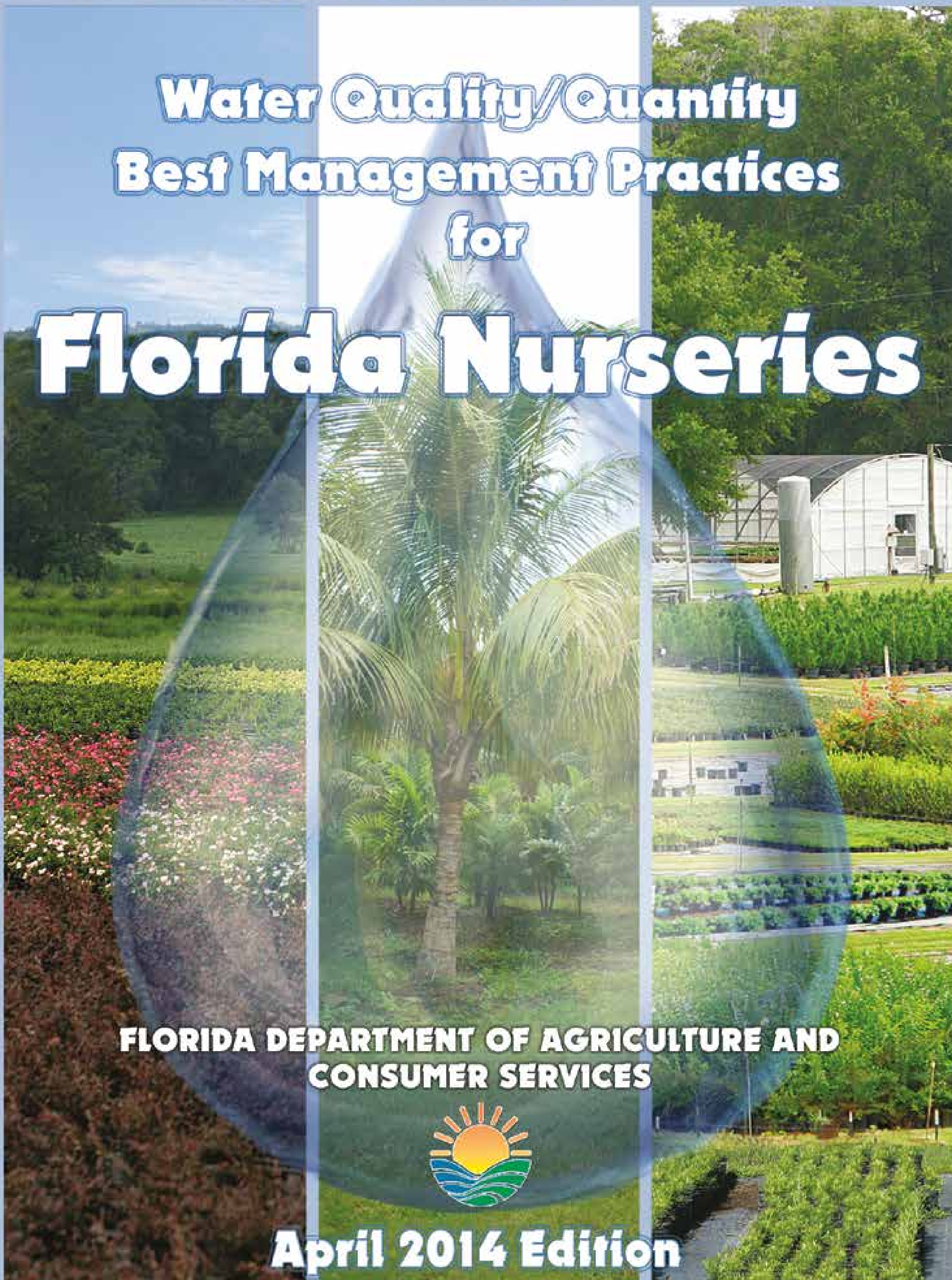

Water Quality/Quantity Best Management Practices for Florida Nurseries

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

April 2014 Edition

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Florida Department of Agriculture and Consumer Services

Commissioner Adam H. Putnam

COMMENTS BY COMMISSIONER ADAM H. PUTNAM

Dear Agricultural Producers:

This manual, *Water Quality/Quantity Best Management Practices for Florida Nurseries*, reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. The manual expands on the previous container nursery manual by incorporating practices for in-ground nurseries and other sectors of the industry, and updates and clarifies the container practices.

While best management practices have been in place for many years in our state, their role in environmental protection was formally established in 1999 with the passage of the Florida Watershed Restoration Act. This legislation provides the framework for implementing Florida's Total Maximum Daily Load program, which sets water quality targets for impaired waters. It also identifies best management practices implementation as the means for agriculture to help meet those targets.

Nursery operations offer great potential for water conservation and fertilizer management, due to the water and nutrient demands of the plants being grown. The BMPs in this manual address water quality and quantity impacts from nursery production activities and help the industry operate efficiently.

As Florida's population continues to increase, there are more impacts to and competition for Florida's limited water resources. All Floridians must take part in conserving and protecting these resources. This manual represents the industry's commitment to do just that.

As a native Floridian whose family has long been involved in agriculture, I want to thank all who participated with the Department in the development of this important manual. With the active support and participation of so many dedicated people, I am optimistic about the future of Florida's agricultural industry. I trust that you will join me in supporting this valuable water resource protection effort.

Sincerely,

Adam H. Putnam
Commissioner of Agriculture

ACKNOWLEDGEMENTS

This statewide BMP manual for the nursery industry expands upon the 2007 Container Nursery manual and extends rule-adopted BMPs to field-grown, greenhouse, and cut foliage production activities. The following is a list of individuals who participated in the development of this manual. Each of these individuals and their organizations made important contributions to the process, and their work is sincerely appreciated.

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INTRODUCTION

Operations Intended to Use this Manual

This manual is designed for use by commercial container plant, field grown, and cut foliage production operations. Therefore, FDACS efforts will be focused on enrolling nursery production operations conducted as an agricultural business. The manual does not apply to retail-only establishments. Nursery operations enrolling in the Florida Department of Agriculture and Consumer Services (FDACS) nursery Best Management Practices (BMP) program should be registered with the FDACS Division of Plant Industry. For the purposes of this manual, container plant production is defined as any type of container or greenhouse system, including citrus nurseries; field grown production as in-ground nursery plants grown to maturity, not including caladiums produced in ground; and cut foliage production as ferns, shrubs, or other flowers grown for the cut foliage industry.

Things to Keep in Mind as You Use this Manual

- Italicized words that appear in ***bolded red italics*** are defined in the glossary.
- Specific record-keeping requirements are noted using a pencil icon: 
- You can access this manual electronically at: http://www.freshfromflorida.com/Business-Services/Water/Agricultural-Best-Management-Practices

Overview of the Industry

Nursery operations in Florida include those that grow container plants, in-ground trees and shrubs, shade house ferns, and greenhouse operations that cultivate foliage plants and seedlings. Nursery operations are located throughout the state, and can range in size from one-half an acre to several hundreds of acres.

Nursery production is a major agricultural contributor to Florida's economy. According to a 2010 University of Florida, IFAS Economic Impact Study, the nursery industry farm gate cash receipts was approximately $4 billion. However, urbanization pressure has made it challenging to sustain existing nursery operations in certain parts of the state. Recently, this has been most evident in Broward, Miami-Dade and Hillsborough counties.

Best Management Practices Defined

BMPs are individual practices or combinations of practices that, based on research, field-testing, and expert review, have been determined to be the most effective and practicable means for maintaining and/or improving water quality. BMPs typically are implemented in combination to prevent, reduce, or treat pollutant discharges. BMPs must be based on sound science, and be technically and economically feasible.

BMPs and Water Quality

Studies conducted in 2002 by the Environmental Protection Agency (EPA), and in 2011 by the United States Geological Survey (USGS), indicate that nonpoint sources (both urban and agricultural) are the nation's greatest contributors to water pollution. Much of the contribution is due to rainwater carrying pollutants into lakes, rivers, wetlands, estuaries, and ground water. It is good stewardship and makes sense for growers to prevent or minimize these impacts by using BMPs. In fact, the Florida Legislature has established BMP implementation as the non-regulatory means for agricultural nonpoint sources to comply with state water quality standards. When you implement BMPs, you are also affirming the Legislature's support for this approach.

Total Maximum Daily Loads

Under the Federal Clean Water Act and Florida law, the Florida Department of Environmental Protection (FDEP) must identify impaired surface waters and establish Total Maximum Daily Loads (TMDLs) for pollutants entering these waters. A TMDL establishes the maximum amount of a pollutant that can be discharged to a waterbody and still meet state water quality standards. Some pollutants for which TMDLs have been set include total phosphorus, total nitrogen, total suspended solids, and coliform bacteria.

FDEP may develop and adopt Basin Management Action Plans (BMAPs), which contain the activities that affected interests will undertake to reduce point and nonpoint source pollutant loadings. In ***watersheds*** with adopted BMAPs, and in some other areas, agricultural producers either must implement FDACS-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district (WMD).

Florida already has adopted a significant number of TMDLs, and many more waterbodies are listed for TMDL development. This list encompasses lakes, rivers, streams, springs, and estuarine systems. More information on listed waterbodies and adopted TMDLs is available at www.dep.state.fl.us/water/tmdl/index.htm. To see a map of BMAP areas and learn more about their development, go to www.dep.state.fl.us/water/watersheds/bmap.htm. If you need help figuring out whether you are in a BMAP area, call (850) 617-1727, or e-mail AgBMPHelp@freshfromflorida.com.

Benefits of Implementing BMPs

Before FDACS adopts BMPs, the FDEP reviews them and determines whether they will be effective in addressing water quality impacts from agricultural operations. Benefits to enrolling in and implementing FDACS BMPs include:

- A demonstration of agriculture's commitment to water resource protection.
- Some BMPs increase production efficiency and reduce costs.
- Technical assistance to help with BMP implementation.
- Eligibility for cost-share for certain BMPs (as available).
- A presumption of compliance with state water quality standards for the pollutants addressed by the BMPs.
- Release from the provisions of s. 376.307(5), Florida Statutes (F.S.), (fines for damages) for pollutants addressed by the BMPs.
- The Florida Right to Farm Act (s. 823.14, F.S.) generally prohibits local governments from regulating an agricultural activity that is addressed through rule-adopted BMPs that growers implement.
- Producers who implement FDACS-adopted BMPs might qualify for exemptions from WMD surface water permitting and/or satisfy other permitting requirements.

Implementation of BMPs does not excuse agricultural operations from complying with applicable permitting or other regulatory requirements.

Permit Exemptions

Some agricultural activities, especially those that alter on-site hydrology, may require an Environmental Resource Permit (ERP) or other surface water permit, such as the construction of complex stormwater management systems. Check with your WMD before beginning construction of any stormwater management system to see whether a permit is needed, or whether the following exemptions apply:

- Under subsection 373.406(2), F.S., any person engaged in the occupation of agriculture may alter the topography of any tract of land for purposes consistent with the practice of agriculture. However, these activities may not be for the sole or predominant purpose of diverting or impeding surface waters, or adversely impacting wetlands. Agricultural activities that meet these criteria may be exempt from an ERP. FDACS has the authority to make this determination whenever a dispute arises, based on specific statutory and rule requirements.
- Under subsection 373.406(9), F.S., environmental restoration activities on agricultural lands that have minimal or insignificant impacts to water resources may also be exempt from an ERP, upon written request by the producer and written notification from FDEP or the WMD that the proposed activity qualifies for the exemption.
- Under subsection 373.406(13), F.S., upland, unconnected farm ponds up to 15 acres in size may be exempt as long as the average depth is less than 15 feet and they are located at least 50 feet from wetlands.

Even if an exemption applies, agricultural producers within a watershed with an adopted BMAP that addresses agricultural loadings either must implement BMPs or conduct water-quality monitoring at their own cost.

Local Government Regulation

Nonresidential farm buildings generally are exempt from the Florida Building Code and associated county building codes, in accordance with ss. 604.50 and 553.73, F.S. However, permits may still be required for construction or improvement of certain farm buildings, so it is important to check with your county building and permitting office before beginning construction.

The Florida Right to Farm Act (s. 823.14, F.S.) that a local government may not adopt any ordinance, regulation, rule, or policy to limit an activity of a bona fide farm operation (with an agricultural land classification under s. 193.461, F.S.) if the activity is regulated through implemented BMPs adopted by FDEP, FDACS, or a WMD. Not all activities conducted on a farm are addressed by adopted BMPs. In addition, the Act provides, with certain exceptions, that a farm that has been in operation for one year or more and was not a nuisance at the time of its established date of operation is not a public or private nuisance, if the farm conforms to generally accepted agricultural management practices.

POTENTIAL WATER QUALITY IMPACTS ASSOCIATED WITH NURSERIES

Impervious Areas

Impervious areas on nursery operations (greenhouses, parking lots, etc.) sometimes are necessary, but should be limited as much as possible. Impervious areas can increase and channelize the runoff (flow), which can lead to greater erosion on site. Conversely, greenhouse roof drains may provide an ideal opportunity to harvest rainfall for future irrigation needs when not in conflict with plant health issues.

Erosion downstream can be compounded because high flows often cause undercutting and slumping along stream banks, leading to increased stream sedimentation. Impervious areas also prevent infiltration and associated filtering of pollutants from runoff, and can contribute to onsite and offsite flooding. Check with your WMD before creating any new impervious areas on your property to see whether a permit is required.

Nutrients

Excess nitrogen and phosphorus are the most common causes of water quality impairments in Florida. These nutrients can enter surface waters through stormwater or irrigation runoff, or leach through soils into ground water.

The nitrogen form most abundant in natural waters is nitrate. Due to nitrate's high mobility, it is prone to leaching into ground water. Phosphorus is one of the key elements necessary for the growth of plants and animals. In terms of freshwater ecology, it tends to be the (growth) limiting nutrient in non-flowing waters. Phosphorus is retained more effectively in the soil than nitrogen. However, phosphorus enters waterbodies attached to particulate matter via sediment transport, or can be dissolved in water. In some soils, phosphorus is prone to leaching into ground water.

Excess Algal Growth

Algae are essential to aquatic systems. As a vital part of the food chain, algae provide the nutrition necessary to support aquatic animal life. Certain types of algae also provide habitat for aquatic organisms. However, high levels of nutrients in surface waters result in abnormal plant growth, including algae. Excess algal production can cause many problems in a waterbody. The presence of algal blooms, noxious weeds, and too many floating aquatic plants can block sunlight necessary for photosynthesis by submerged aquatic plants. If there is a mass die off, the rapid decomposition of these materials can lower the available dissolved oxygen, which can lead to fish kills.

Blue-green algae (***Cyanobacteria***) can become so abundant that they can cause a scum layer to form on the surface, shading the sunlight-dependent life below and disturbing the food chain. Potential risks from recreational contact with blue-green algae include skin, respiratory, and mucous membrane irritation.

Sedimentation

Sedimentation occurs when eroded soils are washed into surface waters, creating a buildup of solids on the bottom and suspended solids (turbidity) in the water column. Sedimentation most commonly associated with agricultural operations comes from the erosion of unprotected soils.

Sediment can fill in water bodies, clog waterways, carry pollutants, and affect water clarity. These effects combine to reduce fish, shellfish, and plant populations, and decrease the overall productivity of lakes, streams, estuaries, and coastal waters. Decreased penetration by sunlight can affect the feeding and breeding behaviors of fish, and the sediments can clog gills and cause irritation to the mucous membranes covering the eyes and scales. As the sediment settles, fish eggs can be buried. Recreational use may also decline because of reduced fish populations, less visibility, and reduced desirability of associated swimming areas.

Deposited sediment also reduces the flow capacity of ditches, streams, rivers, and navigation channels, which can require more frequent maintenance dredging or result in flooding. Nutrients and other contaminants can attach to sediments, which can contribute to downstream water quality impairments. Chemicals, such as some pesticides, phosphorus, and ammonium, may be transported in sediment. Over time, these chemicals may be released from the sediment and become suspended in the water column.

Organic Matter

The decomposition of excessive organic matter in water from aquatic plants, algae, or other materials in runoff can lead to increased biological oxygen demand and lower dissolved oxygen levels. Where uncomposted manure or inadequately treated ***biosolids*** are land applied to nurseries, elevated nutrient and fecal coliform levels may occur. The likelihood of contamination is increased if these materials are applied in excess of agronomic rates, or applied under rainy conditions.

KEYS TO POLLUTION PREVENTION

It is the agricultural industry's responsibility to protect water quality by implementing good land and water management practices. BMPs include many prevention measures that minimize potential water quality and quantity impacts. Implementing BMPs helps demonstrate the industry's commitment to protecting water resources, and garners support for this non-regulatory approach. Below are key guidelines for implementing the specific BMPs in this manual.

Understand Water Quality Issues on Your Operation

Water quality includes chemical, biological, and physical characteristics. Elevated levels of phosphorus, nitrogen, sediment, bacteria, and organic material contribute to the degradation of water quality. The potential for discharges from agricultural operations to cause water quality problems varies, depending on soil type, slope, drainage features, nutrient management, and activities in or near ***wetlands***, surface waters, or sinkholes. For more information on surface water quality, go to the following link: http://lakewatch.ifas.ufl.edu/. For information on ground water quality, go to: http://edis.ifas.ufl.edu/fe601

Manage Nutrient Sources Properly

Minimize the pollutants that leave your property by controlling the types and uses of materials used on your operation. Nutrient-related pollutant discharges can come from excessive use or inefficient placement or timing of commercial fertilizer, manure, and/or biosolids applications. Managing nutrients carefully is critical to protecting water quality.

Manage Irrigation Carefully

Water is the carrier for nearly all pollutants. Precisely managing irrigation inputs to keep moisture primarily in the plant's root zone will significantly reduce nutrient-related impacts from fertilizers. Over-irrigating may exceed the soil's water-holding capacity and lead to runoff or leaching.

