, UF/IFAS



Figure 4. Torpedograss (*Panicum repens*) infestation in dwarf yaupon hollies (*Ilex vomitoria* 'Nana'). In this instance, glyphosate was used around the plants but could not be used over the top because it would kill the hollies, leading to the torpedograss growing up through only the foliage of the plants where glyphosate was not applied. In this instance, a graminicide such as sethoxydim (Segment® II), which is labeled for over-the-top use in this holly, could be applied over the top of the holly and could eventually control the torpedograss.

Because glyphosate is so effective, it is often used as a "stand-alone" tool, which is not recommended. Any pest-control strategy should be integrated, meaning that a variety of tools are used to manage pests in a responsible manner. One herbicide should not be overly relied upon for control due to risks of resistance development, along with a host of other concerns that may arise from an environmental or plant safety standpoint.

Current Glyphosate Use in Florida Landscapes and Licensing

On a commercial level, glyphosate is primarily applied to landscape beds and other nonturf areas of landscapes by landscape maintenance contractors. These companies may provide general lawn and landscape maintenance services and may spot treat weeds in planting beds as part of these services. Anyone applying a pesticide as part of their employment to areas other than their own property must be licensed in the state of Florida. This includes glyphosate applications. More information on pesticide licensing requirements is available on the Florida Department of Agriculture and Consumer Services website (https://www.fdacs.gov/Business-Services/Pesticide-Licensing).

Products that contain glyphosate as the only active ingredient carry a "Caution" label signal word, meaning that applicators with a Florida Limited Commercial Maintenance License (also referred to as the "RoundUp License") can apply it to landscape planting beds as long as no powered equipment is used (only pump sprayers or hand-pump backpack sprayers are allowed). While the Limited Commercial Maintenance License is commonly referred to as the "RoundUp" license, people holding this license can apply any pesticide with a "Caution" label to planting bed (nonturf) areas. More information on each Florida pesticide category is available here: https://sfyl.ifas.ufl.edu/hillsborough/professional-horticulture/licensing/#Orn_turf.

Nonselective Alternatives

Nonselective alternatives to glyphosate include herbicides that generally have activity on all types of weeds (broadleafs, grasses, and sedges). A list of some of the more commonly available nonselective alternatives are included in Table 1. All of these nonselective alternatives are contact herbicides, meaning that they will not translocate throughout the plant. An exception would be glufosinate (Finale®). Glufosinate is minimally translocated but still considered a contact herbicide, although it can be more effective on larger annual weeds and some perennials compared to other products listed in Table 1. All of these products listed in Table 1 usually result in rapid symptom development (burning of foliage, wilting, etc.), sometimes within only a few hours, depending upon weather. While glyphosate may be effective on some weeds even if the coverage is not thorough, contact herbicides will require most (if not all) the leaf surfaces to be covered, especially if weeds are over 6 inches in height or mature. Many of these products must be applied at application volumes ranging from 1 to 9 gallons per 1,000 ft^2, which requires significantly more time and water (refilling) to make applications compared with glyphosate products.

All the products listed in Table 1 will have activity on all weeds but will be more effective on small annuals (species that complete their life cycle in one year). Additionally, these products tend to be more effective

on broadleaf species compared with grasses and sedges. While these herbicides are more effective on annuals, large, established annual species can quickly recover in some cases. In research at the University of Florida with products containing active ingredients including diquat, acetic acid, and capric acid applied at labeled rates, 8-week-old garden spurge (*Euphorbia maculata*), large crabgrass (*Digitaria sanguinalis*), and oxalis (*Oxalis stricta*) fully recovered after 4 weeks. Previous research has shown similar results for other broadleaf and grassy weeds (Lanini 2019). This does not mean that these products are not effective, but rather that follow-up applications will likely be needed to achieve the desired level of weed control.

It will be especially difficult to control large, established perennial species with many of the herbicides listed in Table 1. All perennial weeds (those living more than two years), such as yellow nutsedge (*Cyperus esculentus*), Florida betony (*Stachys floridana*), dollarweed (*Hydrocoytle* spp.), torpedograss (*Panicum repens*) and many others, will quickly regrow following treatment. Multiple applications will be required to control established perennial weeds, but control can be achieved over time, especially when combining with non-chemical methods such as hand weeding and incorporating the use of systemic herbicides discussed below as part of an overall integrated weed-management strategy.

