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A Step-by-Step Fertigation Guide for Blackberry Growers in Florida[1]

Nurjahan Sriti, Elena Máximo-Salgado, Zhanao Deng, Jeffrey Williamson, and Guodong Liu[2]

Introduction

Blackberry cultivation offers significant opportunities for fruit producers in subtropical regions. Effective fertilizer management is essential for maximizing production. However, determining the optimal fertilizer application can be challenging as a result of variations in soil types and climate. To achieve the best results, it is important to follow the 5 Rs of nutrient stewardship. (There are usually only 4 Rs outside the unique environmental conditions of Florida.) These principles focus on applying the right fertilizer source at the right rate, at the right time, in the right place, and with the right irrigation (Dixon and Liu 2020; Sriti et al. 2024). This guide provides Florida blackberry growers with practical recommendations for efficient fertigation practices to boost blackberry yields and improve nutrient use efficiency. It is intended for commercial growers, agricultural consultants, farm managers, Extension agents, Extension specialists, and others interested in blackberry production and sustainable farming.

Fertigation, the process of applying fertilizers through irrigation systems, is gaining popularity worldwide for its ability to enhance both water use and nutrient use efficiencies, ultimately increasing crop yields (Thompson et al. 2018). This method improves nutrient efficiency by facilitating frequent split applications directly to the root zone (Bryla 2011). Small, repeated applications reduce nutrient losses such as ammonia volatilization and nitrogen denitrification, while also minimizing nutrient leaching and fixation, particularly for phosphorus. Fertigation ensures precise timing and even distribution of both water and nutrients, helping crops meet their specific needs at the right time (Narda and Chawla 2002; Patel and Rajput 2000). Additionally, fertigation offers better control over nutrient concentrations in the soil solution and improves the cost-effectiveness of fertilizer use (Solaimalai et al. 2005).

In blackberry cultivation, fertigation plays a crucial role by delivering nutrients directly to the plant roots through the irrigation system. This method enhances nutrient uptake, reduces waste, and ensures that plants receive the optimal nutrients at the right time, supporting healthy growth and fruit production.

Step-by-Step Guide

If a drip irrigation system is already installed, simply connect the fertilizer injector to the system and begin fertigating. If no drip irrigation system is in place, you will need to set one up first.

1. Prepare the irrigation system.

Key components for the irrigation system include:

- Connectors and fittings (elbows, tees, end caps)
- Pressure regulator to maintain consistent water pressure
- Filter to prevent debris from clogging the system
- Hole punch tool to install emitters securely
- Timer to automate the irrigation process for consistent watering schedules (Figure 1)

Figure 1. DIG Corp. Battery Operated Controller.
Credit: Nurjahan Sriti, UF/IFAS

To set up an effective drip irrigation system for blackberry production, follow these steps:

1. **Install the main supply line**: Begin by laying down ½-inch or ¾-inch polyethylene tubing as the primary water supply line. This tubing will deliver water to all the plants, whether they are in pots or planted in the field.
    a. **For field production**, you can use ½-inch or ¾-inch polyethylene tubing with built-in emitters and anti-clogging features. This option simplifies the system and ensures consistent water distribution throughout the field.
    b. **In potted blackberry production systems**, connect ¼-inch drip tubing to the main supply line. This smaller tubing allows for accurate and efficient water delivery directly to each plant.
2. **Properly place emitters**: Install emitters along the ¼-inch tubing, ensuring they are spaced appropriately to provide each pot with the right amount of water. The emitters regulate the flow of water to the plants, preventing overwatering or underwatering. Adjust the flow rate to suit the needs of the blackberry plants.

For detailed guidance on designing and installing a drip irrigation system, refer to the comprehensive instructions in Ask IFAS publication HS1144, "Drip-Irrigation Systems for Small Conventional Vegetable Farms and Organic Vegetable Farms." This resource will help you optimize your irrigation system to maximize water efficiency and promote healthy blackberry growth.

2. Set up the fertigation system.

Once the drip irrigation system is installed, set up the fertigation system to efficiently deliver liquid or water-soluble fertilizers directly to the plant root zones. The key component of the fertigation system is the fertilizer injector, which can be powered either by water (e.g., Venturi or Dosatron [NEWTRY, Clearwater, Florida] injectors) or by electricity or fuel (e.g., peristaltic or centrifugal pumps).