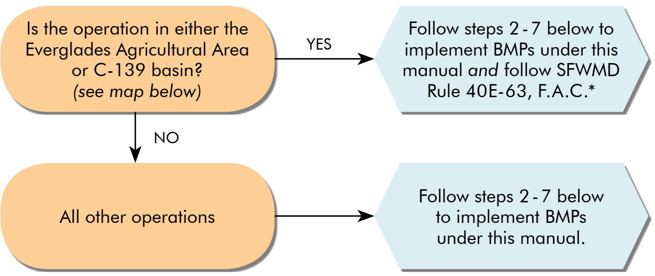
Minimize the Potential for Erosion Impacts

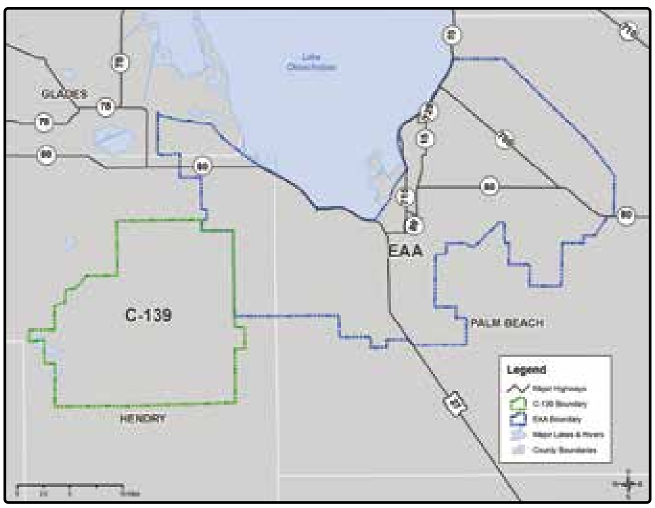
Land clearing, culvert installation, road building, and ditch and canal maintenance can expose soil and lead to erosion that can increase pollutant loading. It is important to take appropriate erosion control measures during these activities.

User's Guide to BMP Enrollment and Implementation

The steps below will help you select which BMPs to implement to reduce or avoid negative impacts to water quality coming from your operation.

1. **Choose the pathway applicable to you:** In the flowchart below, identify the circumstances that apply to you.





***Note:** *In areas where FDEP has adopted a Basin Management Action Plan, agricultural operations must implement applicable FDACS-adopted BMPs or monitor water quality. See www.dep.state.fl.us/water/watersheds/bmap.htm for more information, or contact FDACS field staff (**Appendix 7**).*

2. **Request assistance, as needed, in assessing your nursery and selecting applicable BMPs:** FDACS field staff, UF-IFAS Extension Agents, and some soil and water conservation districts (SWCDs) are available to assist you with evaluating which BMPs are applicable to your operation. To get free assistance, call (850) 617-1729 or email AgBmpHelp@FreshFromFlorida.com.

3. **Conduct an inventory:** The selection of BMPs begins with a basic inventory of the land's natural features, structures, and improvements which will help you determine how the operation and management of your nursery may affect environmentally sensitive areas. When developing the inventory, sketch your site, noting buildings, well locations and other water sources, ditches, retention/detention areas, flow control structures, etc. Identify areas of particular concern that need to be addressed. These may include streams, wetlands, springs, ***sinkholes***, and ponded or other poorly drained areas, among others. You can use the inventory as a starting point to select the BMPs applicable to your operation. To help you conduct your inventory effectively, the following tools are available:

- ✓ Aerial photographs (http://earth.google.com/index.html, or other providers)
- ✓ USDA Natural Resources Conservation Service (NRCS) soil survey maps (http://websoilsurvey.nrcs.usda.gov/app/)
- ✓ USGS topographic maps (http://topomaps.usgs.gov)
- ✓ National Wetlands Inventory (https://www.fws.gov/wetlands/)

4. **Select the applicable BMPs:** Carefully read BMP sections 1.0 through 6.0 and select all of the BMPs in the manual that are applicable to your operation and are technologically and economically feasible for you to implement. Record the BMPs on the appropriate checklist in **Appendix 9** of this manual. The checklist includes a column for you to schedule BMP implementation if a practice is not already in place.

The BMPs in this manual focus primarily on management actions, rather than structural practices. In general, the BMPs should not require cost-share to implement, though there may be a few exceptions. Depending on the location and specific conditions of the operation, not all of the BMPs may be applicable to a particular site.

It is advisable to consolidate your inventory of features, and all your BMP decision-making, including the BMP Checklist, into a simple implementation plan. This can serve as a record of scheduled and completed BMPs, including operation and maintenance activities. A well thought-out, written plan enables managers and owners to schedule their activities and accomplish their objectives. Remember to keep the plan available and update it regularly. It will help you communicate with your employees, your county extension agent, NRCS staff, or others.

5. **File a Notice of Intent to Implement (NOI) BMPs:** Complete and submit to FDACS an NOI, contained in **Appendix 9** of this manual, along with the completed BMP checklist. Once received by FDACS, the NOI formally enrolls your operation in the BMP program. Implementation of the BMPs provides a presumption of compliance with state water quality standards for the pollutants the BMPs address. Implementation includes ongoing record keeping and maintenance of the BMPs.

6. **Implement the BMPs:** Implement all applicable BMPs as soon as practicable, but no later than 18 months after submittal of the Notice of Intent to Implement.

7. **Keep records on BMP implementation:** FDACS rule requires record-keeping to document BMP implementation. Record-keeping requirements are highlighted in the manual using this figure:  Fertilizer applications and rainfall amounts are two types of record-keeping. All BMP records should be accurate, clear, and well-organized. You may develop your own record-keeping forms or use the ones provided in **Appendix 6**. You must retain the records for at least 5 years; however, it is desirable to retain records for as long as possible for your own protection. All documentation is subject to review.

Note: *By FDACS rule, steps 5, 6, and 7 are required to maintain a presumption of compliance with state water quality standards.*

BMP Implementation Follow-Up

FDACS has developed a BMP "Implementation Assurance" program to help evaluate how BMPs are being implemented, and to gather feedback on whether there are obstacles to using any of the practices. FDACS mails surveys to BMP program enrollees, which contain questions about BMP-related activities on enrolled operations. Also, FDACS staff conducts some site visits, to get more direct input from producers. The Implementation Assurance effort helps in:

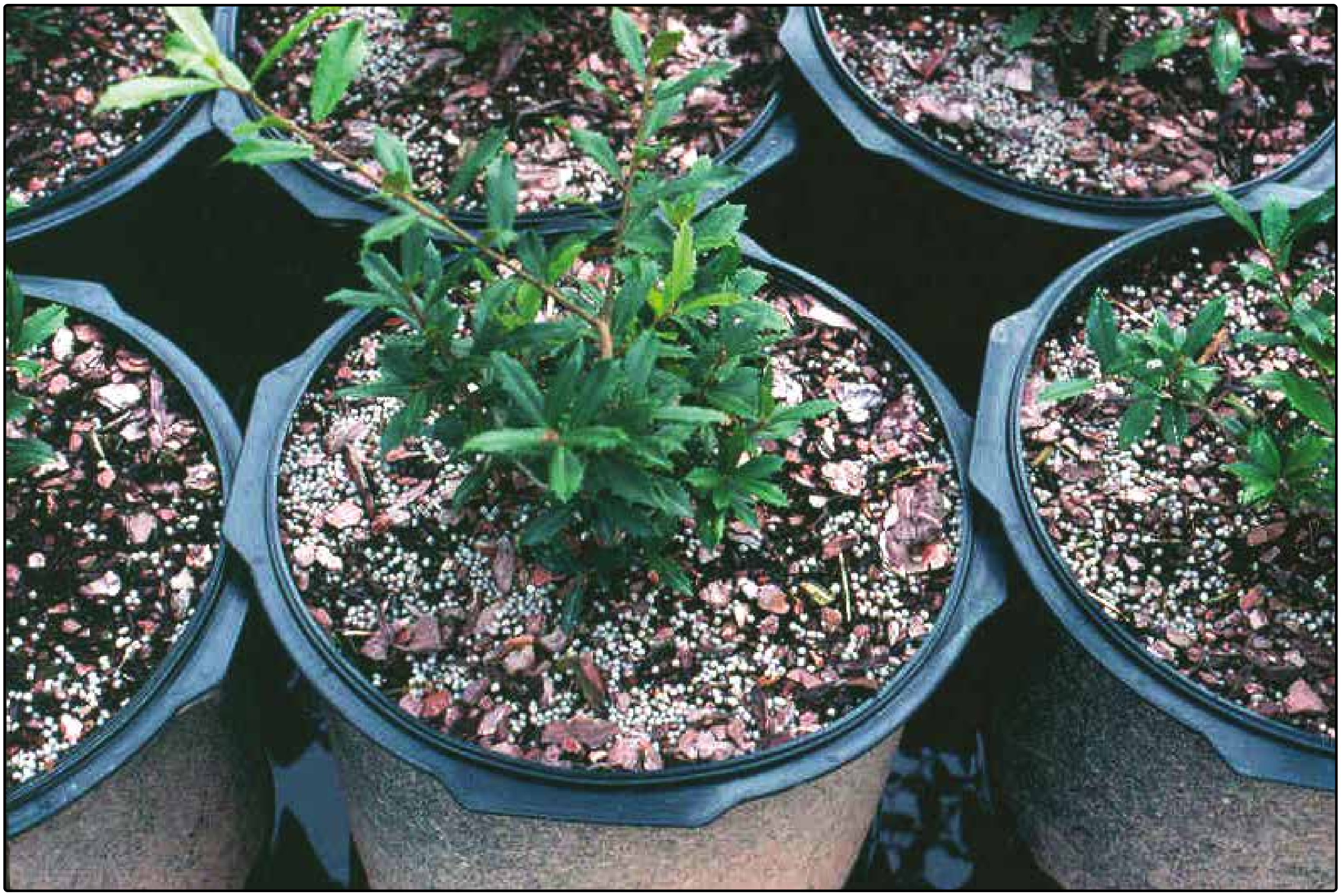
- Documenting the level of participation in implementing agricultural BMPs.
- Identifying needs for education and implementation assistance.
- Reinforcing the importance of BMP implementation.
- Evaluating the effectiveness of FDACS BMP programs.
- Updating FDACS NOI records.

Your participation in these follow-up activities is vital to the continuing success of agricultural BMP programs in Florida.

BEST MANAGEMENT PRACTICES

1.0 NUTRIENT AND IRRIGATION MANAGEMENT

This chapter addresses practices that are among the most necessary to both protect the environment and to maximize the nursery's economic return on investment. It is impossible to successfully address nutrient leaching and runoff without managing both nutrient levels and irrigation practices. Nutrient leaching or surface runoff, regardless of the production system, is heavily dependent on irrigation amount, method and timing. Conversely, the total nutrient requirement is dependent on the nutrients taken up by the plant, and those that are lost to the environment. Therefore, minimizing losses will also reduce nutrient and irrigation expenses. Within the sections below, which are separated by the type of production system, the nutrient and irrigation BMPs are presented together.



1A CONTAINER PLANT PRODUCTION

Container nursery or greenhouse production involves cultivating nursery plants on a short-term production cycle in individual containers that typically range in size from 1 to 200 gallons or in multiple-compartment liners.

Container nursery production is a common method of growing plants for the wholesale and retail markets. Container nurseries range in size from backyard nurseries to very large operations, and may include propagation, potting substrate preparation and storage, production, service and shipping, and nursery office areas. For the purposes of this manual, container nurseries include containers in open fields or shade houses and greenhouses that use containers, trays, and/or flats.

There is significant potential for water and nutrient leaching in container production areas. This section focuses on irrigation and nutrient management practices for container nurseries, and must be used in conjunction with the applicable practices in chapters 2 through 6 of this manual.

General Types of Container Production Systems

There are various production systems used within the container nursery industry, as briefly described below.

1. Conventional Containers – Consists of injection or blow-molded plastic or fiber containers generally ranging from 1 to 200 gallons, sometimes more.
2. Root-Pruning Containers – Designed to help reduce or eliminate the problem of circling roots, these containers deflect or redirect roots via baffles to promote root pruning.
3. Low-profile Containers – Wider, bottomless containers to encourage development of a shallow, broad root system that more closely mirrors natural root systems.
4. Above-Ground System – Uses a double-container system where a production container nests in a double-walled (holder) container that insulates the plant's roots and buffers temperature extremes.
5. Pot-in-Pot – Uses a production container nested inside a holder or "socket" container, both of which are buried in the ground. Pot-in-pot production buffers root zone temperatures from extremes, reduces blow-over of large-canopy trees, provides insulation in cold climates, and reduces irrigation water amounts compared to conventional containers.

Potting Substrate

Container substrate, more commonly referred to as "potting substrate," has solid, gas, and liquid components, as depicted in the schematic in **Figure 1**. They usually are described in terms of physical characteristics such as bulk density, air space, and container moisture capacity. Because a potting substrate's physical characteristics dictate how much water and oxygen are available to roots, it has a major impact on plant growth. Knowing a potting substrate's physical characteristics is essential to achieve effective nutrient and irrigation management for all types of container production systems.

The term "bulk density" refers to the weight of potting substrate per unit volume of particles (g/cc). The gas component is referred to as air or pore space. Pore space exists between and within potting substrate particles; it is critical because pores hold oxygen, which is essential for good root growth. In general, a potting substrate with a relatively high proportion of micro-pores will have a high water-holding capacity due to the attraction of water to the small-pore-space walls.

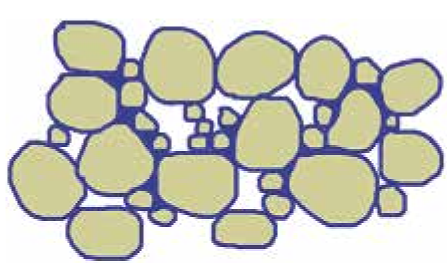


Figure 1

The liquid component often is referred to as "container capacity" or water holding capacity. Water holding capacity is the maximum volume of water that a potting substrate retains following irrigation and drainage due to gravity). Water holding capacity is expressed as the percent of water retained relative to the potting substrate volume (volume of water retained divided by potting substrate volume). The water-holding capacity of the potting substrate should be between 45 to 65 percent for outdoor production. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-1-Substrate-Water-Holding-Capacity.

Video 1: Substrate Water Holding Capacity

The physical properties of a potting substrate also are affected by amendment materials or components – pine bark, sand, and peat being most common. For example, amending pine bark with fine sand increases the amount of plant available water and bulk density, and decreases total air (pore) space. Adding peat moss to pine bark also increases the amount of plant available water. Ultimately, the water in a potting substrate must be balanced with pore space to prevent root rot; however, the potting substrate should retain enough water to minimize leaching yet promote plant vigor. This delicate equilibrium can vary with plant species. The plant available water in the potting substrate should be at least 25% of the container volume. To learn more about this, a short instructional video is avail-

Video 2: Plant Available Water

able at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-2-Plant-Available-Water.

Cation exchange capacity **(CEC)** indicates how well a potting substrate holds positively charged ions (cations) such as ammonium, potassium, calcium and magnesium. High CEC values help minimize leaching of nutrients with irrigation water, but the role of CEC is fairly minimal in soilless potting substrates. Nutrients applied as a single application of a soluble fertilizer leach rapidly from soilless potting substrates. Additionally, the pH of a soilless potting substrate may not influence nutrient availability to the degree that it does in native soils.

It is important to store potting substrate that contains fertilizer in a dedicated area with an impermeable base. If the storage area is not under a roof to protect it from rainfall, manage runoff by directing it to a stormwater treatment area.

Nutrient Management

Container-grown plants must be fertilized because very few nutrients are available from mineralization of the potting substrate materials. Fertilizer material may be in dry or liquid formulation, and is usually a complete fertilizer (N-P-K) that includes micronutrients. Fertilizer can be applied either by incorporating it into the potting substrate prior to potting, placing or "dibbling" it into the bottom of the planting hole, or "topdressing" (applying it to the surface).

Figure 2

Controlled-release fertilizer (CRF) products encase nutrient salts in resin or polymer coatings. The coatings respond to moisture and temperature to release nutrients at a particular rate. CRFs are available in several formulations to meet the nutrient requirements of different plants, and are also available with different coatings to provide nutrient-release rates of varying time frames. In container nurseries, CRFs generally provide more consistent nutrient availability to plants over time than traditional rapid-release granular fertilizers, which would need to be applied in small amounts numerous times per year to minimize leaching losses. Liquid or water-soluble fertilizer may be used, and is generally applied through the irrigation system (known as "fertigation").

Table 1. Leachate Nutritional Guidelines

Analysis	Liquid fertilizer only or liquid and CRF	CRF only
pH	5.0 to 6.0	5.0 to 6.0
Electrical Conductivity, dS/m (mmhos/cm)	0.8 to 1.5	0.5 to 1.0
Nitrate-N, NO3-N mg/L (ppm)	50 to 100	15 to 25
Phosphorous, P mg/L	10 to 15	5 to 10
Potassium, K mg/L	30 to 50	10 to 20
Calcium, Ca mg/L	20 to 40	20 to 40
Magnesium, Mg mg/L	15 to 20	15 to 20
Manganese, Mn mg/L	0.3	0.3
Iron, Fe mg/L	0.5	0.5
Zinc, Zn mg/L	0.2	0.2
Copper, Cu mg/L	0.02	0.02
Boron, B mg/L	0.05	0.05

Fertilizer Storage and Handling

Take care when storing fertilizer to prevent contamination of nearby ground and surface water, and store it in an area that is protected from rainfall. Storage of dry bulk materials on a concrete or asphalt pad may be acceptable if the pad is adequately protected from rainfall and from stormwater flowing across the pad. Load fertilizer away from wells or surface water bodies. Clean up spilled material immediately.

Container Substrate Sampling

Container substrate (potting substrate) sampling helps ensure that adequate nutrient levels are maintained throughout the plant's growing period. An easy method to use, developed at Virginia Polytechnic Institute and State University (Virginia Tech), is the "pour-through" method, which involves testing the leachate for nutrient levels. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-3-Substrate-Nutrition. Most fertilizers (except urea) are salts, and conduct electricity. Thus, the electrical conductivity (EC) of the leachate is indicative of the fertilizer level within the container.