All products listed in Table 1 are registered as pesticides in the state of Florida, but not all have been extensively tested on different weeds, especially many of the plant oil products, so the precise application volumes and concentrations needed for optimal control are largely unknown. Many products simply instruct users to use spray volumes that "ensure thorough coverage" and give wide ranges. However, large-scale broadcast-type applications would be rare in a landscape scenario. In most situations, applicators should mix products at recommended concentrations, spot spray to ensure all parts of the weed are contacted thoroughly, and closely follow other label instructions regarding adjuvants, sprayer pressure, and other precautions.

Another consideration when comparing prices for these products is to note the recommended rates or concentrations. While glyphosate is often used as a spot spray at concentrations ranging from 1% to 2% by volume with water, herbicides listed in Table 1 may be formulated as ready-to-use, meaning that no mixing is needed and the product is applied as-is, or they may be diluted with water at concentrations anywhere from 3% to 50% with water. These high concentrations can considerably increase costs compared to glyphosate.

As an example, two products (Herbicide A and Herbicide B) are sold in 2.5-gallon jugs. Herbicide A is $100 ($40 per gallon or $0.31 per fl. oz.) and Herbicide B is $250 ($100 per gallon or $0.78 per fl. oz.). Without looking at the label instructions prior to purchase, one may automatically choose the less expensive option if both were considered acceptable in terms of their efficacy as an herbicide. However, if Herbicide A required a 20% dilution with water and Herbicide B required only a 5% dilution, the cost for a gallon of spray mixture would be considerably different. In this example, Herbicide A would cost $7.94 per gallon of spray mixture (25.6 fl. oz. of product/gallon of water × $0.31 per fl. oz.) while Herbicide B would only cost $4.99 per gallon of spray mixture (6.4 fl. oz. of product/gallon of water × $0.78 per fl. oz.). Additionally, let us assume that the label for Herbicide A specifies it should be applied with a carrier volume of 4 gallons per 1,000 ft^2, but Herbicide B may be applied at 1 gallon per 1,000 ft^2. In this scenario the chemical cost for application of Herbicide A is $31.76 per 1,000 ft^2, compared to $4.99 per 1,000 ft^2 for Herbicide B.

OMRI Certification

Some of the products listed in Table 1 are OMRI (Organic Materials Review Institute) certified (https://www.omri.org). That means they have been reviewed by the OMRI, which is a nonprofit organization, and the products are allowed for use under the US National Organic Program standards. This certification allows use of these pesticides on organic farm operations that are USDA organic certified. While landscapes are not certified organic, some customers may wish that only organic products be used, and OMRI-certified products would be considered organic. Hundreds of other similar products not listed in this document are available that are not registered with the EPA but are considered exempt from registration under the Federal Insecticide, Fungicide, and Rodenticide (FIFRA) Act, section 25 (b). These labels may state "This product is exempt from registration with the Federal EPA under section 25 (b) of FIFRA." These products contain active ingredients that are considered minimum risk and are exempted from registration. However,

many of these products are still registered by individual states and have labeling and instructions for how they can be used as pesticides. For a pesticide to be legally distributed, sold, or offered for sale in Florida, it should still be registered by the Florida Department of Agricultural and Consumer Services (FDACS). More information on the registration process can be found here: https://www.epa.gov/minimum-risk-pesticides. To determine if a specific product is registered by FDACS, the National Pesticide Information Retrieval System (NPIRS) can be used to look up products by manufacturer, trade name, or active ingredient (NPIRS 2019).

A number of homemade herbicide recipes using ingredients such as salt and vinegar, soaps, and bleach are available online. Most of these mixtures have not been tested and have no safety or use instructions because they were never intended to be used as pesticides. In addition, it is illegal for commercial applicators to apply homemade herbicides as part of a landscape contract. Only products that are registered by the EPA may be used commercially.