Fertilizer Injector

The selection of the right fertilizer injector for a particular fertigation system often depends on specific needs, farm size, and preferences. For small-scale fertigation, injectors like the Venturi injector, Dosatron injector, or peristaltic pump are often ideal due to their efficiency and simplicity. However, for large-scale fertigation systems, a centrifugal pump may be required to handle the higher volumes and pressures needed for effective nutrient delivery. These details further describe the different injector types:

- **Venturi Injector:** This injector uses a pressure differential to create a vacuum, drawing fertilizer from a tank into the irrigation system (Figure 2). It is commonly employed in drip irrigation systems where uniform nutrient delivery is required. Venturi injectors are cost-effective and require neither electricity nor fuel, making them ideal for remote areas. They are best suited for small and medium-sized farms where high flow rates or advanced automation are not critical.
- **Dosatron Injector:** The Dosatron is a water-powered fertilizer injector that automatically mixes liquid fertilizers or nutrient solutions with water (Figure 3). It operates using the flow of water through the system, powering an internal piston or motor, thus eliminating the need for electricity or fuel. The system draws fertilizer from a tank via a suction tube and proportionally mixes it at a pre-set, adjustable ratio. This ensures efficient and consistent nutrient delivery to plants, making it suitable for small-to-medium-scale operations.
- **Peristaltic Pump:** This type of positive displacement pump moves liquids through a flexible tube by compressing and releasing sections of the tube (Figure 4). Peristaltic pumps are widely used in fertigation systems for their precise and controlled delivery of fertilizers and nutrients. They are ideal for small-to-medium-scale fertigation, such as in greenhouses or hydroponic systems, where accurate dosing is crucial. While they can be used for larger-scale systems, centrifugal pumps are often more efficient for handling higher volumes of fluid.
- **Centrifugal Pump:** A centrifugal pump injects a precise amount of fertilizer solution into the irrigation line (Figure 5). It is typically powered by a gas-fueled engine or electricity. These pumps are essential for ensuring accurate and consistent fertilizer delivery, which is crucial for optimizing plant growth, especially in large-scale systems where high flow rates and pressures are necessary.

Figure 2. A Venturi injector, shown with (left) and without (right) a valve connected via tubing.
Credit: Nurjahan Sriti, UF/IFAS

Figure 3. A Dosatron injector that allows precise adjustment of the ratio between water and nutrient solution, ensuring optimal mixing for efficient fertigation.
Credit: Guodong Liu, UF/IFAS

Figure 4. A peristaltic pump that is highly suitable for small-to-medium-scale fertigation systems, offering precision and reliability in delivering liquid fertilizers.
Credit: Guodong Liu, UF/IFAS

Figure 5. A centrifugal pump that allows optimal mixing of dissolved nutrients with irrigation water for efficient fertigation.
Credit: Nurjahan Sriti and Guodong Liu, UF/IFAS

Fertilizer Injection Technologies: By integrating a fertilizer injection pump into irrigation systems, growers can have better control over plant nutrition, ensuring plants receive the right nutrients at the right time, maximizing yield, and minimizing environmental impact.

Fertilizer Tank

A fertilizer tank (Figure 6) is a key component in systems designed to deliver nutrients to crops via fertigation, often in conjunction with irrigation systems such as drip or sprinkler irrigation. The primary function of a fertilizer tank is to store liquid fertilizers or dissolved nutrient solutions that will be injected into the irrigation water and delivered directly to plants. This helps ensure plants receive consistent and accurate doses of nutrients, optimizing growth and yield.

Figure 6. A tank of liquid fertilizer.
Credit: Nurjahan Sriti, UF/IFAS

3. Check the system.

Ensure the irrigation system is properly installed and fully operational, checking for any leaks or blockages that could affect water flow and nutrient delivery.

4. Choose the right fertilizer.

When choosing a fertilizer for fertigation, it is crucial to select one that is either liquid or water-soluble. Water-soluble fertilizers dissolve completely in water, ensuring an even mix with the irrigation water. Not all fertilizers are suitable for fertigation; some may be insoluble depending on their chemical composition. To avoid clogging the system, the fertilizer stock solution should be fully dissolved in a separate container before being added to the irrigation system, preventing scum or sediment formation (Liu and McAvoy 2012). This ensures that nutrients are consistently and efficiently delivered directly to the plant roots. Additionally, the solution should be mixed continuously, and any sludge that accumulates at the bottom of the tank should be removed regularly (Hakkim et al. 2016). Fertilizers designed specifically for fertigation are optimized for plant absorption and formulated to work seamlessly with irrigation systems, helping to prevent blockages and ensuring an even nutrient distribution.