Video 3: Substrate Nutrition

Figure 2 shows collecting a pour-through sample ready for testing. Remember to collect several samples to obtain an average nutrient level representative of the plants being grown. **Table 1** should be used for interpreting nutrient levels for most container-grown plants; however, plants with a low nutrient requirement may grow adequately with nutrient levels lower than those given in the table, while other plants will respond better to slightly higher nutrient levels.

Irrigation Management

Irrigation is mandatory for container production, and is usually a daily event during the growing season. Most growers use well or surface water as their supply. For surface water sources, it is suggested that 1 acre-inch, or 27,000 gallons of water, be maintained in storage for each acre of land under container production. While less than 1-inch per acre per day may be needed, the additional volume of water in storage will compensate for losses during periods of excessive heat and drought. When evaluating irrigation application efficiency, take into consideration the uniformity of application; the amount of water retained within the potting substrate following irrigation; and the amount of water that enters containers compared to that which exits the containers and/or falls between containers. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-4-Considerations-for-Efficient-Irrigation.

Video 4: Considerations for Efficient Irrigation

Irrigation may be applied overhead via sprinkler systems, micro-irrigation (drip or spray systems), or sub-irrigation or capillary systems.

- Overhead sprinkler systems are used widely on smaller containers, but applications by this method usually result in excessive water application. One strategy to minimize water losses is to use ***cyclic irrigation*** (multiple applications of small amounts), which is discussed in more detail below. For larger nurseries, another strategy may be to incorporate variable speed pump motors, which will save electricity and water by allowing individual zones to be irrigated without affecting pumping pressure.
- Compared to overhead irrigation, micro-irrigation of container plants can result in less water applied. Savings in equipment costs can be realized because micro-irrigation systems require smaller pumps and pipe sizes. However, micro-irrigation systems have higher initial and maintenance costs, and overhead irrigation may still be needed to relieve heat stress during high-temperature months.
- Several different sub-irrigation systems have been developed for nurseries. Some include capillary mat and flood systems, ebb-and-flow benches, and trays or benches with liners. All rely on the principle of capillary action to move water upwards through the container substrate. Sub-irrigation systems can conserve water and reduce nutrient loss, particularly when nutrients are supplied in irrigation water that is reused.

A central potting location is common for nurseries that produce container plants outdoors or under shade. At this location, containers are filled with potting substrate and plants transplanted after which they are transported to a watering station where plants are irrigated thoroughly. Irrigation water is applied rapidly with high-volume, shower-like nozzles that are elevated above the plants. Plants are passed through the water station several times. A large volume of water is applied to "settle" the potting substrate around roots and ensure that it achieves maximum water-holding capacity. Water not retained by the container becomes runoff in addition to the water that fell between containers.

Soluble nutrients from the potting substrate along with extraneous fertilizer granules can be readily transported in this runoff.

Irrigation Uniformity

It is critical to ensure all irrigation water is applied uniformly and in the correct amount to meet plant needs. Wind can reduce uniformity, so if wind frequently interferes with water distribution, consider creating a windbreak, as demonstrated in **Figure 3**. See references below or the video at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-5-Sprinkler-Irrigation-Uniformity for more information on performing an irrigation uniformity determination for overhead or sprinkler systems, or contact a Mobile Irrigation Lab (MIL). A list of MIL locations and technician contact information are on the FDACS BMP website.

Video 5: Sprinkler Irrigation Uniformity

Figure 3

Irrigation Application

The amount of irrigation water needed per application will depend on container size, plant size, potting substrate water content, plant spacing, weather conditions, and the ability of the plant's canopy to capture irrigation water that falls between containers. To learn more about this, short instructional videos are available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-6-Irrigation-Application-Considerations-for-Container-Grown-Plants and http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-7-Irrigation-Capture-Factor. Considering these application factors and adjusting the irrigation amount, growers can manage their water more efficiently. One way to determine if the correct amount of water was applied is by measuring the leaching fraction. A leaching fraction is the amount of water that drains from a container after irrigation divided by the total amount of water that entered the container during irrigation. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-8-Leaching-Fraction.

Video 6: Irrigation Application Considerations for Container-Grown Plants

Video 7: Irrigation Capture Factor

Video 8: Leaching Fraction

Most container nurseries irrigate daily (except when rain supplies adequate moisture), delivering the water in a single, continuous application. Water applied continuously to a container can move quickly through the potting substrate, leaching nutrients in the process. Very little lateral wetting occurs, while a large portion of the water and nutrients are lost through the bottom of the container. In contrast, during the first application of water in a three-application cyclic irrigation, the foliage canopy and the surface of the potting substrate are moistened but not saturated. Because only one-third of the total water is applied at a time, water moves laterally and slowly downward, into small pore spaces between particles, resulting in greater wetting and moisture retention than with one continuous irrigation application. The second and third irrigation cycles continue moistening the potting substrate throughout the container.

Cyclic irrigation also helps avoid exceeding the water-holding capacity of the potting substrate because smaller amounts are applied at timed intervals until the daily water allotment is reached. Compared to continuous irrigation events, cyclic irrigation has been shown to reduce the volume of irrigation runoff and the amount of nitrate leached from containers. Cyclic irrigation can be used with overhead and micro-irrigation, but automation usually is necessary.

Irrigation Water Recovery

An increasing number of container nurseries recycle water successfully, and its success is based on carefully monitoring water quality which can vary greatly. For example, storm runoff from roofs is generally of high quality and usually does not need disinfection, while water collected from nursery production areas is much poorer in quality because it often contains nutrients, floating potting substrate constituents, humic acid, agricultural chemicals, and possibly plant pathogens. To make it suitable for reuse, this water may have to be pretreated to remove contaminants such as litter and silt; disinfected to remove plant pathogens; or, it may have to be acidified to lower the pH to a more neutral level.

If you are considering incorporating a water recovery system into the nursery, be aware that daily fluctuations can occur in nutrient content of leachates, especially when fertigating. During a yearly production cycle, water quality should at least be monitored:

- Right after potting activities
- Once during the winter and summer periods
- Once during dry or wet periods

It is essential that you measure electrical conductivity (EC), pH and nitrate before reusing the recovered water on nursery production areas. The EC should be less than 1 dS/m. Other parameters such as sodium, chloride, bicarbonate alkalinity, boron, aluminum, iron and copper should also be monitored if they are suspected to be a problem. To reiterate, the water may need to be treated before using. Treatment procedures to consider include clarification, filtration and storage, salinity management, the use of disinfection chemicals, etc. For more information about water recovery and reuse guidelines, go to: http://www.ngia.com.au/Section?Action=View&Section_id=556.

Irrigation Water Quality

Irrigation water quality is a critical factor in the production of container-grown nursery plants. Poor-quality water applied with overhead sprinkler irrigation can damage foliage, change potting substrate pH, or create unsightly foliar residues or stains. Poor-quality water also can clog micro-irrigation emitters and cause non-uniform applications. Annual testing of the irrigation water source will help growers characterize their source water quality. If irrigation runoff and rainwater are collected and recycled, the water may need additional treatment to prevent plant disease, depending on nursery stock. See **Appendix 3** for a list of irrigation water quality guidelines.

Container Fruit Tree Producers

Container-grown grafted or budded trees are often produced in greenhouses. Nutrition and irrigation management practices are used that ensure successful propagation and growth of marketable trees. Citrus trees are mandated to be grown in closed greenhouses and the duration of production often exceeds many other greenhouse crops. In addition to the applicable BMPs in this chapter, nurseries propagating citrus follow the guidelines of the certification program administered by FDACS, Division of Plant Industry (DPI) pursuant to Rule Chapter 5B-62, F.A.C.; and must follow the procedures in the *Citrus Nursery Stock Certification Procedure Manual* (2014) as incorporated by reference in Rule 5B-62.004, F.A.C. and available at: http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Agriculture-Industry/Citrus-Industry/Citrus-Budwood-Program. Further, citrus nurseries must also participate in the Citrus Health Response Program that can be found at: http://www.freshfromflorida.com/content/download/24016/486837/chrp-compliance-2012-2013.pdf.

Container Nursery and Greenhouse Practices

Note: *Please remember to review chapters 2 through 6 and select the BMPs in those chapters that are applicable to your operation.*

1A.1 Nutrient Management for Container and Greenhouse Plants

✓ **1.** Store fertilizer or bulk quantities of potting substrate that contain nitrogen and phosphorus fertilizer in an area with a water impermeable barrier above and below. Load fertilizer away from wells or surface water bodies. Clean up spilled material immediately.

✓ **2.** Fertilize plants with controlled-release fertilizer (CRF) amendments in the potting substrate. Ensure that CRF rate of application and release characteristics match the plant's need.

✓ **3.** Fertilize sub-irrigated plants at less than the manufacturer's recommended fertilizer application rate (approximately one-half).

✓ **4.** Apply supplemental fertilizer only when potting substrate leachate electrical conductivity (EC) is below the levels listed in **Table 1**.

✓ **5.** Use windbreaks or other means (e.g. pot in pot) to minimize plant blowover when applicable.

✓ **6.** ✏ Use the table in **Appendix 6** to keep records of annual nutrient applications that contain N or P, and records of the leachate EC concentrations.

References:

1. North Carolina State University, Floriculture Research, 1,2,3s of Pour Thru, www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_PTS.htm

2. University of Massachusetts, Massachusetts Nursery Industry Best Management Practices Guide, http://extension.umass.edu/floriculture/fact-sheets/best-management-practices-bmps-nursery-crops

1A.2 Irrigation Management for Container and Greenhouse Plants

✓ **1.** Based on the stage of plant growth, space containers and flats as close as possible.

✓ **2.** Group plants of similar irrigation needs together.

✓ **3.** Irrigate based on determination of plant need (e.g. sensors, evapotranspiration (ET) based programs, container plant weight, potting substrate sample).

✓ **4.** Calculate the leachate fraction; if needed, adjust the irrigation system run time or amount of water applied so the leachate fraction does not exceed 15 percent.

✓ **5.** Use pulse or cyclic irrigation to decrease the amount of water applied.

✓ **6.** Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters. When using overhead fertigation, retain leachate and runoff using a retention basin or other effective means. Runoff water may be reused by constructing a water recovery system.

✓ **7.** Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health. See **Appendix 3**.

✓ **8.** ✏ Determine irrigation uniformity at least every three years for each type of irrigation system, and maintain these records. A Mobile Irrigation Lab can help with this determination. See www.floridaagwaterpolicy.com/MobileIrrigationLabs.html for a map of MIL service areas.

For outdoor production, implement the additional BMPs below:

✓ **9.** Ensure that the water-holding capacity of the potting substrate is at least 45 percent of its volume.

✓ **10.** Use micro-irrigation, or an equally efficient irrigation system, for containers 7 gallons and larger. This does not preclude the use of micro-irrigation on smaller containers.

✓ **11.** Water when temperatures and winds are at a level to minimize water loss, unless irrigating to relieve heat stress.

✓ **12.** Install and maintain automatic rain shutoff devices.

✓ **13.** If your container operation has a watering station used to irrigate plants immediately after potting, collect runoff in a small basin, direct the runoff to an existing basin, or route runoff through an onsite vegetative treatment area.

References:

1. Bilderback, T.E. and W.C. Fonteno. 1987. Effects of container geometry and media physical properties on air and water volumes in containers. J. Environ. Hort. 5(4): 180-182.

2. Fare, D.C., C.H. Gilliam, G.J. Keever, and J.W. Olive. 1994. Cyclic irrigation reduces container leachate nitrate-nitrogen concentration. HortScience 29(12): 1514-1517.

3. UF-IFAS, Field evaluation of container nursery irrigation systems: uniformity of water application in sprinkler systems, FS98-2, http://edis.ifas.ufl.edu/ae194

4. UF-IFAS, Measuring the irrigation requirements of container-grown nursery plants, ENH-1197, http://edis.ifas.ufl.edu/ep458

5. UF-IFAS, Nursery irrigation system checklist, ENH1208, http://edis.ifas.ufl.edu/ep469

6. Yeager, T.H. 2007. BMP Guide for Producing Nursery Crops, Southern Nursery Association.

7. NRCS, Irrigation System – Microirrigation, Code 441; Irrigation Water Management, Code 449; Irrigation Tailwater Recovery, Code 447; Structure for Water Control, Code 587. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

Note: *See **Appendix 6** for list of record-keeping requirements and example record-keeping forms.*

1B FIELD-GROWN PRODUCTION

Field-grown production involves cultivating shrubs, trees, or palms in native soils until the plant reaches maturity or market size.

Field-grown plants such as shrubs, trees, and palms grown in native soils represent a significant sector of the Florida nursery industry. According to a 2012 Florida Nursery, Growers and Landscape Association report, there were approximately 50,000 acres devoted to field-grown production. This sector of the industry is likely to expand as landscape consumers desire mature landscapes.

Field-grown producers encounter diverse climates and soils throughout the state. In addition, shallow ground water tables present production challenges, particularly in the southern regions. Producers respond by growing plants adapted to nursery site characteristics. While plant production practices vary to accommodate diverse production environments, growers strive to ensure these practices are environmentally sound. This section focuses on irrigation and nutrient management practices for field production, and must be used in conjunction with the applicable practices in chapters 2 through 6 of this manual.

Site Characteristics

Site characteristics can directly affect the type and quantity of inputs needed to produce healthy plants, and should be considered, whether selecting a new site or expanding an existing site. Soils with low water permeability, poor drainage or excessive water retention, and hardpans within the rooting depth should be avoided when possible. Residual nutrients in the soil and pests harbored in biological debris might inhibit plant growth. The types of plants (e.g., trees, palms, or shrubs) or species of plants to be grown should thrive in soils native to the locale and tolerate local temperature, wind, and moisture extremes.

Irrigation water source, quality, and quantity are also important considerations. Some plants will tolerate a water source of low quality due to ion or salt concentrations, but these constituents may clog pipes and micro-irrigation emitters. If micro-irrigation is used, the impact of slope on the irrigation system pressure should be factored into irrigation system design. Other topographic features such as natural lakes, rivers, and other surface waters may necessitate special consideration because they provide habitat for wildlife and watershed protection. Management decisions that consider site characteristics will optimize production efficiency and minimize the cost to implement BMPs.

Site Development and Layout

Topographic features of the land such as slope, water conveyance and surface water storage areas, protected areas, and vegetative buffers may affect the location, orientation, number of rows planted, and number of plants per acre. The number of plants per acre also is influenced by plant spacing, which is a reflection of market plant size, access to fields and plants, and equipment used for transporting or producing plants. Transportation needs, farm equipment size, and turning radii can dictate the width of field borders, the space between rows, or distance between plants within a row.

Efficient use of space while accommodating production operations that have minimal impact on native soils, natural features of the site, and surrounding areas is key to site development and layout. In some cases, regulations and codes govern site development and layout, and must become a part of the operation's prospectus regardless of efficiency.

Field Preparation

Field preparation is necessary whether planting a new field or one previously used for nursery plant production. Use cultivation and vegetation control practices that prevent loss of soil and maintain or improve soil quality. Clear the soil of debris, such as large roots, and remove stumps. Previously used fields may require the addition of fertile soil to compensate for soil removed when plants were harvested. Soil also can be lost due to wind and rain erosion. Whether a field is new or previously used, organic amendments (i.e., composted bark, crop residues, composted animal or municipal wastes, or decomposed wood from pruned plants) can improve soil water and nutrient-holding capacities and improve the soil's physical structure which is important when digging plants. Based on soil test results, soil amendments may be used on the entire field or only in areas where plants are located. After applying amendments, the field is tilled, contoured, or mounded to accommodate the production methods at the site. Exercise care so that soil preparation is not excessive and does not result in loss of soil due to wind or rain erosion, or in soil compaction that reduces aeration, microbial activity, and root and water penetration.

Nutrient Management

Soil Testing

Video 9: Soil Testing

Soil tests should be used to determine soil fertility status so that appropriate actions can be taken regarding fertilization. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-9-Soil-Testing. Soil test results provide critical information for correcting soil nutrient deficiencies or toxicities, adjusting pH, or altering the organic content of the soil. For example, soil tests might reveal that additional phosphorus is not needed or that potassium and magnesium are needed, for the production of palms. Soil testing also will determine the need for application of limestone to raise pH and provide calcium and magnesium. Soil testing should be conducted prior to planting and annually for fields already in production.

Fertilizer Application

Soil amendments should be broadcast-incorporated prior to planting, or directed applications used after planting. Not the entire acreage or soil surface in a field needs to be fertilized. Instead, fertilizer should be placed where the majority of plant roots are located. This is typically within an area where roots were pruned or within the drip line of the canopy. Fertilizer can be broadcast on the soil surface along the rows of plants or placed in bands or rings around each plant. Care should be taken not to apply fertilizer to areas susceptible to surface erosion.

The amount of fertilizer applied per application and the number of applications per year depend on plant size, species, number of plants per acre, projected market, soil tests, and soil characteristics. The total amount of fertilizer applied per year to plants grown on one acre of land commonly is referred to as the fertilizer application rate. Because nitrogen is the primary growth-limiting nutrient in most production systems, the fertilizer application rate often is given in terms of the amount of nitrogen applied rather than fertilizer applied. When recommended per-tree rates are available, the amount of nitrogen per acre per year to be applied can be calculated using the following formula:

(Rate) lb N per tree × (no.) applications/year × (no.) trees per acre = (Amount) lb N per acre

Granular fertilizers with N-P_2O_5-K_2O ratios of 3-0-2 or 3-0-3 should be applied to trees and shrubs 3 to 4 times per year, unless a soil test justifies the addition of phosphorus. Fertilizers should contain 20 to 30 percent long-term or controlled-release nitrogen (e.g. sulfur coated urea). For palms, fertilizers with N-P_2O_5-K_2O-Mg ratio of 4-1-6-2 are needed. The nitrogen, potassium, and magnesium should be supplied as long-term release components. Small amounts of fertilizer applied more frequently to the soil surface should be used to minimize significant quantities of fertilizer moving into surface water or leaching during storm events. Shallow incorporation of fertilizers into the soil can be used to minimize granule movement.