"Organic" and "Natural" Do Not Mean Safe

There are no "safe" pesticides, because all, including natural and organic pesticides, can cause harm to people, pets, wildlife, and the environment in general if they are misused. Just because a product is organic or marketed as "natural" does not mean it is safe if it is used incorrectly and proper precautions are not followed. Vinegar (acetic acid) is often recommended as an alternative to synthetic herbicides, but at concentrations generally required for weed control, products usually carry "Warning" labels and are highly acutely (rapid onset of symptoms) toxic, meaning that they can cause severe burns, permanent eye damage, and pose an inhalation hazard. Many of the organic or natural herbicides also require more personal protective equipment (PPE) than those that typically apply glyphosate, such as Limited Commercial Landscape Maintenance Applicators, are used to wearing. Many require eye protection or face masks, respirators, aprons while mixing, and typical PPE such as long-sleeve shirts, long pants, shoes and socks, chemical-resistant footwear and gloves, and more. All of these natural and organic products are still pesticides and are still chemicals, so they should be treated as such. Read and follow all label instructions and use products in accordance with directions.

Selective Alternatives

Nonselective herbicides have activity on all types of weeds, but selective herbicides only have activity on certain types of weeds, such as broadleafs, grasses, or sedges. Several different selective herbicides are available and labeled for use in landscape planting beds. These products may work either primarily through contact or systemic activity and have a variety of modes of action. A full list of selective alternatives to glyphosate are included in Table 2.

For sedge control, products such as halosulfuron (Prosedge®, SedgeHammer®), sulfentrazone (Dismiss®), bentazon (Basagran® T/O), and imazaquin (Sceptor® T/O) could be used. Many of these herbicides are also commonly applied to warm-season turfgrasses in Florida. While these products have activity on sedges, they may also control certain broadleaf species, but not all (or even most) broadleafs will be controlled.

For grassy weed control, there are several graminicides (selective herbicides that control grasses only) labeled for use in and around hundreds of ornamental plants. These products include clethodim (Envoy®), fenoxaprop (Acclaim® Extra), fluazifop-p (Fusilade® II), and sethoxydim (Segement®). These herbicides can be used as spot applications (around the base of plants), or when needed, they can be applied over the top of broadleaf plants listed on individual product labels (Figure 4).

Broadleaf weed control is more challenging because few selective options exist. Clopyralid® (Lontrel) is labeled for use around certain landscape ornamentals and provides a high level of control of weeds in the Asteraceae family (e.g., horseweed, eclipta [*Eclipta prostrata*], tasselflower [*Emilia* spp.]) and the Fabaceae (bean) family (e.g., vetch [*Vicia* spp.], beggarweed [*Desmodium* spp.], and others).

Many of these selective alternatives are systemic and are often as effective as or more effective than glyphosate on certain weeds. The disadvantage of these products is that they do not provide broad-spectrum control. Consider a planting bed that is infested with yellow nutsedge, southern crabgrass (*Digitaria ciliaris*), and beggarticks (*Bidens pilosa*), three of the most common weeds in Florida landscapes. Using selective

herbicides only, three different herbicides may be needed for control of these three species: for example, halosulfuron (for nutsedge), clopyralid (for beggarticks) and a graminicide, such as fenoxaprop-ethyl (Acclaim Extra®), for the crabgrass. Additionally, each herbicide will be labeled for use around different ornamentals, have different sensitive species, and list other precautions and instructions. This can create a challenging scenario when trying to manage weeds strictly with selective postemergence herbicides.

Preemergence Herbicides

Many landscape maintenance companies often do not use preemergence herbicides, usually due to costs or phytotoxicity concerns. However, in the absence of a broad-spectrum postemergence herbicide like glyphosate, preemergence herbicides become more important and advantageous from a cost scenario. Of all the herbicides labeled for use in and around ornamental plants, applicators have more options and the ability to control more weeds without harming ornamentals by choosing to use preemergence herbicides properly.