To better understand how fertilizer selection and fertigation principles are applied in practice, the next section provides an example from a blackberry field trial.

An Example of Fertigating Blackberry Bushes

This example shares details from a blackberry trial at the UF/IFAS Plant Science Research and Education Unit in Citra, Florida, focusing on fertigation.

1. Selecting the Right Fertilizer

Before choosing a fertilizer, it is critical to first understand the specific nutrient needs of blackberry plants, which can be determined through soil and leaf analyses. A soil analysis provides key insights into current nutrient levels, pH, texture, and organic matter content of the soil. In contrast, a leaf analysis reveals the plant's actual nutrient status, helping to identify any deficiencies in essential nutrients (Strik and Vance 2016). Together, these analyses offer a comprehensive picture of the nutrients your blackberries need and in what quantities.

Effective fertilizer management is critical for maximizing yields and maintaining the quality of blackberry crops (Sriti et al. 2024). Based on the results of the soil and leaf analyses, growers can select a fertilizer formulation that delivers the right balance of nitrogen, phosphorus, potassium, and micronutrients necessary for optimal blackberry plant growth and fruit production. For instance, Dyno Flo 5-2-8 YZ is a water-soluble fertilizer designed specifically for fertigation, ensuring complete dissolution in water for even distribution through the irrigation system. This provides a consistent, efficient supply of nutrients directly to the plant roots.

2. Calculating the Fertilizer Dosage

Based on the results of soil and leaf nutrient analyses, determine the optimal fertilizer dosage required for healthy blackberry growth. The following guide is for calculating the appropriate amount (Liu et al. 2021):

- Fertigation area: 19,200 square feet (0.44 acres)
- Nitrogen Requirement: 5 lb N per acre per week
- Fertilizer: Dyno Flo 5-2-8 YZ
- Fertilizer Density: 10.24 lb per gallon
- N Content in Fertilizer: 5%
- Target N Concentration: 200 ppm
- Flow rate: 0.5 gallons per 100 feet per minute
- Drip line length in targeted area: 3,840 ft

Total Nitrogen Requirement

N requirement × fertigated area = total N requirement

5 lb N per acre x 0.44 acres = 2.2 lb N

Pounds of Fertilizer Needed

Total N requirement/N content = weight of fertilizer needed

2.2 lb N/0.05 = 44 lb Dyno-Flo 5-2-8 YZ

Gallons of Fertilizer Needed

Weight of fertilizer needed/fertilizer density = volume of fertilizer needed

44 lb/10.24 lb per gallon = 4.3 gallons

Dilution Factor

N content × (1,000,000/target nitrogen concentration) = dilution factor

0.05 × (1,000,000/200 ppm) = 250

Drip Irrigation Flow Rate

Considering that the flow rate is measured in units of GPM per 100 ft,

(Drip line length/100) × flow rate in GPM = total flow rate in GPM

(3,840 feet/100) × 0.5 GPM = 19.2 GPM

Injection Rate

Total flow rate/dilution factor = fertilizer injection rate

Convert from gallons to ounces: 1 gallon = 128 ounces

19.2 GPM/250 = 0.0768 GPM = 9.8304 oz per minute

The injection rate is roughly 10 ounces per minute.

Injection Time

Weight of fertilizer needed/fertilizer injection rate = injection time

4.4 gallons/0.0768 GPM = 57.14 minutes

In other words, this fertigation event needs about 1 hour.

3. Considering the Fertigation Frequency and Timing

In Florida's subtropical climate, blackberry plants benefit from weekly fertigation during active growth and fruiting periods. A typical schedule involves once-a-week fertigation from the onset of flowering through the end of fruit harvest. During early vegetative growth or after pruning, fertigation may be applied once every two weeks, depending on plant demand and residual soil nutrients. It is best to fertigate early in the morning when transpiration rates begin to rise and irrigation systems are already scheduled to run. Avoid fertigation during heavy rainfall or waterlogged soil conditions to minimize leaching losses and root stress.