Fertilizer applied in the irrigation water (fertigation) in small, frequent amounts also may reduce the potential for surface movement or leaching of fertilizer. For example, if the crop needs 200 pounds of nitrogen per acre per year and 100 irrigation applications are used to supply the nitrogen, then each irrigation application would deliver 2 pounds of nitrogen to 500 plants per acre, or the equivalent of 0.004 pounds of nitrogen per plant per application. To learn more about fertilizer applications, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-10-Fertilizer-Application-Considerations.

Video 10: Fertilizer Application Considerations

Irrigation Management

Field grown plants usually are irrigated either through seepage or a micro-irrigation system (micro-sprays or emitters) connected to a water source via a network of pipes. Water from wells and municipal sources usually requires minimal filtration for micro-irrigation, while surface water from rivers, ponds, canals, or collection structures often requires extensive filtration to prevent clogging and reduced water flow of micro-irrigation emitters. Thus, the irrigation water source and system for application can affect field layout. For example, micro-irrigation pipes typically are laid the length of plant rows; however, long pipes result in reduced water pressure due to friction. Therefore, the field design must consider the irrigation water pressure needed throughout the field.

Micro-irrigation water is applied directly to the area where roots are located (root zone). The water application rate typically is 0.5 to 6.0 gallons in one hour. The rate of water application should not exceed the infiltration rate of the soil, so output from emitters and pump capacity must be sized appropriately. When irrigation rate exceeds the infiltration rate, water will move laterally across the soil surface, which may result in runoff. Water infiltration rates for soil textures are given in **Table 2**. The amount of irrigation water to apply depends on the ***evapotranspiration***, which is a function of plant size and weather. Plants with large canopies and open space between canopies will require more water than plants with small canopies and minimal space between canopies.

It is very important that irrigation water is applied uniformly. Producers can determine the micro-irrigation system distribution uniformity using the procedure given in University of Florida IFAS publication, http://edis.ifas.ufl.edu/ae193 or contact a MIL for an evaluation. A list of MILs is given on the FDACS website at: http://www.freshfromflorida.com/Business-Services/Water/Mobile-Irrigation-Labs. Representative areas of each irrigation system having different infrastructure components such as emitters, emitter spacing, pressures, rates of flow, pumps, etc., should be checked every 3 years, or more often if needed (e.g., if there is a change to the system). Acceptable uniformity values are given in the distribution uniformity publication. Irrigation systems should be repaired or modified as needed

Table 2. Water Infiltration Rates

Soil texture	Maximum Rate of Irrigation (Inches per Hour, Bare Soil)
Sand	0.75
Fine sand	0.60
Loamy sand	0.50
Loamy fine sand	0.45
Sandy loam	0.40
Loam	0.35
Silt loam	0.30
Clay loam	0.25
Silty clay	0.25
Clay	0.15

(Data extracted from Western Fertilizer Handbook Horticulture Edition, 1990, Interstate Publishers, Inc., Danville, IL.)

Figure 4

to achieve acceptable uniformity. To learn more about uniformity, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-11-Micro-irrigation-Uniformity.

Video 11: Micro-irrigation Uniformity

Ground Cover Management

Vegetation maintained between rows, in field borders, in grassed waterways, road banks, and other open areas stabilizes soil and minimizes soil erosion from wind and storm events. Perennial non-invasive plants are best for these areas. These plants should be easily maintained and form a dense mat when mowed. As water moves across this vegetation, velocity is slowed, enhancing the settling of particulates and associated contaminates. **Figure 4** shows vegetation between rows of plants which is used to reduce soil and nutrient loss from erosion. Aside from planted vegetated areas, swales, surface water detention and collection areas, natural riparian areas, and/or onsite wetlands may be used for additional water quality treatment before water is discharged from the property. To learn more about buffers, go to: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcs143_023568.

Organic mulches may be used in place of vegetation between plant rows. Mulch will stabilize the soil and minimize erosion, particularly if used for travel lanes. Mulch placed within rows also helps conserve soil moisture and can suppress weed growth and the need for mowing or herbicide applications.

Fields not in production should be planted with non-invasive species that will stabilize the soil and produce biomass that can be incorporated into the soil to enhance structure and improve nutrition for future crops. Leguminous cover crops should be considered for their capacity to increase soil nitrogen fertility. To learn more about ground cover management, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-12-Ground-Cover-Management.

Video 12: Ground Cover Management

Record Keeping

Record keeping is an important component and requirement of BMPs. Records provide a history that can be referred to in adjusting application rates and diagnosing problems associated with plant growth. To learn more about this, a short instructional video is available at: http://www.freshfromflorida.com/Media/Files/Agricultural-Water-Policy-Files/Best-Management-Practices/Nursery-Videos/Video-13-Fertilizer-Application-Record-Keeping.

Video 13: Fertilizer Application Record-Keeping

Appendix 6 provides a list of records that should be maintained, along with examples of record-keeping forms.

Field-Grown Nursery Practices

Note: *Please remember to review chapters 2 through 6 and select the BMPs in those chapters that are applicable to your operation.*

1B.1 Nutrient Management for Field-Grown Plants

✓ **1.** ✎ Conduct soil tests prior to planting, and annually thereafter. Base P fertilization rate on soil test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.

✓ **2.** When available, consult applicable UF-IFAS recommended fertilization rates or other research-based rates to help determine the appropriate amount of N to apply.

✓ **3.** Calibrate fertilizer application equipment regularly, and anytime when changing products.

✓ **4.** Place fertilizer material within the root zone/dripline (do not field broadcast).

✓ **5.** Do not apply fertilizer under situations with a high risk of fertilizer loss to the environment, such as before a forecasted rainfall or frost/freeze event.

✓ **6.** Protect stored fertilizer from wind and rainfall, to prevent accidental loss to the environment.

✓ **7.** ✎ Use the table in **Appendix 6** to keep records of annual nutrient applications that contain N or P.

1B.2 Irrigation Management for Field-Grown Plants

✓ **1.** Use plant size and other characteristics (e.g., deciduous versus non-deciduous) to determine the amount of water to apply.

✓ **2.** Use available tools and data to assist in making irrigation decisions. Tools may include tensiometers, water table observation wells, on-site soil moisture sensors, crop water use information, and weather data. Real-time weather data is available by visiting the FAWN website or by installing your own on-site weather station.

✓ **3.** Irrigate when evaporation is likely to be minimal.

✓ **4.** Ensure that irrigation application rate does not exceed the soil infiltration rate (See **Table 2** or by observation).

✓ **5.** ✎ Contact a MIL (if available) to perform an irrigation system distribution uniformity procedure and document the results. This should be performed every 3 years. Between MIL evaluations, inspect the system frequently and maintain it to ensure proper system operation and efficiency.

✓ **6.** Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health. See **Appendix 3**.

✓ **7.** Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters.

References:

1. Eakes, D.J., C.H. Gilliam, H.G. Ponder, C.E. Evans, and M.E. Marini. 1990. Effect of trickle irrigation, nitrogen rate, and method of application on field-grown 'Compacta' Japanese holly. J. Environ. Hort. 8(2): 68-70.

2. Rose, M.A. 1999. Nutrient use patterns in woody perennials: implications for increasing fertilizer efficiency in field-grown and landscape ornamentals. HortTechnology. 9(4): 613-617.

3. Struve, D.K. 2002. A review of shade tree nitrogen fertilization research in the United States. Abor. Urban Forestry. 28(6):252-263.

4. NRCS, Nutrient Management, Code 590; Irrigation Sprinkler System, Code 442; Irrigation System – Microirrigation, Code 441; Irrigation Water Management, Code 449; Irrigation Tailwater Recovery, Code 447. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

Note: *See **Appendix 6** for list of record-keeping requirements and example record-keeping forms.*

1C CUT FOLIAGE PRODUCTION

Cut foliage production involves cultivating ferns and other woody plants, such as Pittosporum, that are produced under shade and harvested for the cut foliage industry.

Most of the field-grown ferns produced in Florida are leatherleaf varieties, which is the cut foliage most used by florists worldwide. Leatherleaf fern is a shade-loving herbaceous perennial plant that is still grown predominantly in the Pierson and Barberville areas of Volusia County. Pittosporum foliage and other woody plants also are widely grown in these areas, and used by florists to complement floral arrangements. The industry produces all of its cut foliage under shade either from tree canopies or from polypropylene shade cloth. The production areas are comprised mostly of sandy soils. These soils generally are characterized by very rapid permeability, low water-holding capacity, and low nutrient-holding capacity. The practices in this section focus on enhanced nutrient and irrigation management.

Nutrient Management for Ferns

A primary nutrient that is often deficient and limits growth in leatherleaf ferns is N. Both N and K must be supplied through fertilization. The P in soils usually is sufficient for the commercial production of leatherleaf ferns. N must be managed very carefully because the nitrate (NO3-) ion and soil are both negatively charged, making nitrate very prone to leaching in sandy soils. P has low solubility at the ideal pH level recommended for leatherleaf ferns (5.5 to 6.5), making it much less prone to leaching.

Nutrient contributions from water, soil, and pesticides must be determined to aid in planning fertilizer inputs. Water and soil can be analyzed in a lab, and pesticide labels will list the amount of active ingredients – all may contain plant nutrients. Soil samples should be taken at the bottom of the effective root zone, which is four to six inches on average, and analyzed by a soil testing lab. Tissue analysis of the elemental composition of leatherleaf fern fronds can be used throughout the growing season to help determine the effects of nutrient management and aid in diagnosing problems. However, the lab's turnaround time for results may be problematic for fertilizer application scheduling, depending on the stage of fern growth. **Table 3** lists desirable nutrient concentration ranges for N, P, and K in mature leatherleaf fern fronds.

Table 3. Nutrient Levels in Fronds

Element	Frond Concentration Range (%)
N	2.0 – 3.0
P	0.22 – 0.40
K	2.3 – 3.4

Most fertilization of leatherleaf ferns occurs weekly through overhead fertigation. This allows small amounts of fertilizer to be applied at frequent intervals. However, some of the fertilizer applied through this method may end up outside the root zone (e.g., in aisles and roadways), so emitters should be adjusted to minimize this potential. Fertilizers, whether liquid or dry, should not be administered in a single large application as this can result in nutrient leaching and contribute to ground water contamination. Fertilizer applications in smaller, more frequent amounts or use of a controlled-release fertilizer (CRF) will reduce the potential for leaching.

Fern growers that have a mature stand with a solid root mass that extends approximately four inches below the soil surface should fertigate weekly, at a rate of no more than 300 lbs N/acre/year. The exact rate will depend upon the age of the fernery and the amount of disease pressure from Anthracnose and/or nematodes. Fern growers that recently have rejuvenated their beds, which largely will be devoid of rhizomes and root mass, also should fertigate weekly, but use a significantly lower amount of N until they can demonstrate that the beds have a uniform solid root mass.

Nutrient Management for Woody Ornamentals

For cut foliage, yields typically are higher with 47 to 55 percent shade than under lower or higher shade levels. In general, the same fertilization principles apply to woody plants as to ferns. Growers that have a mature woody ornamental crop should fertilize weekly at a rate of no more than 325 lbs N/acre/year, with 25 percent of that amount in the form of a CRF. **Appendix 4** is a good resource to acquaint growers with the formulations and release characteristics of CRF.

Irrigation Management for Cut Foliage

All commercial cut foliage production occurs under shade. This results in reduced solar radiation and wind speeds; therefore, the supplemental irrigation water used to produce a crop averages about 20 inches annually. Almost all commercial cut foliage operations have permanent solid-set sprinkler irrigation systems used both for irrigation and freeze protection.

It is very important to provide adequate drying time when applying either fertilizer and/or pesticides through the irrigation system. Reapplying water too frequently likely will leach fertilizer material beyond the root zone, or will wash off pesticide residue from leaves, rendering the applications ineffective.

The water-holding capacity of the soil is the basis for irrigation scheduling. For information on irrigation scheduling, including doing a soil water budget, consult UF-IFAS Publication, *Irrigation and Nutrient Management Practices for Commercial Leatherleaf Fern Production in Florida (Second Edition)* at: http://edis.ifas.ufl.edu/pdffiles/EP/EP02700.pdf.

Cut Foliage Production BMPs

Note: *Please remember to review chapters 2 through 6 and select the BMPs in those chapters that are applicable to your operation.*

1C.1 Nutrient Management for Cut Foliage Production

✓ **1.** Apply fertilizer in small amounts on a frequent basis (e.g., weekly if fertigating), or use CRF products. If using CRFs, select products that will release nutrients at the appropriate rate for the plant.

✓ **2.** For mature ferneries with a solid root mass, apply N fertilizer at a rate of no more than 300 lbs N/acre/year. If applying more than 225 lbs N/acre/year, tissue test for leaf N content at least annually.

✓ **3.** On rejuvenated fields, use a rate of no more than 80 lbs N/acre/year for the first 6 months.

✓ **4.** For mature woody plants, apply N fertilizer at a rate of no more than 325 lbs N/acre/year, with at least 25 percent of that in the form of a CRF.

✓ **5.** To minimize nitrate leaching, maintain an average 25 foot buffer consisting of trees or deeply-rooted grasses around the outside edges of all non-contiguous production areas.

✓ **6.** Base P fertilization rate on soil and/or leaf tissue test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing

Laboratory. Keep a copy of all laboratory test results to track changes over time.

✓ **7.** Maintain soil pH between 5.5 and 6.5, so that any residual soil P will have a low solubility.

✓ **8.** Do not apply fertilizer under high-risk situations, such as before a forecasted rainfall or frost/freeze event.

✓ **9.** Protect stored fertilizer from wind and rainfall.

✓ **10.** ✎ Use the table in **Appendix 6** to keep records of annual nutrient applications that contain N or P.

References:

1. UF-IFAS, Irrigation and Nutrient Management Practices for Commercial Leatherleaf Fern Production in Florida, UF-IFAS Bulletin 300, http://edis.ifas.ufl.edu/EP027

1C.2 Irrigation Management for Cut Foliage Production

✓ **1.** Use available tools and data to assist in making irrigation decisions. Tools may include tensiometers, water table observation wells, on-site soil moisture sensors, crop water use information, and weather data. Real-time weather data is available by visiting the FAWN website; or by installing your own on-site weather station.

✓ **2.** ✎ Document the irrigation system's water application rate in inches per hour and adjust the amount as needed, to ensure you are not over-irrigating.

✓ **3.** Apply irrigation during the night, or early in the morning when dew is present, to reduce disease and evaporative losses. This does not apply during times when pesticides are used in the irrigation system.

✓ **4.** Develop an irrigation schedule that allows adequate drying time for past liquid fertilizer and pesticide applications.

✓ **5.** When using irrigation for frost/freeze protection, monitor wet-bulb temperatures, and shut off the irrigation system as soon as the risk of evaporative cooling has ended. You can find wet-bulb temperatures at http://fawn.ifas.ufl.edu/tools/irrigation_cutoff/. You can use a psychrometer to get site-specific wet and dry bulb temperatures.

✓ **6.** Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters.

✓ **7.** ✎ Inspect the system frequently and maintain it to ensure proper system operation and efficiency. Keep records on inspection and maintenance of irrigation system components. Compare records over time for changes that might indicate problems with the system.

References:

1. UF-IFAS, Irrigation and Nutrient Management Practices for Commercial Leatherleaf Fern Production in Florida, UF-IFAS Bulletin 300, http://edis.ifas.ufl.edu/EP027

2. NRCS, Irrigation System – Microirrigation, Code 441; Irrigation Water Management, Code 449. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

Note: *See* ***Appendix 6*** *for list of record-keeping requirements and example record-keeping forms.*

2.0 WATER RESOURCES PROTECTION

Water resources are distinct hydrologic features, including wetlands, springs, lakes, streams, and aquifers.

Wetlands, Springs, and Streams Protection

Under Florida Law, wetlands are areas inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

Chapter 62-340, Florida Administrative Code, entitled *Delineation of the Landward Extent of Wetlands and Surface Waters*, contains the methodology that must be used by all state and local governments in Florida to determine the boundary between wetlands and uplands and other surface waters. The National Food Security Act manual is used by NRCS to determine wetlands boundaries on agricultural lands. In most cases, both methodologies produce the same or nearly the same determinations.

Springs are defined by the Florida Geological Survey as a point where underground water emerges to the earth's surface. They flow naturally from underlying aquifers and are classified based on their magnitude, or amount of flow coming from the spring vent. Springs and spring runs attract wildlife, provide over-wintering habitat for endangered manatees, contain unique biological communities, and are important archeological sites.

The area within ground water and surface water basins that contributes to the flow of the spring is a spring's recharge basin, also called "springshed," as depicted in **Figure 5**. This area may extend for miles from the spring, and the size of the area may fluctuate as a result of underground water levels. First magnitude springs discharge 64.6 million gallons per day (MGD) or more; second magnitude springs

Figure 5

discharge between 6.46 to 64.6 MGD. FDEP has initiated an effort to delineate springsheds in the state, on a prioritized basis.

Wetlands and springs are important components of Florida's water resources. Wetlands often serve as spawning areas and nurseries for many species of fish and wildlife, perform important flood-storage roles, cycle nutrients in runoff water, contribute moisture to the hydrologic cycle, and add plant and animal diversity. They can also provide limited grazing opportunities. Both wetlands and springs offer valuable recreational opportunities for the public and can provide an economic benefit to the surrounding communities.

Rivers and streams are naturally flowing watercourses. There are approximately 51,000 miles of rivers and streams in Florida. They are generally classified as sand-bottom, calcareous, swamp and bog, alluvial, or spring-fed systems. There are three measurable components that contribute to stream flow: base flow, interflow, and surface runoff. Surface runoff is most affected by rainfall (stormwater runoff), and contributes most to peak flow. Rivers and streams can readily transport pollutants received in stormwater runoff to wetlands, lakes, estuaries, and other water bodies. Consequently, it is important to minimize pollutant discharges to rivers and streams.

Conservation Buffers

Conservation buffers are permanently vegetated, non-cultivated areas that function to retain water and soil onsite to help reduce pollutants in surface water runoff. They include nursery production area borders, filter strips, grassed waterways, and ***riparian*** buffers, and are particularly effective in providing water quality treatment near sensitive discharge areas.