In contrast to most postemergence herbicides, many preemergence herbicides can be applied over the top of woody ornamentals, ornamental grasses, and herbaceous perennials listed on product labels. Exceptions include flumioxazin (SureGuard®) and the spray-applied formulation of indaziflam (Specticle® FLO), which can be applied only as directed applications away from ornamental foliage.

Preemergence herbicides are often granular formulations, which can increase the safety of the herbicides to ornamental plants and allow them to be used around more species of ornamentals. Granular products should only be applied to ornamentals if the foliage is dry, because wet foliage can trap herbicide granules and cause damage to leaves and growing points. While many of the liquid or spray-applied herbicides are labeled for over-the-top application, these products can also be applied as directed applications away from the plant foliage to provide a higher degree of plant safety. While many applicators are wary of potential root absorption by these herbicides causing severe injury to ornamental plants, this rarely happens when equipment is properly calibrated and products are applied to species listed on the label. These herbicides all also tend to bind tightly to the soil and do not leach significantly.

A list of some common preemergence herbicides labeled for use in landscapes is included in Table 3. These preemergence herbicides are effective, but none will provide year-long weed control. Rotate through different preemergence herbicides with different modes of action throughout the year. A more thorough guide to preemergence herbicides, including efficacy rankings and crop safety information, is available in the *2017 Southeast Pest Management Guide*.

The Importance of an Integrated Strategy

Whether glyphosate can be used or not, successful weed-control programs are based on an integrated approach using both chemical and non-chemical methods. This is even more important now because many people may have used glyphosate as their primary (or only) weed-management tool. One of the most effective non-chemical approaches to weed management in landscape planting beds is organic mulch, such as pine straw, pine bark, or wood chips, applied at a 2- to 3-inch depth. While all types of mulch can provide plant benefits, for weed control, pick coarse-textured mulch materials that dry rapidly following rainfall to prevent germination of weed seeds within the mulch and allow water infiltration to the soil below.

Hand weeding is laborious and expensive, but in many cases it may be the most effective method of control. Flame weeders, hoeing, raking, and other methods of non-chemical control may have a place in different landscape scenarios, depending on the situation. For more information on non-chemical methods of control, see HS1170, *Nonchemical Weed Control for Home Landscapes and Gardens*. Regardless of what type of program or strategy is implemented or what herbicides are available, regular scouting and correct identification of weeds is important to success because it will allow action to be taken before weeds become uncontrollable. A complete guide to integrated weed management in landscape planting beds, including information on mulching, fertilization, irrigation, and chemical and non-chemical management, is available in the EDIS document Improving Weed Control in Landscape Planting Beds.

Conclusion

- Glyphosate is an important weed management tool. While useful and economical, glyphosate is not essential for having satisfactory weed control in landscapes.
- Many nonselective alternatives are available. The advantages of these products are that they work quickly, are active on most types of seedling weeds, can be diluted with water and applied in the same manner as glyphosate, and usually do not cause permanent damage to ornamentals if accidental contact is made and the plants are otherwise healthy and established.
- The disadvantages to nonselective alternatives are that they are not systemic, so multiple applications are often needed for thorough control; they are generally less effective on grasses, sedges, and established weeds; and they are typically costlier than glyphosate, both when considering the herbicide cost alone, as well as when considering the number of applications that will be required for control of established weeds.
- Thorough coverage is essential when using contact-action herbicides such as the nonselective alternatives listed in Table 1.
- "Organic" and "natural" do not mean safe. All products used to kill weeds are chemicals and are pesticides, so they should be treated as such by strictly following label instructions.
- Selective alternatives (Table 2) can be used and may be as or more effective than glyphosate, but each herbicide will only control certain types of weeds.
- Preemergence herbicides (Table 3) can be used to control a wide variety of weeds from seed but will not control existing weeds.
- Integrated weed control, using a variety of non-chemical options such as hand weeding, mulch, etc. and responsibly using herbicides, is the best way to manage weeds, regardless of whether glyphosate is used.

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Tables

Table 1. Nonselective postemergence herbicide alternatives to glyphosate for use in landscape planting beds.