4. Fertigating Blackberry Bushes

To prepare the fertilizer solution for fertigation, follow these steps:

1. Add 25 gallons of water directly into the fertigation tank.
2. Measure 4.4 gallons of Dyno Flo 5-2-8 YZ fertilizer and gradually add it to the tank. Since this liquid fertilizer contains only NPK, additional micronutrients will need to be incorporated.
3. Next, measure 0.25 ounces of Microplex (a brand/product name for a fertilizer micronutrient mix, often from Miller Chemical) and add it to the tank for each fertigation event. Mix the solution thoroughly to ensure complete dissolution and uniform distribution of both Dyno Flo 5-2-8 YZ and Microplex.
4. After dissolution, check to ensure that no undissolved particles remain, that the solution is homogeneous and well-mixed.
5. Initiate fertigation:
    - **Start by applying irrigation** to pressurize the system before introducing the fertilizer. This step is crucial for enhancing nutrient absorption and ensuring even distribution. Water the soil enough to reach the root zones without over-saturating it, aiming for a moist, not waterlogged, condition. Ensure the water is evenly distributed to support uniform fertilizer application.
    - **Activate the fertigation system**: After irrigating for 10 minutes to pressurize the system, run the fertigation system to begin delivering the fertilizer solution.
    - **Monitor the application**: Continuously monitor the system during the application to ensure even distribution and to check for any issues such as clogs or uneven flow.
6. Perform post-fertigation practices:
    - **Flush the system**: After applying the fertilizer solution, flush the fertigation system with irrigation water to remove any remaining fertilizer and prevent buildup that could cause clogging issues.
    - **Inspect the plants**: Monitor the plants for signs of nutrient uptake and ensure they are responding positively to the fertigation.
7. Record and evaluate:
    - **Document the application**: Record key details of the fertigation event, including the volume of solution applied and any observations made during the process.
    - **Evaluate for effectiveness**: Assess the impact of the fertigation on plant growth and health. Use these observations to adjust future applications based on the plants' evolving needs.

By following these steps, you can ensure efficient fertilizer application through irrigation, optimize nutrient uptake, and promote healthy plant growth.

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Table 1. Overview of fertilizer injector technologies for drip irrigation systems.

Injector type	Power source	Farm size suitability	Pros	Cons
Venturi injector (Figure 2)	Water-powered (relies on pressure differential)	Small to medium	Cost-effective. No electricity/fuel needed. Effective in low-pressure systems. Ideal for remote areas.	Requires a pressure differential (can reduce main line pressure). Flow rate can be less precise if pressure fluctuates. Not suitable for high flow rates.
Dosatron injector (Figure 3)	Water-powered (internal piston/motor)	Small to medium	Automatically mixes at pre-set, adjustable ratios. No electricity/fuel needed. Consistent nutrient delivery regardless of water flow/pressure variations.	Higher initial cost than Venturi. Maintenance can be more complex. Some models may have flow rate limitations for very large systems.
Peristaltic pump (Figure 4)	Electricity or fuel	Small to medium	Highly precise and controlled delivery. Ideal for accurate dosing of concentrated solutions. Can handle viscous fluids. Low maintenance (tubing replacement).	Flow rate limitations for very large volumes. Tubing wears down over time and needs replacement. Pulsed flow at low speeds (can be mitigated with dampeners).
Centrifugal pump (Figure 5)	Electricity or fuel (e.g., gas engine)	Large	Delivers larger volumes and higher pressures quickly. Suitable for extensive systems. Robust for continuous operation.	Requires external power. Can be less precise for small dose adjustments. Not self-priming (often requires manual priming or being placed below fluid level). Can be damaged if it runs dry.

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[2] Nurjahan Sriti, graduate research assistant, UF/IFAS Department of Horticultural Sciences, Gainesville, FL; Elena Maximo-Salgado, graduate research assistant, UF/IFAS Department of Horticultural Sciences, Gainesville, FL; Zhanao Deng, professor, breeding and floriculture, Department of Horticultural Sciences, UF/IFAS Gulf Coast Research and Education Center; Jeffrey Williamson, professor, UF/IFAS Department of Horticultural Sciences; Guodong Liu, associate professor, UF/IFAS Department of Horticultural Sciences, Gainesville, FL; UF/IFAS Extension, Gainesville, FL 32611.