- *Borders* are strips of permanent vegetation, either natural or planted, at the edge or perimeter of nursery production areas. They function primarily to help reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Consider installing borders in nurseries, based on adjacent land uses and their environmental sensitivity.
- *Filter strips and grassed waterways* are areas of permanent vegetation between production areas that drain to natural waterbodies. Their main purpose is to decrease the velocity of runoff water and remove sediment particles before they reach surface waters.
- *Riparian buffers* can be forested or herbaceous areas located adjacent to streams, which help reduce amounts of sediment, organic material, nutrients, and pesticides in surface water sheetflow. Riparian buffers are most effective on highly sloped lands when next to perennial or intermittent streams with high ground water recharge potential.

Consider using native vegetation to establish conservation buffers. Conservation buffers should be inspected periodically, and restored as needed to maintain their intended purpose. Any use of fertilizers, pesticides, or other chemicals should be done so as to not compromise the intended purpose of the buffer. As necessary, use prescribed burns in accordance with Florida Forest Service guidelines, to maintain the native vegetation and discourage the establishment of nuisance vegetation.

Aquifer Protection

With the majority of Florida's water supply originating from underground sources (***aquifers***), it is extremely important for agricultural operations to protect wellheads from contamination. Successful wellhead protection includes complying with regulatory requirements and using common-sense measures with regard to well placement and agricultural practices near wells. For existing wells, the focus should be on management activities near the wellhead, aimed at reducing the potential for contamination. For new-well construction, the initial focus should be on well location and following sound well-construction practices, followed by proper maintenance.

Water Resources Protection BMPs

2.1 Wetlands Protection

Do not dredge or fill in wetlands. Consult with the WMD and the NRCS prior to conducting activities in or near wetlands to ensure that you are complying with any permitting or NRCS program eligibility requirements.

Minimize adverse water quality impacts to receiving wetlands by progressively applying measures until the problem is adequately addressed. Practices such as filter strips, conservation buffers, swales, or holding water on-site may preclude the need for more aggressive treatment measures.

Note: *Use an NRCS county soil survey map to help identify the location of wetlands, hydric soils, or* *frequently flooded areas. If you do not have an ERP (which provides a wetlands delineation), seek technical assistance from the WMD or NRCS to determine the landward boundary of wetlands on your operation.*

✓ **1.** Install and/or maintain a minimum 25-foot, non-fertilized ***vegetated buffer*** upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD permit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For lakes that have an adopted TMDL for nutrients, expand the buffer to 50-feet.

✓ **2.** For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts *(Use the comments section at the end of the BMP checklist)*.

When applying fertilizer near a wetlands buffer, ensure that the fertilizer does not land inside the buffer.

References:

1. NRCS, Wetland Enhancement, Code 659, Nutrient Management, Code 590, FOTG-Section IV. www.nrcs.usda.gov/technical/efotg
2. EPA, National Management Measures for the Control of Nonpoint Pollution from Agriculture. http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm

2.2 *Streams Protection*

✓ **1.** Install and/or maintain a riparian buffer along ***perennial streams*** on production areas that exceed 1-percent slope and discharge directly to the streams. Contact FDACS, NRCS, or an NRCS-approved Technical Service Provider for assistance in properly designing the riparian buffer.

✓ **2.** Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function and to maintain natural flows.

References:

1. NRCS Field Border, Code 386, Riparian Herbaceous Cover, Code 390, Riparian Forest Buffer, Code 391, Filter Strip, Code 393, Grassed Waterway, Code 412, and Stream Crossing, Code 578. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

2.3 *Protection for First- and Second-Magnitude Spring Recharge Basins*

✓ **1.** Install and/or maintain a 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.

✓ **2.** Install and/or maintain a 50-foot non-fertilized vegetated buffer around sinkholes.

✓ **3.** If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other materials.

References:

1. Protecting Florida's Springs, Land Use Planning Strategies and Best Management Practices, 2002. Florida Departments of Community Affairs and Environmental Protection, and 1000 Friends of Florida. www.dep.state.fl.us/springs/reports/files/springsmanual_2002.pdf.

2.4 *Well Operation and Protection*

When installing a new well, contact your WMD to see whether the well requires a consumptive use/water use permit. Potable water wells as defined by Chapter 62-521, F.A.C, must follow the requirements of that rule.

Locate new wells up-gradient as far as possible from likely pollutant sources, such as petroleum storage tanks, septic tanks, chemical mixing areas, or fertilizer storage facilities. Use a licensed Florida water well contractor, and drill new wells according to local government code and WMD well-construction permit requirements.

✓ **1.** Use backflow-prevention devices at the wellhead to prevent contamination of the water source, if injecting fertilizer or chemicals.

✓ **2.** Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.

✓ **3.** Maintain records of new well construction and modifications to existing wells.

References:

1. NRCS Water Well, Code 642; Well Decommissioning, Code 351; Well Plugging, Code 755. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg
2. FDEP, Water Well Permitting and Construction Requirements Rule, Chapter 62-532, F.A.C. http://www.dep.state.fl.us/legal/Rules/rulelist.htm
3. Florida Water Permits. http://flwaterpermits.com/

Note: *See* ***Appendix 6*** *for list of record-keeping requirements and example record-keeping forms.*

3.0 STORMWATER MANAGEMENT

Stormwater management is the on-site management of rainfall and associated runoff through the use of nonstructural and structural BMPs to provide flood protection and water quality protection.

Alteration of the land (e.g., construction of impervious surfaces such as roads, driveways, parking lots, large numbers of greenhouses, and other agricultural structures) usually increases the potential for stormwater runoff. Lack of appropriate stormwater management can lead to on-site and off-site flooding, increased pollutant loading to surface and ground waters, and erosion and sedimentation.

Construction of complex stormwater management systems with drainage pumps and outfall structures may alter on-site hydrology, and therefore may require an ERP or other WMD surface water management permit. Check with your WMD before beginning construction of any stormwater management system.

There may be individual circumstances that create the need for specific stormwater management practices. Some operations may already have an ERP or other WMD surface water management permit that contains on-site stormwater management requirements. However, if stormwater problems exist that are not addressed by a WMD permit, it is important to develop and implement a stormwater management plan suited to the operation's unique circumstances.

Stormwater BMPs

3.1 Stormwater Conveyance Systems

✓ **1.** Install gutters and downspouts on all buildings adjacent to nursery production areas, and divert stormwater away from the production area toward vegetated areas. When not in conflict with the health of the plant, the practice of rainfall harvesting from all roof areas (including greenhouses) to meet irrigation demand is encouraged.

✓ **2.** Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure that they operate as designed.

✓ **3.** If you have an existing operation that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment. Evaluate the plan's effectiveness, and make adjustments as needed.

✓ **4.** If the total impervious area of your nursery operation (e.g., asphalt or concrete roads/parking lots, roofs, greenhouses) exceeds 10 percent, have a site-specific evaluation performed to determine whether off-site stormwater runoff is an issue. USDA-NRCS may be able to perform this at no cost.

In developing a stormwater management plan:

- Contact your local NRCS District Conservationist to obtain information about the soil types for the proposed or existing farm location. The District Conservationist can identify soil types that are historically prone to flooding or standing water. Evaluate the storage capacity, size, and elevations of existing ditches, ponds, creeks, rivers, and wetlands, and the size, layout, and elevations of the fields. You should also contact your county or water management district to obtain maps (FEMA, FIRM) or other information related to flooding issues at the proposed or existing location. You can access this information via the web at: https://www.fema.gov/flood-insurance-rate-map-firm.
- Consult with a public or private agricultural engineer to discuss your stormwater management needs and considerations, especially if you are on poorly drained lands. Find an engineer qualified to provide an appropriate stormwater runoff analysis for your site.
- Determine the maximum storm size for which you want to provide flood protection. The flood control design storm addressed by WMD ERP regulations varies from a 25-year, 24-hour storm to a 100-year, 3-day storm. For example, a 25-year, 24-hour storm produces from 8 to 10 inches of rainfall in a 24-hour period. Generally, the larger the design storm event used, the more extensive the stormwater management system needs to be. Factors that will affect this decision include land availability, the existence of internal natural features such as creeks, rivers, ponds, or wetlands, the potential to flood downstream property owners, and costs.
- Include both nonstructural pollution prevention BMPs and structural BMPs, as needed.

References:

1. USDA-NRCS, Runoff Management System Code 570, FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

2. Water Management Districts, ERP Stormwater Quality Applicant's Handbook.

3. ANSI/ASAE, Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas, EP302.4. http://www.asabe.org/standards/

4.0 SEDIMENT AND EROSION CONTROL MEASURES

Sediment and erosion control measures are permanent or temporary practices to prevent sediment loss, slow water flow, and/or trap or collect debris and sediments in runoff.

Sediments or suspended solids are recognized forms of water pollution and often result in the loss of ditch or canal capacity. Unlike many chemical pollutants, sediment is a natural component of water bodies and the resources they support. However, excessive amounts of suspended solids or sediments are often a product of erosion from un-stabilized or disturbed land areas. These solids originate from three primary sources:

- Soil particles eroded into or from ditches
- Plant material washed into ditches
- Plant and biological material growing within the ditches and canals

Excessive sediments deposited on stream bottoms and suspended in the water column can affect fish spawning and impair fish food sources, reduce habitat complexity, potentially harm public water supply sources, and reduce water clarity. Reduction in water clarity can affect aquatic resources, such as sea grasses and oysters, in the receiving estuary.

Erosion control begins with limiting the loss of soil by minimizing the amount of land that is cleared of vegetation. Removal of natural vegetation and topsoil increases the potential for soil erosion, which can change runoff characteristics and result in loss of soil and increased turbidity and sedimentation in surface waters. When clearing vegetation to develop production areas, re-vegetation should occur as quickly as possible. All land-clearing activities should be planned and conducted when soil moisture and wind conditions are appropriate to prevent transport of sediment by air or water.

In addition to potential downstream water quality impacts, the build-up of silts and sediments in ditches and canals can affect the operation negatively. This reduction in cross-sectional area results in higher water velocities, as compared to a clean ditch or canal, and may induce greater amounts of erosion of fine and coarse particles from ditch and canal banks. The presence of shoals and sandbars are good indicators of soil losses. Field erosion also results in site degradation, with increased costs for ditch cleaning and reshaping of beds and furrows.

Minimizing downstream transport of sediments from nurseries and canal/ditch banks requires an integrated approach of managing erosion in production areas and in ditch and canal systems.

Efforts should focus on keeping soils in the production areas and stabilizing canal and ditch banks. Therefore, the BMPs that follow have been designed with these principles in mind.

Sediment and Erosion Control BMPs

4.1 Production Area Buffers and Groundcovers

Buffers/groundcovers can be used on sloped areas where mowing is not feasible, or in shaded areas where grass establishment is difficult.

✓ **1.** Use vegetated buffers or filter strips for erosion control when observable points of discharge exist. These are strips or areas of vegetation that control runoff by slowing its velocity, thus increasing retention and percolation opportunities. Select non-invasive plants or a seeding mixture to provide vegetative cover. Apply mulch on steep areas to provide temporary erosion control until plants establish.

✓ **2.** Utilize a synthetic (geotextile) groundcover material to stabilize disturbed areas and prevent erosion in areas where vegetative cover is not an option.

✓ **3.** In areas with a large amount of traffic, use appropriate aggregate such as rock and gravel for stabilization.

4.2 Erosion Control for Roads, Ditches and Canals

✓ **1.** Repair and maintain access roads on a regular basis; use practices such as crowning and turnouts to control runoff.

✓ **2.** Slope ditch bank berms to divert surface water away from drainage ditches and canals. This is especially important when there is an access road adjacent to the water feature.

✓ **3.** Establish and maintain perennial vegetation on all ditch and canal banks.

✓ **4.** In areas subject to high water velocities, protect ditch and canal banks from erosion using rip-rap, concrete, headwalls, or other materials that buffer against turbulence.

✓ **5.** Maintain ditch and canal drainage function by removing unconsolidated sediments in order to retain the original design cross-sectional area. Use slotted or cross-drilled buckets, avoid disrupting ditch side slopes, and deposit vegetation and other material in an appropriate upland location.

✓ **6.** Use drain pipe or flexible pipe to connect all water furrows to lateral ditches. Extend the pipe on the downstream side far enough away from the ditch bank to prevent bank scouring.

✓ **7.** Create and maintain sumps upstream of pump intakes (e.g. lift pumps) within collector ditches.

4.3 Erosion Control Specific to Field-Grown Nurseries

✓ **1.** Plant cover crops in all fields not in production.

✓ **2.** Ensure that plant row orientation is compatible with topographic features of the site.

✓ **3.** Manage vegetation between rows to prevent soil erosion.

References:

1. NRCS, Access Road, Code 560; Runoff Management System, Code 570; Irrigation Field Ditch, Code 388; Surface Drainage Field Ditch, Code 607; Sediment Basin, Code 350; Drainage Water Management, Code 554; Conservation Cover, Code 327; Heavy Use Protection, Code 561; Structure for Water Control, Code 587. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

2. The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, FDEP. www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

3. National Management Measures for the Control of Nonpoint Pollution from Agriculture, Chapter 4C, EPA Document No. 841B03004. http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm

5.0 DEBRIS MANAGEMENT

Debris management involves minimizing the generation of wastes and properly managing discarded plant material and potting substrate to protect water resources.

It is important to dispose properly of discarded plant material and other wastes. Careless or illegal dumping or disposal may spread non-native nursery plants to natural areas. Depending on the situation and local ordinances, several options are available to dispose of plant material. Materials can be burned, composted, and/or staged in disposal areas pending shipment offsite.

Figure 6

Onsite Composting

Natural nursery waste products, or debris, which can include old potting substrate and/or discarded plants, can be a source of pollution that is not readily recognized by nursery personnel. On-site composting, as shown in **Figure 6**, is a practical way to deal with this product to minimize the generation of routine nursery wastes that might otherwise be destined for a permitted landfill. Composting also helps prevent unintended water quality impacts from unmanaged debris areas. However, using compost material at a volume in excess of 25% may result in plant toxicity issues.

By following the basic steps outlined below, nurseries can create a beneficial product that can be reused onsite, or possibly sold to others in the trade:

- Separate woody and herbaceous plant material before composting. Chip woody wastes, if needed.
- Use a compost storage/processing area that is not prone to leaching (i.e. impermeable or concrete base).
- Place larger-sized debris underneath smaller debris when composting dead nursery plants.

The finished compost product can be used onsite. It can be used to fill in holes after digging trees, for landscape use, or to augment potting substrate. Before using compost-amended product, test its electrical conductivity to ensure it is less than 0.5 mmhos/cm.

For more detailed guidelines on composting, go to: http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/1330/Field_Guide_to_Compost_Use.pdf.

Container Reuse

An on-site cleaning center allows for the reuse of nursery containers. It reduces container costs and container waste, and can save on labor costs. It also reduces weed seeds and other disease organisms. To prevent the spread of soil-borne diseases, it is critical to ensure proper cleaning of all containers. Before re-using containers, soak them in water that is 180° F or greater for at least 30 minutes, or treat them with aerated steam at 140° F for at least 30 minutes. While the upfront capital investment can be somewhat high, the payback can be relatively quick (within one year), depending upon the operation's container turnover rate.

Another practical option for reusing existing containers is to use them on fast-turn woody crops that take 3 to 6 months to produce. This should help reduce the disease incidence as well.

Miscellaneous Wastes

As practicable, all standard materials (cardboard, metal and most plastics) should be recycled. For containerized chemicals, use the first-in, first-out principle to ensure all products are used well within their respective shelf-life.

Debris Management BMPs

5.1 Debris Management

✓ **1.** Dispose of pathogen-laced potting substrate or diseased plants in an appropriate solid waste facility, or burn them after obtaining all applicable burn permits.

✓ **2.** Compost vegetative debris, or properly dispose of the material.

✓ **3.** If composting, establish a nursery composting area that is at least 100 feet away from wetlands, delineated floodplains, and other water bodies.

✓ **4.** Properly reuse, recycle, or dispose of used polyfilm, containers, and other plastic-based products.

References:

1. US Composting Council, Field Guide to Compost Use. http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/1330/Field_Guide_to_Compost_Use.pdf

2. FDEP/FDACS, Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance. http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/agbmp3p.pdf

3. Oregon Association of Nurseries, Best Management Practices for Climate Friendly Nurseries. www.climatefriendlynurseries.org/resources/best_management_practices_for_climate_friendly_nurseries.pdf

6.0 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) combines the monitoring of pest and environmental conditions with the judicious use of cultural, biological, physical, and chemical controls to manage pest problems.

Under Florida law (s. 482.021, F.S.), IPM is defined as: …*"the selection, integration, and implementation of multiple pest control techniques based on predictable economic, ecological, and sociological consequences, making maximum use of naturally occurring pest controls, such as weather, disease agents, and parasitoids, using various biological, physical, chemical, and habitat modification methods of control, and using artificial controls only as required to keep particular pests from surpassing intolerable population levels predetermined from an accurate assessment of the pest damage potential and the ecological, sociological, and economic cost of other control measures."*

The basic steps of an IPM program are as follows:

- Identify key pests (scouting).
- Determine the pest's life cycle and which stage of the life cycle to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Decide which pest management practices are appropriate, and implement associated corrective actions. Use cultural, biological, and physical methods to prevent problems from occurring (for example, prepare the site and select resistant plant cultivars), and/or reduce pest habitat (for example, practice good sanitation). Consider all of the cultural, biological, and physical control measures available and appropriate before moving to a chemical control method for preventing and controlling pest infestations.
- Direct the control where the pest lives or feeds. Use properly timed preventive chemical applications only when your experience indicates that they are likely to control the target pest effectively, while minimizing the economic and environmental costs.

Scouting

Scouting is the most important element of a successful IPM program. It involves monitoring pest presence and development throughout the growing season. By observing plant conditions regularly and noting which pests are present, an informed decision can be made regarding severity of nursery plant damage and what pest control method is necessary. It is essential to record the results of scouting to develop historical information, document patterns of pest activity, and document the treatment's success or failure.