Active ingredient	Example trade name(s)[1]	Label signal word[2]	OMRI certified?[3]	Example application rate(s)[4]
Acetic acid (vinegar)	WeedPharm®, many others	Danger	Yes	Ready to use (no mixing needed). Apply at 15 to 30 gallons per acre or spot spray to thorough coverage.
Ammoniated soap of fatty acids	FinalSan®	Warning	Yes	20% solution applied at an application volume of 75 to 200 gallons per acre (2 to 5 gal. per 1,000 ft^2).
Ammonium nonanoate (i.e., pelargonic acid)	Axxe®, Mirimichi® Green Pro Weed Control	Warning	Yes	10% to 13% solution (13 to 16 fl. oz. per gal.) for spot spraying; broadcast 10% to 13% solution at 30 to 125 gallons per acre.
Caprylic + Capric acids	FireWorxx®, Homeplate®, Supress®	Caution to Warning	Yes	3% to 9% solution at 35 to 400 gallons per acre application volume (0.7 to 9.2 gal. per 1,000 ft^2).
Citric acid + clove oil	Bonide Burnout®	Danger	No	33% solution applied with an application volume of approximately 0.7 gallons per 1,000 ft^2.
Clove oil + cinnamon oil	Weed Zap®	Caution	Yes	6.4 fl. oz. per 1 gallon of water and spray to thorough coverage
Diquat	Reward®	Caution	No	0.75 fl. oz. per gallon as a spot spray; for broadcast, 1 to 2 pints per acre with an application volume that achieves thorough coverage. A non-ionic surfactant is needed.
d-limonene (citrus oil)	Avenger® Ag	Caution	Yes	14% to 30% solution and spray to thorough coverage
Eugenol	Weed Slayer®	Caution	Yes	1 quart per acre with an application volume of 25 to 30 gal. per acre.
glufosinate	Finale®	Warning	No	2 to 4 fl. oz. per gallon of water as a spot spray; for broadcast, apply 2 to 6 quarts per acre at a minimum of 40 gallons per acre application volume.
Pelargonic acid	Scythe®	Warning	No	3% to 10% solution applied with an application volume of 75 to 200 gallons per acre (1.7 to 4.6 gal. per 1,000 ft^2).

[1]Many active ingredients are marketed and sold under different trade names. Trade names listed here are for informational purposes and do not imply endorsement or the use of suitable alternatives.

[2]Label signal words listed here are examples for trade names listed and are for informational purposes only. Depending upon product concentration, signal words may be different for different products and individual labels should always be consulted for required personal protective equipment (PPE) and use directions.

[3]OMRI = Organic Materials Review Institute; shows which products are allowed for use under the US National Organic Program Standards for organic agricultural production.

[4]Application rates are given as examples for each active ingredient to illustrate typical application rates needed for weed control. Application rates will vary depending upon individual product formulations. Different rates will also be required depending upon weed growth stage, use site, use pattern, and environmental condition. See individual labels for details on each product.

Table 2. Selective postemergence herbicide alternatives to glyphosate for use in landscape planting beds.

Active ingredient	Example trade name(s)[1]	Label signal word[2]	WSSA herbicide group[1]	Notes[3]
Bentazon	Basagran® T/O	Caution	6	Use as a directed application around established ornamentals for sedge control. May be applied over the top to ornamentals listed on the product label.
Clethodim	Envoy®	Caution	1	Controls annual and perennial grasses and may be applied over the top of ornamentals listed on product label.
Clopyralid	Lontrel®	Caution	4	Controls many annual and broadleaf weeds such as clovers, dollarweed, beggarticks, and others. Check label for sensitive species and use directions. Can damage some ornamentals and can be absorbed by ornamental roots, especially ornamental legumes such as acacia and redbuds.
Fenoxaprop-ethyl	Acclaim® Extra	Caution	1	Controls annual and perennial grasses and may be applied over the top of ornamentals listed on product label.
Fluazifop-p	Fusilade® II	Caution	1	Controls annual and perennial grasses and may be applied over the top of ornamentals listed on product label.
Halosulfuron	Prosedge®, SedgeHammer®	Caution	2	Use as a directed application around established woody ornamentals for sedge control.
Imazaquin	Sceptor® T/O	Caution	2	Controls sedges and some broadleaf weeds. Is safe for use around only certain ornamentals but can cause damage to those not listed on the label if foliage is contacted, or through root uptake.
Sethoxydim	Segment® II	Caution	1	Controls annual and perennial grasses and may be applied over the top of ornamentals listed on product label.
Sulfentrazone	Dismiss®	Caution	14	Use as a directed application around ornamentals for sedge control. May provide control of some small broadleaf weed species.
Sulfosulfuron	Certainty®	Caution	2	Primarily used a directed application around established ornamental species. Can severely injure species not listed on the label. Controls most sedge species and a few broadleaf weed species.