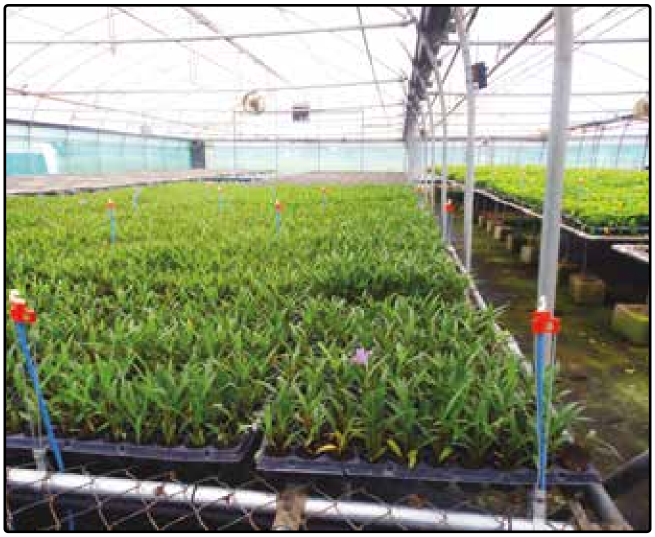


Figure 7

Cultural Controls

Most cultural control methods are designed to help plants avoid contact with pests, create unfavorable conditions for pests, and eradicate or reduce the incidence of pests in a nursery. Site selection, choosing disease-free nursery stock, plant selection and establishment, and production techniques are key cultural control practices. Site selection should take the soil type(s) and site elevation into consideration to avoid prolonged surface flooding, which can encourage fungal growth. Growers should practice strict sanitation, and planting stock should be disease-free. Planting schemes should promote good air circulation, which reduces the incidence of disease. It is important to keep the air inside greenhouses moving with ventilation and circulation fans as noted in **Figure 7**. This also prohibits air stagnation.

Biological Controls

Biological controls (and some cultural controls) improve plant resistance to pests, or utilize organisms that prey upon pests. Biological controls involve the use of natural enemies to control, suppress, or the active manipulation of antagonistic organisms to reduce pest population densities to acceptable levels. Natural enemies help to reduce the amount of pesticides needed to control pests, thus protecting water quality and reducing production costs. Biological control techniques should be tailored to the pest's life cycle, availability of effective predators and parasites, environmental conditions, and historical data.

Physical Controls

Physical methods generally are used to deter, trap, destroy, or provide barriers to pests. The EPA regulates various mechanical devices and allows their use to minimize or prevent negative impacts from nuisance pests. EPA refers to these as "pest control devices." A product is a pest control device if it uses only physical or mechanical means to trap, destroy, repel, or mitigate any pest and does not include any pesticidal substance or mixture of substances.

Pest control devices alone are not required to be registered with EPA. However, if a device and a pesticide product are packaged together, the combined product is a pesticide product subject to registration requirements. For more information, refer to: www.epa.gov/pesticides/factsheets/devices.htm.

Chemical Controls

Chemical methods involve the use of chemical pesticides or other repellants. The EPA and FDACS regulate the use of pesticides in Florida. The term pesticide is defined by EPA as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Chemical control involves the use of pesticides, as necessary. Factors that influence the selection of chemical controls in Florida include:

1. The product's registration status within Florida.
2. The effectiveness of the product against the target pest.
3. The potential risk of a particular pesticide to beneficial organisms (e.g., honey bees).
4. The product's cost effectiveness.
5. The potential hazards to applicators, bystanders (e.g., residents, nearby businesses) and the environment (i.e., non-target organisms, water quality).

Choosing the proper pesticide requires familiarity with product labels and performance. **Always follow the label directions.** The label is the single most important document in determining the correct use of a pesticide. State and federal pesticide laws require strict adherence to label directions.

Restricted Use Pesticides

Certain pesticides are classified as Restricted Use Pesticides (RUPs). Florida Pesticide Law (Chapter 487, F.S.) requires licensed applicators to keep records of all RUP use. Pursuant to Rule 5E-9.032, F.A.C., information on RUPs must be recorded within two working days of the application and maintained for two years from the application date.

There are many other important issues involving pesticide use that affect storage, calibration, mixing and loading, and spill management decisions. For additional information, contact your County Extension Agent or the Division of Agricultural Environmental Services of the Florida Department of Agriculture and Consumer Services at www.flaes.org.

Record Keeping

Proper records of all pesticide applications must be kept according to state and federal requirements. These records help to establish proof of proper use, facilitate the comparison of results of different applications, or find the cause of an error. Sample record keeping forms can be found at the FDACS Bureau of Compliance Monitoring at: www.flaes.org/complimonitoring/databasesearch/pesticidecertlicensingformsanddocuments.html.

There are many other important issues involving pesticide use that affect storage, calibration, mixing and loading, and spill management decisions. For additional information, refer to *Best Management Practices for Agrichemicals and Farm Equipment Maintenance* at: http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/agbmp3p.pdf.

Pest Management BMPs

Practice IPM and use all pesticides in accordance with the label. Rinse, recycle, or dispose of empty pesticide containers following federal, state, and local regulations. When applying a pesticide close to a stream, canal, pond, or other waterbody, choose a pesticide with an active ingredient that has a lower toxicity to aquatic organisms.

6.1 Pesticide Storage and Mixing

✓ **1.** Store pesticides in an enclosed, roofed structure with an impervious floor and lockable door, at least 100 feet from wetlands or other waterbodies.

✓ **2.** When practicable, construct a permanent mix/load facility with an impermeable surface, and locate it at least 100 feet from wells, wetlands and/or waterbodies.

✓ **3.** Where permanent facilities are not practicable, use portable mix/load stations or conduct any field mix/load activities at random locations in the field, with the aid of nurse tanks if applicable.

✓ **4.** Use a check valve or air gap separation to prevent backflow into the tank or water source when filling a sprayer.

References:

1. FDEP/FDACS, Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance. http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/agbmp3p.pdf
2. UF-IFAS, Integrated Pest Management Program. http://ipm.ifas.ufl.edu/
3. Southern Region Integrated Pest Management Center. www.sripmc.org/
4. UF-IFAS, Protecting Water Resources from Agricultural Pesticides, CIR PI-1. http://edis.ifas.ufl.edu/PI001
5. NRCS Agrichemical Handling Facility, Code 309; Pest Management Code 595. FOTG-Section IV. www.nrcs.usda.gov/technical/efotg

APPENDICES

APPENDIX I: ACRONYM LIST AND GLOSSARY

Aquifer: Soil or rock formation that contains groundwater and serves as a source of water that can be pumped to the surface.

Best Management Practices (BMPs): A practice or combination of practices based on research, field-testing, and expert review, to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality in agricultural and urban discharges. Best management practices for agricultural discharges shall reflect a balance between water quality improvements and agricultural productivity.

Biosolids: Solid, semisolid, or liquid residue generated during the treatment of domestic wastewater in a domestic wastewater treatment facility.

BMAP: Basin Management Action Plan.

Ca: Calcium.

Cation Exchange Capacity: The sum total of exchangeable cations that a soil can adsorb expressed in milliequivalents per 100 grams of soil, clay, or organic colloid.

CREP: Conservation Reserve Enhancement Program.

CRP: Conservation Reserve Program.

CSP: Conservation Security Program.

CRF: Controlled Release Fertilizer.

Cu: Copper.

Cyanobacteria: Also known as blue-green bacteria, which produce their energy through photosynthesis. Certain Cyanobacteria produce cyanotoxins that can be toxic to animals and humans.

Cyclic Irrigation: Split or pulsed irrigation events.

ECP: Emergency Conservation Program.

EDIS: Electronic Document Information System.

EPA: Environmental Protection Agency.

EQIP: Environmental Quality Incentives Program.

ERP: Environmental Resource Permit.

ESTL: Extension Soils Testing Laboratory.

Evapotranspiration (ET): The combined loss of water through evaporation and emission of water vapor (transpiration) through plant leaf openings (stomata).

F.A.C.: Florida Administrative Code.

FAWN: Florida Automated Weather Network.

FDACS: Florida Department of Agriculture and Consumer Services.

FDEP: Florida Department of Environmental Protection.

FFWCC: Florida Fish and Wildlife Conservation Commission.

FOTG: Field Office Technical Guide.

F.S.: Florida Statutes.

FSA: Farm Services Agency.

GCGA: Gulf Citrus Growers Association.

GPS: Global Positioning System.

IPM: Integrated Pest Management.

Mg: Magnesium.

MGD: Million Gallons Per Day.

MIL: Mobile Irrigation Lab.

N-P-K: Nitrogen, Phosphorus and Potassium.

NOI: Notice of Intent.

NRCS: Natural Resources Conservation System.

Perennial Streams: Streams or rivers that flow in a well-defined channel throughout most of the year under typical climatic conditions.

PPM: Parts Per Million.

PVC: Poly Vinyl Chloride.

Restricted Use Pesticides (RUPs): Pesticides registered by EPA that may only be applied by or under the direct supervision of trained and certified applicators.

Riparian: Vegetated areas along a watercourse through which materials and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent watercourse.

SFWMD: South Florida Water Management District.

Sinkhole: For the purposes of this manual, a sinkhole is an opening in the ground resulting from the collapse of overlying soil, sediment, or rock into underground voids created by the dissolution of limestone or dolostone.

Spoil: The soil material obtained from excavating an area to construct such works as canals/ditches and/or ponds. This material is typically used to build berms and/or dikes along or in the vicinity of the excavation site.

SWCD: Soil and Water Conservation District.

TDS: Total Dissolved Solids.

TMDL: Total Maximum Daily Load.

UF-IFAS: University of Florida, Institute of Food and Agricultural Sciences.

Uncoated sands: Sand particles that lack clay and organic matter coating, and have poor water and nutrient holding capacities.

USGS: United States Geological Survey.

Vegetated Buffer: An area covered with vegetation suitable for nutrient uptake and soil stabilization, located between a production area and a receiving water or wetland.

Watershed: Drainage basin or region of land where water drains downhill into a specified body of water.

Wetlands: As defined in section 373.019(27), F.S., wetlands means those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above.

WHIP: Wildlife Habitat Incentives Program.

WMDs: Water Management Districts.

WRP: Wetland Reserve Program.

APPENDIX 2: SOIL AND TISSUE TESTING INFORMATION

Soil Testing

The soil testing process comprises four major steps, and understanding each one clearly will increase the reliability of the process tremendously. The steps in the soil testing process are:

- container media and soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

Container Media Sampling: The test is designed for estimating the nutritional needs of container grown plants. Analyses performed are pH, electrical conductivity, Nitrate-N, P, K, Ca, and Mg. Specialized interpretation of the test results is required. The Container Media Test Information Sheet can be obtained at: http://edis.ifas.ufl.edu/ss185.

Soil Sampling: Soil samples need to be representative of the field and soil types and the soil analysis results will be only as good as the submitted sample. Samples collected from areas that differ from typical characteristics of the nursery should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the IFAS Soil Testing page at: http://edis.ifas.ufl.edu/topic_soil_testing for further information and to obtain the appropriate soil test sheet.

Sample Analysis: The soil samples that are submitted to the testing laboratories undergo a series of physical and chemical processes that are specific to the soil types, crops, and management regimes. Once the soil samples are homogenized through grinding and/or sieving, a precise volume of the sample will be extracted for plant nutrient through an extraction procedure. The following standard methods are followed at the IFAS Extension Soils Testing Laboratory (ESTL) for different soils in Florida:

a. Mehlich-3 extraction – method used on all acid-mineral soils.

b. AB-DTPA extraction – method used on alkaline (calcareous) soils with a pH of 7.4 and above.

c. Water extraction – method used for extraction of P in all organic soils.

d. Acetic acid extraction – method used on all organic soils for extraction of K, Mg, Ca, Si, and Na.

It is extremely important that procedures used at private laboratories are well understood before submitting the samples, because BMPs are tied to the standardized procedures used by the ESTL. Similarly, it is also very important to note that the ESTL laboratory does not offer any test for N because there is no reliable test for plant available N under Florida conditions. N recommendations are based on crop nutrient requirements found in the research literature. More information regarding the procedures used at the IFAS ESTL in Gainesville can be found in the extension publication, Circular 1248, at: http://edis.ifas.ufl.edu/ss312.

Interpretation of Test Results: The primary goal of laboratories that offer soil test services is to provide interpretation of the soil test results. These should be based on soil test-crop response trials and field calibration of the test results using optimum economic yields. Economic yield increases resulting from added nutrients cannot be obtained once the test results are interpreted as 'High' resulting in no recommendation for that particular nutrient. The interpretations provided are specific to the soil and plant species.

Nutrient Recommendations: Nutrient recommendations based on soil test results are formulated based on the optimum economic crop response to an added nutrient to the soil. Recommendations can originate from crop nutrient requirement research, soil test results, and/or tissue test results as discussed below.

Tissue Testing

Tissue testing is the analysis and diagnosis of the plant's nutritional status based on its chemical composition. It is commonly performed as analyses on dried leaves, with results compared to recommended nutrient ranges. For nursery plants (with the exception of ferns), the literature is spotty, so growers are encouraged to contact their local extension agent before embarking on a tissue testing regimen.

References:

1. Obreza, T.A. and K.T. Morgan. 2008. Nutrition of Florida Citrus, 2nd Edition. SL253. Soil and Water Science, Cooperative Extension Service. IFAS. http://edis.ifas.ufl.edu/ss478.

2. Mylavarapu, R.S. and E.D. Kennelley. 2002. UF/IFAS Extension Soil Testing Laboratory Analytical

Procedures and Training Manual. Soil and Water Science, Circular 1248, Cooperative Extension Service, IFAS. http://edis.ifas.ufl.edu/SS312.

3. Rao Mylavarapu, Kelley Hines and Thomas Obreza. 2008/2011. Diagnostic Nutrient Testing for Commercial Citrus in Florida. http://edis.ifas.ufl.edu/ss492

APPENDIX 3: IRRIGATION WATER QUALITY GUIDELINES

The table below lists general irrigation water quality guidelines for plant production.

Characteristic	**Degree of Problem**		
	None	**Increasing**	**Severe**
Potting Substrate			
pH	6.5-7.0	> 7.0	-
Bicarbonate (ppm alkalinity)	< 61	61-214	> 214
Bicarbonate (meq/L)	< 1.0	1.0-3.5	> 3.5
Sodium Absorption Ratio	< 35	>35	-
Soluble Salts			
Electrical Conductivity (dS/m)	< 0.75	0.75-1.4	> 1.4
Root Toxicity			
Sodium Absorption Ratio	< 3	3-9	> 9
Chloride (ppm)	< 70	70-345	>345
Foliar Toxicity			
Sodium (ppm)	< 70	>70	-
Chloride (ppm)	< 100	> 100	-
Foliar Residues			
Bicarbonate (ppm hardness)	< 90	90-520	> 520
Bicarbonate (meq/L)	< 1.5	1.5-8.5	> 8.5
Iron (ppm)	< 3	> 3	-

For more information on irrigation water source issues, go to:
UF-IFAS Publication *Causes and Prevention of Emitter Plugging* at: http://edis.ifas.ufl.edu/AE032.

APPENDIX 4: SLOW-RELEASE AND CONTROLLED-RELEASE FERTILIZERS

Whether a nursery plant is an annual or perennial, the source and amount of fertilizer applied, its placement, and the timing of application are key factors that affect how much the plant actually uses. In all these aspects, slow-release and controlled-release fertilizers (SRFs and CRFs) are viable alternatives to conventional soluble sources. Both release nutrients more slowly over a period of time, which means the nutrients more likely will be available when the plant needs them, and that the potential for nutrients to be lost into the environment is lessened. These benefits are particularly important in sandy soils with comparatively low nutrient- and water-holding capacities. Use of SRFs and CRFs can reduce total nutrient inputs, labor costs (through fewer applications), and water quality impacts to receiving waters. As a result, these forms of fertilizers have become more popular over time.

Slow-release fertilizers involve the release of the nutrient at a slower rate than is usual, but in which the rate, pattern, and duration of release are not well-controlled. The term controlled-release fertilizer is applied to fertilizers in which, during preparation, the key factors affecting the rate, pattern, and duration of release are well-known and controllable. The mechanisms for SRFs and CRFs are discussed below.

Slow-Release Fertilizers

Slow-Release Fertilizers activate in response to water solubility, microbiological decomposition, and chemical hydrolysis. Particle size, soil temperature, and microbial activity are key factors in decomposition and hydrolysis. Most SRFs are only slightly soluble in water or are broken down slowly by microbial action.

Non-manufactured SRF materials include manures, composts, and biosolids, which release nutrients through mineralization of organic matter based on moisture and soil temperature. As soil moisture and temperature increase, so does nutrient availability; consequently, SRFs are most effective in warmer weather. The release of these nutrients normally happens over a period of two to three years. Soil fumigation inhibits decomposition because it reduces populations of bacteria required for mineralization.

Some manufactured SRFs rely on particle size to delay delivery of nutrients. Larger pellets have less combined surface area than the same volume of smaller pellets, which reduces the points of contact for soil microorganisms and delays surface breakdown. As the fertilizer material is released gradually from the larger pellet or fertilizer granule, it is exposed to chemical and biological processes that render it soluble (through oxidation) and available to plant roots.

Another group of SRFs comprises reaction products of urea and aldehydes. Nitrogen is released through hydrolysis, which is accelerated by low pH and high soil temperatures. Because this mechanism is not microbe-dependent, nutrients can become available at low temperatures; consequently, SRFs in this group are favored for cool-season application. One example of this type of product is isobutylidene diurea (IBDU), which also depends on particle size.

Two microbe-dependent manufactured SRF materials are ureaformaldahyde (UF) and methylene urea (MU). Due to their low solubility, these materials enter the soil solution slowly, where they convert to plant-available N through microbial decomposition or hydrolysis.

Controlled-Release Fertilizers

Controlled-release fertilizers are coated materials (often urea), products with a soluble-fertilizer core covered with a water-insoluble, semi-permeable, or impermeable coating, or a combination thereof. CRF release rates are a function of temperature and soil water content. The coating limits the rate at which water penetrates to the fertilizer core, slowing the release of the fertilizer to the soil. CRFs fall into three categories, based on the coating material: sulfur, polymer, and sulfur/polymer hybrids.

Sulfur has low water solubility, relatively low cost, and value as a secondary nutrient. In sulfur-coated urea (SCU), water penetration through micropores and imperfections in the coating release N, triggering a rapid release of dissolved urea from the particle's core. Coating thickness affects release rate, as more thickly coated particles have fewer imperfections to penetrate. Wax sealants may be used to create a dual-release mechanism whereby soil microbes must break through to the imperfections in the sulfur coating. SCU has been in production for nearly 50 years.

Polymer-coated fertilizers are the most advanced with regard to managing release rate and nutrient-use efficiency. Coated materials may consist of urea alone or a composite of N, phosphorus, and potassium. Most polymer-coated products are released by diffusion through a semi-impermeable membrane, and the rate of release is a function of coating composition and thickness, as well as soil moisture and temperature. As water vapor penetrates the coating it dissolves the fertilizer core, and the nutrients diffuse through the coating into the soil.

Although manufactured SRFs and CRFs usually are more expensive than conventional soluble sources, they often weigh less and are more convenient to use. CRF applications generally are limited to one time per year, which saves money on equipment and labor costs. This is the norm for most container nursery operations as the CRF product is incorporated into the potting substrate. Field-grown nursery operations may benefit from using a mixture of SRF/CRF products and conventional soluble sources, especially when growing high-value crops in environmentally sensitive areas.

Nitrogen Inhibitors

Nutrient release also may be slowed through fertilizers additives generally referred to as nitrification and urease inhibitors. Nitrification inhibitors slow down the conversion (biological oxidation) of ammonium (ammoniacal nitrogen) to nitrate by soil bacteria. Urease (an enzyme) inhibitors are used on urea also to delay the conversion process. Inhibitors can offer even more nutrient management precision based on soil conditions and high crop-value considerations. Inhibitors may be more practical for certain row crop operations as opposed to use by nurseries. However, questions remain as to its usefulness even in a field setting. This depends upon the form, rate, and method of nitrogen application. The use of urease inhibitors may be effective with surface application of dry urea in high-residue situations.

The table below summarizes some of the main attributes of common SRF/CRF product classes.

Product Class	Release Characteristics	Cost
Organic Fertilizers	Mineralization Book Values	Low
Low-Solubility Compounds	Microbial, Particle Size	Low to Medium
Sulfur-Coated Urea	Coating Thickness	Low to Medium
Resin-Coated Urea	Temperature	High
Coated N-P-K	Coating Thickness, Temperature, Moisture	High

Reference:

Release Mechanisms for Slow- and Controlled-release Fertilizers and Strategies for Their Use in Vegetable Production. Kelly T. Morgan, Kent E. Cushman, and Shinjiro Sato. HortTechnology January-March 2009 vol. 19 no. 1 10-12. http://horttech.ashspublications.org/content/19/1/10.full

Additional Information:

Slow- and Controlled-Release and Stabilized Fertilizers: An Option for Enhancing Nutrient Use Efficiency in Agriculture. M.E. Trenkel. International Fertilizer Industry Association (IFA) Paris, France, 2010.

APPENDIX 5: INCENTIVE PROGRAMS FOR QUALIFYING OPERATIONS

Implementation of Best Management Practices can reduce non-point sources of pollution, conserve valuable soil and water resources, and improve water quality. The implementation of these management practices can also be expensive and, in some cases, may not be economically feasible for agricultural producers. To reduce the financial burden associated with the implementation of selected practices, several voluntary cost-share programs have been established. These programs are designed to conserve soil and water resources and improve water quality in the receiving watercourse. The narrative below is intended to provide basic information regarding the primary federal, state, and regional cost-share programs. Sources of additional information have also been included, and growers are encouraged to contact the identified agencies or organizations for current information about each program.

I. Programs Administered by USDA — Farm Services Agency (FSA)

Conservation Reserve Program (CRP): This program encourages producers to convert highly erodible cropland or other environmentally sensitive lands to vegetative cover including grasses and/or trees. This land use conversion is designed to improve sediment control and provide additional wildlife habitat. Program participants receive annual rental payments for the term of the contract in addition to cost share payments for the establishment of vegetative cover. CRP generally applies to highly erodible lands and is more applicable to North Florida.

Conservation Reserve Enhancement Program (CREP): CREP uses a combination of federal and state resources to address agricultural resource problems in specific geographic regions. This program (which is not limited to highly erodible lands) is designed to improve water quality, minimize erosion, and improve wildlife habitat in geographic regions that have been adversely impacted by agricultural activities.

Emergency Conservation Program (ECP): The ECP provides financial assistance to producers and operators for the restoration of lands on which normal agricultural operations have been impeded by natural disasters. More specifically, ECP funds are available for restoring permanent fences, terraces, diversions, irrigation systems, and other conservation installations. The program also provides funds for emergency water conservation measures during periods of severe drought.

For further information on CRP and CREP, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at www.fsa.usda.gov.

II. Programs Administered by NRCS

Conservation Plans

Conservation planning is a natural resource problem-solving and management process, with the goal of sustaining natural resources. Conservation Plans include strategies to maintain or improve yields, while also protecting soil, water, air, plant, animal, and human resources. They are particularly well-suited to livestock operations and farming operations that produce multiple commodities. Conservation Plans are developed in accordance with the NRCS FOTG. Assistance in developing a plan can be obtained through the local Soil and Water Conservation District (SWCD), the NRCS, the Cooperative Extension Service, and private consultants who function as technical service providers. However, the decisions included in the Conservation Plan are the responsibility of the owner or manager of the farm. Conservation Plans are usually required to receive cost share for any of the programs described below.

Environmental Quality Incentives Program (EQIP): EQIP provides financial assistance for the implementation of selected management practices. Eligibility for the program requires that the farm have a NRCS-approved conservation plan. Practices eligible for EQIP cost share are designed to improve and maintain the health of natural resources and include cross-fences, water control structures, brush management, prescribed burning, nutrient management and other erosion control measures.

Conservation Security Program (CSP): CSP is a voluntary conservation program that supports ongoing stewardship on private lands. It rewards farmers and operators who are meeting the highest standards of conservation and environmental management. Its mission is to promote the conservation and improvement of soil, water, air, energy, plant and animal life.

Wetlands Reserve Program (WRP): WRP is a voluntary program designed to restore wetlands. Program participants can establish easements (30-year or perpetual) or enter into restoration cost-share agreements. In exchange for establishing a permanent easement, the landowner usually receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. Under the 30-year easement, land and restoration payments are generally reduced to 75 percent of the perpetual easement amounts. In exchange for the payments received, landowners agree to land use limitations and agree to provide wetland restoration and protection.

Wildlife Habit Incentives Program (WHIP): The Wildlife Habitat Incentives Program provides financial incentives for the development of fish and wildlife habitat on private lands. Program eligibility requires that landowners develop and implement a Wildlife Habitat Development Plan. Participants enter multiyear (5 to10 year) agreements with NRCS.

For further information on these programs, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at the following web site: www.nrcs.usda.gov.

III. Programs Administered by State and Regional Entities

Office of Agricultural Water Policy: To assist growers in the implementation of BMPs, the Florida Department of Agriculture and Consumer Services/ Office of Agricultural Water Policy contracts with several of the state's Soil and Water Conservation Districts and Resource Conservation and Development Councils to provide cost share, as funding is available.

Water Management District Cost-Share Programs: Some of the WMDs may have agricultural cost-share programs in place for eligible producers.

For further information on these programs, including eligibility criteria, please contact your soil and water conservation district, your WMD, or FDACS. Information and links to other sites are also available on the Internet at the following web site: http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy.

APPENDIX 6: EXAMPLE RECORD-KEEPING FORMS

Keeping records aids in operating and maintaining BMPs. The following record keeping is required:

Container Nurseries

1A.1.6 Use the table in this appendix to keep records of annual nutrient applications that contain N or P, and records of the leachate EC concentrations.

1A.2.8 Determine irrigation uniformity at least every three years for each type of irrigation system, and maintain these records. Contact a MIL for assistance.

Field-grown Nurseries

1B.1.1 Conduct soil tests prior to planting, and annually thereafter. Base P fertilization rate on soil test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.

1B.1.7 Use the table in this appendix to keep records of annual nutrient applications that contain N or P.

1B.2.5 Contact a MIL (if available) to perform an irrigation system distribution uniformity procedure and document the results. This should be performed every 3 years. Between MIL evaluations, inspect the system frequently and maintain it to ensure proper system operation and efficiency.

Cut Foliage Nurseries

1C.1.6 Base P fertilization rate on soil and/or leaf tissue test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.

1C.1.10 Use the table in this appendix to keep records of annual nutrient applications that contain N or P.

1C.2.2 Document the irrigation system's water application rate in inches per hour and adjust the amount as needed, to ensure you are not over-irrigating.

1C.2.7 Inspect the system frequently and maintain it to ensure proper system operation and efficiency. Keep records on inspection and maintenance of irrigation system components. Compare records over time for changes that might indicate problems with the system.

2.4.3 Maintain records of new well construction and modifications to existing wells.

You may maintain your records as hard copies or in an electronic format, depending on your preference. Below is a set of example record-keeping forms. You may use these tables, develop your own, or choose commercially available record-keeping software suited to your operation.

Soil Sample Records for Field Grown or Cut Foliage (Retain all Lab Results)				
Sample Date	Field Location	# of Samples	Name of Lab	Records Location

Tissue Sample Records for Cut Foliage (Retain all Lab Results)				
Sample Date	Field Location	# of Samples	Name of Lab	Records Location

Fertilization Records (Retain all Receipts)								
Field Name					Production Acreage		Year	
Brand	Application method	Grade $N-P_2O_5-K_2O$	% CRN	% CRP_2O_5	Amount of fertilizer applied (lbs/total production acreage)	Amount of fertilizer applied (lbs/acre)	Total N applied (lbs/acre)	Total P_2O_5 applied (lbs/acre)

Rainfall (inches)											
Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.

Well Records					
Location	Year Constructed	Constructed By	Last Modified	Deficiencies Noted	Records Location

APPENDIX 7: CONTACT INFORMATION

Emergency Information

Emergency Reporting Numbers	24 hours	
State Warning Point *Division of Emergency Management – contact in case of oil or hazardous substance spill*	Toll-Free	1-800-320-0519

Emergency Information and Follow-Up Numbers	Monday - Friday	
State Warning Point Information Line	8:00 am - 5:00 pm	(850) 413-9900
DEP Emergency Response	8:00 am - 5:00 pm	(850) 245-2010
State Emergency Response Commission *For follow-up reporting only*	Toll-Free	1-800-635-7179

Non-Emergency Information

Florida State Agency Numbers — **Toll Free**

Department of Agriculture and Consumer Services — **www.freshfromflorida.com**

Office of Agricultural Water Policy	(850) 617-1727	
Division of Agricultural and Environmental Services	(850) 617-7900	
Bureau of Pesticides	(850) 617-7917	
Bureau of Compliance Monitoring	(850) 617-7850	

Department of Environmental Protection — **www.dep.state.fl.us**

Non-point Source Management Section	(850) 245-7508	
Hazardous Waste Management Section	(850) 245-8707	
Northwest District Office (Pensacola)	(850) 595-8300	
Northeast District Office (Jacksonville)	(904) 256-1700	
Central District Office (Orlando)	(407) 897-4100	
Southeast District Office (West Palm)	(561) 681-6600	
Southwest District Office (Tampa)	(813) 632-7600	
South District Office (Ft. Myers)	(239) 344-5600	

Water Management Districts — **www.flwaterpermits.com**

Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. Johns River (Palatka)	(904) 329-4500	1-800-451-7106
Southwest Florida (Brooksville)	(352) 796-7211	1-800-423-1476
South Florida (West Palm)	(561) 686-8800	1-800-432-2045

Other Helpful Numbers - *Main offices*

NRCS - Florida Office (Gainesville)	(352) 338-9500	
UF/IFAS Extension Administration	(352) 392-1761	
Association of Florida Conservation Districts *Soil and Water Conservation Districts*	(407) 321-8212	

APPENDIX 8: RULE CHAPTER 5M-6

CHAPTER 5M-6
WATER QUALITY/QUANTITY BEST MANAGEMENT PRACTICES FOR FLORIDA NURSERIES

5M-6.002 Approved BMPs.

The manual titled Water Quality/Quantity Best Management Practices for Florida Nurseries (Edition April 2014 DACS-P-01267) is hereby incorporated and adopted by reference. Copies of the document may be obtained from the University of Florida County Extension offices or from the Florida Department of Agriculture and Consumer Services (FDACS) Office of Agricultural Water Policy, 1203 Governor's Square Blvd., Suite 200, Tallahassee, FL 32301 or accessed online at https://www.flrules.org/Gateway/reference.asp?No=Ref-04141.

Rulemaking Authority 403.067(7)(c)2. FS., 570.07(10) and (23), FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-31-06, Amended 8-2-07;________.

5M-6.003 Presumption of Compliance.

Pursuant to Section 403.067(7)(c)3., F.S., implementation of best management practices (BMPs), in accordance with FDACS rules, that have been verified by the Florida Department of Environmental Protection as effective in reducing pollutants addressed by the practices provides a presumption of compliance with state water quality standards and release from the provisions of Section 376.307(5), F.S., for those pollutants. In order to qualify for a presumption of compliance and release from Section 376.307(5), F.S., the applicant must:

(1) Submit a Notice of Intent to Implement, as provided in Rule 5M-6.003, F.A.C., that identifies the applicable BMPs;

(2) Implement all applicable BMPs in accordance with the timeline requirements in Rule 5M-6.003, F.A.C.; and,

(3) Maintain documentation to verify the implementation and maintenance of the identified BMPs.

Rulemaking Authority 403.067(7)(c)2. FS., 570.07(10) and (23), FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-31-06, Amended 8-2-07; ________.

5M-6.004 Notice of Intent to Implement.

(1) A Notice of Intent (NOI) to Implement BMPs and the accompanying BMP checklist, both of which are in the Water Quality/Quantity Best Management Practices for Florida Nurseries (Edition 2014, DACS-P-01267), hereby incorporated and adopted by reference, shall be submitted to FDACS, Office of Agricultural Water Policy, 1203 Governor's Square Boulevard, Suite 200, Tallahassee, Florida 32301. The NOI to Implement Water Quality/Quantity Best Management Practices for Florida Nurseries (DACS-01349, Rev. 11/13), hereby adopted and incorporated by reference, may be obtained from FDACS or accessed online at https://www.flrules.org/Gateway/reference.asp?No=Ref-04141.

(2) The NOI shall include:

- (a) The name of the property owner, the location of the property, the property tax ID number(s), and any other pertinent property identification information;
- (b) The amount of acreage on which BMPs will be implemented;
- (c) The name and contact information of a person to contact;
- (d) The signature of the owner, lease holder, or authorized agent; and,
- (e) A BMP checklist with a schedule for implementation, as contained in the Water Quality/Quantity Best Management Practices for Florida Nurseries (Edition 2014 , DACS-P-01267), hereby incorporated and adopted by reference. The applicant shall select the applicable BMPs by following the instructions in this document. All applicable BMPs must be implemented as soon as practicable, but no later than 18 months after submittal of the NOI.

(3) Once the NOI is filed, the applicant is eligible to apply for cost-share assistance with implementation.

Rulemaking Authority 403.067(7)(c)2. FS., 570.07(10) and (23), FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-31-06, Amended 8-2-07;________.

5M-6.005 Record Keeping.

BMP participants must keep records for a period of at least five years to document implementation and maintenance of the practices identified in the NOI. All documentation is subject to inspection.

Rulemaking Authority 403.067(7)(c)2. FS., 570.07(10) and (23), FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-31-06, *Amended 8-2-07;_______.*

5M-6.006 Previously Submitted Notices of Intent to Implement.

In order to retain a presumption of compliance with state water quality standards, nursery growers who have submitted an NOI and BMP checklist for the Water Quality/Quantity Best Management Practices for Florida Container Nurseries (Edition 2007, DACS-P-01267) prior to the effective date of this rule must either:

(1) Submit a new NOI and BMP checklist and implement the identified BMPs, pursuant to Rules 5M-6.001, F.A.C., through 5M-6.004, F.A.C., or

(2) Continue to implement and maintain records on the BMPs identified on the BMP checklist previously submitted and, within 18 months of the effective date of this rule, implement the practices listed below that are applicable to the operation, if any, and maintain documentation:

(a) BMP 1A.2.13 Watering station practices.

(b) BMP 2.1.1 Wetland buffers.

(c) BMP 2.4.2 Annual inspection of wellheads.

Rulemaking Authority 403.067(7)(c)2. F.S., 570.07(10) and (23), FS. Law Implemented 403.067(7)(c)2. FS. History–New 8-2-07;_______.

APPENDIX 9

Notice of Intent and BMP Checklist

ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

FDACS-OAWP
1203 Governor's Sq. Blvd.
Suite 200
Tallahassee. FL 32301

NOTICE OF INTENT TO IMPLEMENT

WATER QUALITY / QUANTITY BEST MANAGEMENT PRACTICES FOR FLORIDA NURSERIES (2014)

Rule 5M-6.003, F.A.C.

- **Complete all sections of the Notice of Intent** (NOI). The NOI may list multiple properties only if they are within the same county, they are owned or leased by the same person or entity, and the same BMPs identified on the checklist are applicable to them.
- Submit the **NOI** and the **BMP Checklist**, to the Florida Department of Agriculture and Consumer Services (FDACS), at the address below.
- **Keep a copy of the NOI and the BMP checklist in your files** as part of your BMP record keeping.

You can visit https://www.flrules.org/Gateway/reference.asp?No=Ref-04141 to obtain an electronic version of this NOI form.

If you would like assistance in completing this NOI form or the BMP Checklist, or with implementing BMPs, contact FDACS staff at (850) 617-1727 or AgBmpHelp@freshfromflorida.com.