[1]Many active ingredients are marketed and sold under different trade names. Trade names listed here are for informational purposes and do not imply endorsement or the use of suitable alternatives.

[2]Label signal words listed here are examples for trade names listed and are for informational purposes only. Depending upon product concentration, signal words may be different for different products and individual labels should always be consulted for required personal protective equipment (PPE) and use directions.

[3]General information is provided on each product to give readers an idea of spectrum of control but does not substitute for reading and following all label guidelines. Products listed in this table have the potential to cause severe injury or death to ornamentals if used on species not listed as safe on product labels. Use directed applications when possible to avoid potential injury and be certain that equipment is calibrated properly.

Table 3. Preemergence herbicides labeled for use in landscape planting beds in Florida.

Active ingredient(s)	Example trade name[1]	Label signal word	WSSA herbicide group[2]	Weeds controlled[3]	Over the top?[4]
dithiopyr	Dimension®[2]	Warning	3	Grasses and some broadleaf	
oryzalin	Oryzalin 4 Pro	Caution	3	Grasses and some broadleafs	YES
pendimethalin	Pendulum®G	Caution	3	Grasses and some broadleafs	YES
	Pendulum®EC	Caution		Grasses and some broadleafs	YES
prodiamine	Barricade®	Caution	3	Grasses and some broadleafs	YES
trifluralin	Treflan G	Caution	3	Grasses and some broadleafs	YES
flumioxazin	Broadstar™G	Caution	14	Broadleafs and grasses	YES
	SureGuard®	Caution		Broadleafs and grasses	NO
oxadiazon	Ronstar®G[2]	Warning	14	Broadleafs and some grasses	YES
dimethenamid-p	Tower®[2]	Warning	15	Broadleafs, grasses, and nutsedge suppression	YES
s-metolachlor	Pennant Magnum®	Caution	15	Grasses, sedges, and some broadleafs	YES
isoxaben	Gallery® SC	Caution	21	Broadleaf weeds	YES
indaziflam[4]	Specticle® Flo	Caution	29	Broadleafs and grasses	NO
	Specticle® G	Caution	29	Broadleafs and grasses	YES
benefin + oryzalin	XL 2G[3]	Caution	3 + 3	Grasses and some broadleafs	YES
pendimethalin + dimethenamid-p	FreeHand®G	Caution	3 + 15	Broadleafs, grasses, and sedge suppression	YES
trifluralin + isoxaben	Snapshot®TG	Caution	3 + 21	Broadleafs and grasses	YES
prodiamine + isoxaben	Gemini® G	Caution	3 + 21	Broadleafs and grasses	YES
	Gemini®SC	Caution	3 + 21	Broadleafs and grasses	YES
oxyfluorfen + pendimethalin	OH2®G	Caution	14 + 3	Broadleafs and grasses	YES

[1]Many active ingredients are marketed and sold under different trade names. Trade names listed here are for informational purposes and do not imply endorsement or the use of suitable alternatives.

[2]Herbicide groups are based according to primary sites of action and can be used to select herbicides that have differing sites of action (*Weed Technology* 17: 605–619 [2003]).

[3]"Weeds controlled" is given only as a general guideline. No herbicide controls all weeds. Check label for specific weed species controlled.

[4]"Over the top" shows which herbicides can be applied over the top of ornamental species. Check label for lists of ornamental species tolerant to each herbicide.

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Use pesticides safely. Read and follow directions on the manufacturer's label.

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