Mail this completed form and the BMP Checklist to: **FDACS Office of Agricultural Water Policy**
1203 Governor's Square Boulevard, Suite 200
Tallahassee, Florida 32301

Person To Contact

Name: ____________________

Business Relationship to Landowner/Leaseholder: ____________________

Mailing Address: ____________________

City: ____________________ State: __________ Zip Code: __________

Telephone: ____________________ FAX: ____________________

Email: ____________________

☐ **Landowner or** ☐ **Leaseholder Information** *(check all that apply)*
NOTE: If the Landowner/Leaseholder information is the same as the Contact Information listed above, please check: ☐ **Same as above.** If not, complete the contact information below.

Name: ____________________

Mailing Address: ____________________

City: ____________________ State: __________ Zip Code: __________

Telephone: ____________________ FAX: ____________________

Email: ____________________

FDACS-01349 Rev. 11/13 Page 1 of 3

Complete the following information for the property on which BMPs will be implemented under this NOI. You may list multiple parcels if they are located within the same county and are owned or leased by the same person or entity.

Operation Name: ______________________________

County: ______________________________

Tax Parcel Identification Number(s) from County Property Appraiser

Please submit a copy of your county tax bill(s) for all enrolled property, with owner name, address, and the tax parcel ID number(s) clearly visible. **If you cannot provide a copy of the tax bill(s), please write the parcel owner's name and tax parcel ID number(s) below in the format the county uses.** Attach a separate sheet if necessary *(see form provided)*.

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

☐ Additional parcels are listed on separate sheet. *(check if applicable)*

Total # of acres of all parcels listed *(as shown property tax records)*: ______________

Total # of acres on which BMPs will be implemented under this NOI: ______________

In accordance with section 403.067(7)(c)2, Florida Statutes, I submit the foregoing information and the BMP Checklist as proof of my intent to implement the BMPs applicable to the parcel(s) enrolled under this Notice of Intent.

Print Name: ______________________________

(check all that apply) ☐ **Landowner** ☐ **Leaseholder** ☐ **Authorized Agent** *(see below)**

**Relationship to Landowner or Leaseholder:* ______________________________

Signature: ______________________________ Date: ______________

Name of Staff Assisting with NOI:

NOTES:

1. You must keep records of BMP implementation, as specified in the BMP manual. All BMP records are subject to inspection.
2. You must notify FDACS if there is a full or partial change in ownership with regard to the parcel(s) enrolled under this NOI.
3. Please remember that it is your responsibility to stay current with future updates of this manual. Visit the following website periodically to check for manual updates: www.floridaagwaterpolicy.com

Additional Tax Parcel Listings

Operation Name: ______________________________

County: ______________________________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

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Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

Parcel No.: ______________ Parcel Owner: ______________

FLORIDA NURSERY OPERATIONS WATER QUALITY/QUANTITY BMP CHECKLIST

Checklist Instructions

Note: Before you fill out this checklist, follow the section on BMP Enrollment and Implementation, which begins on page 7 of this manual. Read the text and the BMPs in Sections 1.0 – 6.0 before filling out the checklist, in order to know what the practices entail. The checklist summaries are for identification purposes only.

1. Check "In Use" for each BMP that you are currently practicing and will continue to practice. In Section 1.0 Nurtrient and Irrigation Management, note that there are three subsections: container and greenhouse grown plants; field-grown plants; and cut foliage. Only fill out the subsection(s) applicable to your operation.
2. For the applicable BMPs you do not implement currently but will implement, enter the month and year you plan to implement them in the "Planned" column. FDACS rule requires that applicable Level 1 BMPs in the manual be implemented as soon as practicable, but not later than 18 months after submittal of the NOI.
3. If you are using or will be using a practice similar to a BMP in the checklist, you may enter AMU (alternative measures used) under the "In Use" or "Planned" column. Be sure to include an implementation date (month/year) in the "Planned" column. Explain in the comments section what alternative measure(s) you are or will be implementing. If applicable, include the NRCS FOTG number associated with the practice.
4. For BMPs you will not implement, check all of the following that apply under "Will Not Implement."
   - NA = Not Applicable (you do not have a resource concern that requires use of the BMP).
   - TNF = Technically Not Feasible.
   - ENF = Economically Not Feasible.
   - Other = You must explain your reason in the comments section at the end of the checklist.
5. Make sure you follow the record-keeping requirements. BMPs that include record keeping are marked by the following pencil icon:
6. Mail this BMP checklist with your NOI form to FDACS, and keep a copy of both documents in your files.

1.0 Nutrient and Irrigation Management

BMP #	BMP Group (See body of manual for full description of practices)	In Use: Check/ or AMU	Planned: Month/ Year	Will not implement *(check reason below)*: NA	TNF	ENF	Other
	Container Nursery Practices – Subsection A						
1A.1.	Nutrient Management for Container and Greenhouse Grown Plants *(skip this part if you do not grow container or greenhouse grown plants)*						
	1. Store fertilizer or bulk quantities of potting substrate that contain nitrogen and phosphorus fertilizer in an area with a water impermeable barrier above and below. Load fertilizer away from wells or surface water bodies. Clean up spilled material immediately.						
	2. Fertilize plants with controlled-release fertilizer (CRF) amendments in the potting substrate. Ensure that CRF rate of application and release characteristics match the plant's need.						
	3. Fertilize sub-irrigated plants at less than the manufacturer's recommended fertilizer application rate (approximately one-half).						
	4. Apply supplemental fertilizer only when potting substrate leachate electrical conductivity (EC) is below the levels listed in **Table 1**.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use: Check/ or AMU	Planned: Month/ Year	Will not implement (check reason below): NA	TNF	ENF	Other
5.	Use windbreaks or other means (e.g. pot in pot) to minimize plant blowover when applicable.						
6.	Use the table in **Appendix 6** to keep records of annual nutrient applications that contain N or P, and records of the leachate EC concentrations.						
1A.2.	**Irrigation Management for Container and Greenhouse Grown Plants**						
1.	Based on the stage of plant growth, space containers and flats as close as possible.						
2.	Group plants of similar irrigation needs together.						
3.	Irrigate based on determination of plant need (e.g. sensors, evapotranspiration (ET) based programs, container plant weight,potting substrate sample).						
4.	Calculate the leachate fraction; if needed, adjust the irrigation system run time or amount of water applied so the leachate fraction does not exceed 15 percent.						
5.	Use pulse or cyclic irrigation to decrease the amount of water applied.						
6.	Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters. When using overhead fertigation, retain leachate and runoff using a retention basin or other effective means. Runoff water may be reused by constructing a water recovery system.						
7.	Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health. See **Appendix 3**.						
8.	Determine irrigation uniformity at least every three years for each type of irrigation system, and maintain these records. A Mobile Irrigation Lab can help with this determination. See www.floridaagwaterpolicy.com/MobileIrrigationLabs.html for a map of MIL service areas.						
	Irrigation Management for Container and Greenhouse Grown Plants – *Outdoor Production Only*						
9.	Ensure that the water-holding capacity of the potting substrate is at least 45 percent of its volume.						
10.	Use micro-irrigation, or an equally efficient irrigation system, for containers 7 gallons and larger. This does not preclude the use of micro-irrigation on smaller containers.						
11.	Water when temperatures and winds are at a level to minimize water loss, unless irrigating to relieve heat stress.						
12.	Install and maintain automatic rain shutoff devices.						
13.	If your container operation has a watering station used to irrigate plants immediately after potting, collect runoff in a small basin, direct the runoff to an existing basin, or route runoff through an onsite vegetative treatment area.						

		In Use	Planned	Will not implement *(check reason below)*			
BMP #	**BMP Group** (See body of manual for full description of practices)	**Check/ or AMU**	**Month/ Year**	**NA**	**TNF**	**ENF**	**Other**
	Field-Grown Production Practices – Subsection B						
1B.1.	**Nutrient Management for Field-Grown Plants** *(skip this part if you do not produce field-grown plants)*						
1.	Conduct soil tests prior to planting, and annually thereafter. Base P fertilization rate on soil test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.						
2.	When available, consult applicable UF-IFAS recommended fertilization rates or other research-based rates to help determine the appropriate amount of N to apply.						
3.	Calibrate fertilizer application equipment regularly, and anytime when changing products.						
4.	Place fertilizer material within the root zone/dripline (do not field broadcast).						
5.	Do not apply fertilizer under situations with a high risk of fertilizer loss to the environment, such as before a forecasted rainfall or frost/freeze event.						
6.	Protect stored fertilizer from wind and rainfall, to prevent accidental loss to the environment.						
7.	Use the table in **Appendix 6** to keep records of annual nutrient applications that contain nitrogen or phosphorus.						
1B.2.	**Irrigation Management for Field-Grown Plants**						
1.	Use plant size and other characteristics (e.g., deciduous versus non-deciduous) to determine the amount of water to apply.						
2.	Use available tools and data to assist in making irrigation decisions. Tools may include tensiometers, water table observation wells, on-site soil moisture sensors, crop water use information, and weather data. Real-time weather data is available by visiting the FAWN website or by installing your own on-site weather station.						
3.	Irrigate when evaporation is likely to be minimal.						
4.	Ensure that irrigation application rate does not exceed the soil infiltration rate (See **Table 2** or by observation).						
5.	Contact a MIL (if available) to perform an irrigation system distribution uniformity procedure and document the results. This should be performed every 3 years. Between MIL evaluations, inspect the system frequently and maintain it to ensure proper system operation and efficiency.						
6.	Test irrigation source water quality annually to detect issues with water chemistry that may result in irrigation system plugging or affect plant health. See **Appendix 3**.						
7.	Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use Check/ or AMU	Planned Month/ Year	Will not implement *(check reason below)* NA	TNF	ENF	Other
Cut Foliage Production Practices – Subsection C							
1C.1.	Nutrient Management for Cut Foliage Production *(skip this part if you do not produce cut foliage)*						
1.	Apply fertilizer in small amounts on a frequent basis (e.g., weekly if fertigating), or use CRF products. If using CRFs, select products that will release nutrients at the appropriate rate for the plant.						
2.	For mature ferneries with a solid root mass, apply N fertilizer at a rate of no more than 300 lbs N/acre/year. If applying more than 225 lbs N/acre/year, tissue test for leaf N content at least annually.						
3.	On rejuvenated fields, use a rate of no more than 80 lbs N/acre/year for the first 6 months.						
4.	For mature woody plants, apply N fertilizer at a rate of no more than 325 lbs N/acre/year, with at least 25 percent of that in the form of a CRF.						
5.	To minimize nitrate leaching, maintain an average 25 foot buffer consisting of trees or deeply-rooted grasses around the outside edges of all non-contiguous production areas.						
6.	Base P fertilization rate on soil and/or leaf tissue test results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.						
7.	Maintain soil pH between 5.5 and 6.5, so that any residual soil P will have a low solubility.						
8.	Do not apply fertilizer under high-risk situations, such as before a forecasted rainfall or frost/freeze event.						
9.	Protect stored fertilizer from wind and rainfall.						
10.	Use the table in **Appendix 6** to keep records of annual nutrient applications that contain N or P.						
1C2.	Irrigation Management for Cut Foliage Production						
1.	Use available tools and data to assist in making irrigation decisions. Tools may include tensiometers, water table observation wells, on-site soil moisture sensors, crop water use information, and weather data. Real-time weather data is available by visiting the FAWN website; or by installing your own on-site weather station.						
2.	Document the irrigation system's water application rate in inches per hour and adjust the amount as needed, to ensure you are not over-irrigating.						
3.	Apply irrigation during the night, or early in the morning when dew is present, to reduce disease and evaporative losses. This does not apply during times when pesticides are used in the irrigation system.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use: Check/ or AMU	Planned: Month/ Year	Will not implement *(check reason below)*: NA	TNF	ENF	Other
4.	Develop an irrigation schedule that allows adequate drying time for past liquid fertilizer and pesticide applications.						
5.	When using irrigation for frost/freeze protection, monitor wet-bulb temperatures, and shut off the irrigation system as soon as the risk of evaporative cooling has ended. You can find wet-bulb temperatures at http://fawn.ifas.ufl.edu/tools/irrigation_cutoff/. You can use a psychrometer to get site-specific wet and dry bulb temperatures.						
6.	Manage irrigation runoff to minimize the discharge and leaching of nutrients into surface and ground waters.						
7.	Inspect the system frequently and maintain it to ensure proper system operation and efficiency. Keep records on inspection and maintenance of irrigation system components. Compare records over time for changes that might indicate problems with the system.						
	2.0 Water Resources Protection *(for all nurseries)*						
2.1.	Wetlands Protection						
1.	Install and/or maintain a minimum 25-foot, non-fertilized vegetated buffer upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD pennit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For lakes that have an adopted TMDL for nutrients, expand the buffer to 50-feet.						
2.	For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (Use the comments section at the end of the BMP checklist):						
2.2.	Streams Protection						
1.	Install and/or maintain a riparian buffer along perennial streams on production areas that exceed 1-percent slope and discharge directly to the streams. Contact FDACS, NRCS, or an NRCS-approved Technical Service Provider for assistance in properly designing the riparian buffer.						
2.	Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function and to maintain natural flows.						
2.3.	Protection for First- and Second-Magnitude Spring Recharge Basins						
1.	Install and/or maintain a 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.						
2.	Install and/or maintain a 50-foot non-fertilized vegetated buffer around sinkholes.						
3.	If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other materials.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
2.4.	**Well Operation and Protection**						
1.	Use backflow-prevention devices at the wellhead to prevent contamination of the water source, if injecting fertilizer or chemicals.						
2.	Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.						
3.	Maintain records of new well construction and modifications to existing wells.						
3.0	**Stormwater Management** *(for all nurseries)*						
3.1.	**Stormwater Conveyance Systems**						
1.	Install gutters and downspouts on all buildings adjacent to nursery production areas, and divert stormwater away from the production area toward vegetated areas. When not in conflict with the health of the plant, the practice of rainfall harvesting from all roof areas (including greenhouses) to meet irrigation demand is encouraged.						
2.	Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure that they operate as designed.						
3.	If you have an existing operation that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment. Evaluate the plan's effectiveness, and make adjustments as needed.						
4.	If the total impervious area of your nursery operation (e.g., asphalt or concrete roads/parking lots, roofs, greenhouses) exceeds 10 percent, have a site-specific evaluation performed to determine whether off-site stormwater runoff is an issue. USDA-NRCS may be able to perform this at no cost.						
4.0	**Sediment and Erosion Control Measures** *(for all nurseries)*						
4.1.	**Production Area Buffers and Groundcovers**						
1.	Use vegetated buffers or filter strips for erosion control when observable points of discharge exist. These are strips or areas of vegetation that control runoff by slowing its velocity, thus increasing retention and percolation opportunities. Select noninvasive plants or a seeding mixture to provide vegetative cover. Apply mulch on steep areas to provide temporary erosion control until plants establish.						
2.	Utilize a synthetic (geotextile) groundcover material to stabilize disturbed areas and prevent erosion in areas where vegetative cover is not an option.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use: Check/ or AMU	Planned: Month/ Year	Will not implement *(check reason below)*: NA	TNF	ENF	Other
3.	In areas with a large amount of traffic, use appropriate aggregate such as rock and gravel for stabilization.						
4.2.	**Erosion Control for Roads, Ditches and Canals**						
1.	Repair and maintain access roads on a regular basis; use practices such as crowning and turnouts to control runoff.						
2.	Slope ditch bank berms to divert surface water away from drainage ditches and canals. This is especially important when there is an access road adjacent to the water feature.						
3.	Establish and maintain perennial vegetation on all ditch and canal banks.						
4.	In areas subject to high water velocities, protect ditch and canal banks from erosion using rip-rap, concrete, headwalls, or other materials that buffer against turbulence.						
5.	Maintain ditch and canal drainage function by removing unconsolidated sediments in order to retain the original design cross-sectional area. Use slotted or cross-drilled buckets, avoid disrupting ditch side slopes, and deposit vegetation and other material in an appropriate upland location.						
6.	Use drain pipe or flexible pipe to connect all water furrows to lateral ditches. Extend the pipe on the downstream side far enough away from the ditch bank to prevent bank scouring.						
7.	Create and maintain sumps upstream of pump intakes (e.g. lift pumps) within collector ditches.						
4.3.	**Erosion Control Specific to Field-Grown Nurseries**						
1.	Plant cover crops in all fields not in production.						
2.	Ensure that plant row orientation is compatible with topographic features of the site.						
3.	Manage vegetation between rows to prevent soil erosion.						

5.0 Debris Management *(for all nurseries)*

BMP #	BMP Group	Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
5.1.	**Debris Management**						
1.	Dispose of pathogen-laced potting mix or diseased plants in an appropriate solid waste facility, or burn them after obtaining all applicable burn permits.						
2.	Compost vegetative debris, or properly dispose of the material.						
3.	If composting, establish a nursery composting area that is at least 100 feet away from wetlands, delineated floodplains, and other water bodies.						
4.	Properly reuse, recycle, or dispose of used polyfilm, containers, and other plastic-based products.						

BMP #	BMP Group (See body of manual for full description of practices)	In Use: Check/ or AMU	Planned: Month/ Year	Will not implement (check reason below): NA	TNF	ENF	Other

6.0 Integrated Pest Management *(for all nurseries)*

6.1. Pesticide Storing and Mixing

BMP #	BMP Group	Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
1.	Store pesticides in an enclosed, roofed structure with an impervious floor and lockable door, at least 100 feet from wetlands or other waterbodies.						
2.	When practicable, construct a permanent mix/load facility with an impermeable surface, and locate it at least 100 feet from wells wetlands and/or waterbodies.						
3.	Where permanent facilities are not practicable, use portable mix/load stations or conduct any field mix/load activities at random locations in the field, with the aid of nurse tanks if applicable.						
4.	Use a check valve or air gap separation to prevent backflow into the tank or water source when filling a sprayer.						

Nursery Checklist Comments Section

BMP #	**Describe Alternative Measures Used**
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	**Enter "Other" reasons for not implementing BMPs**
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	
Field Notes and Comments:	
ERP #	