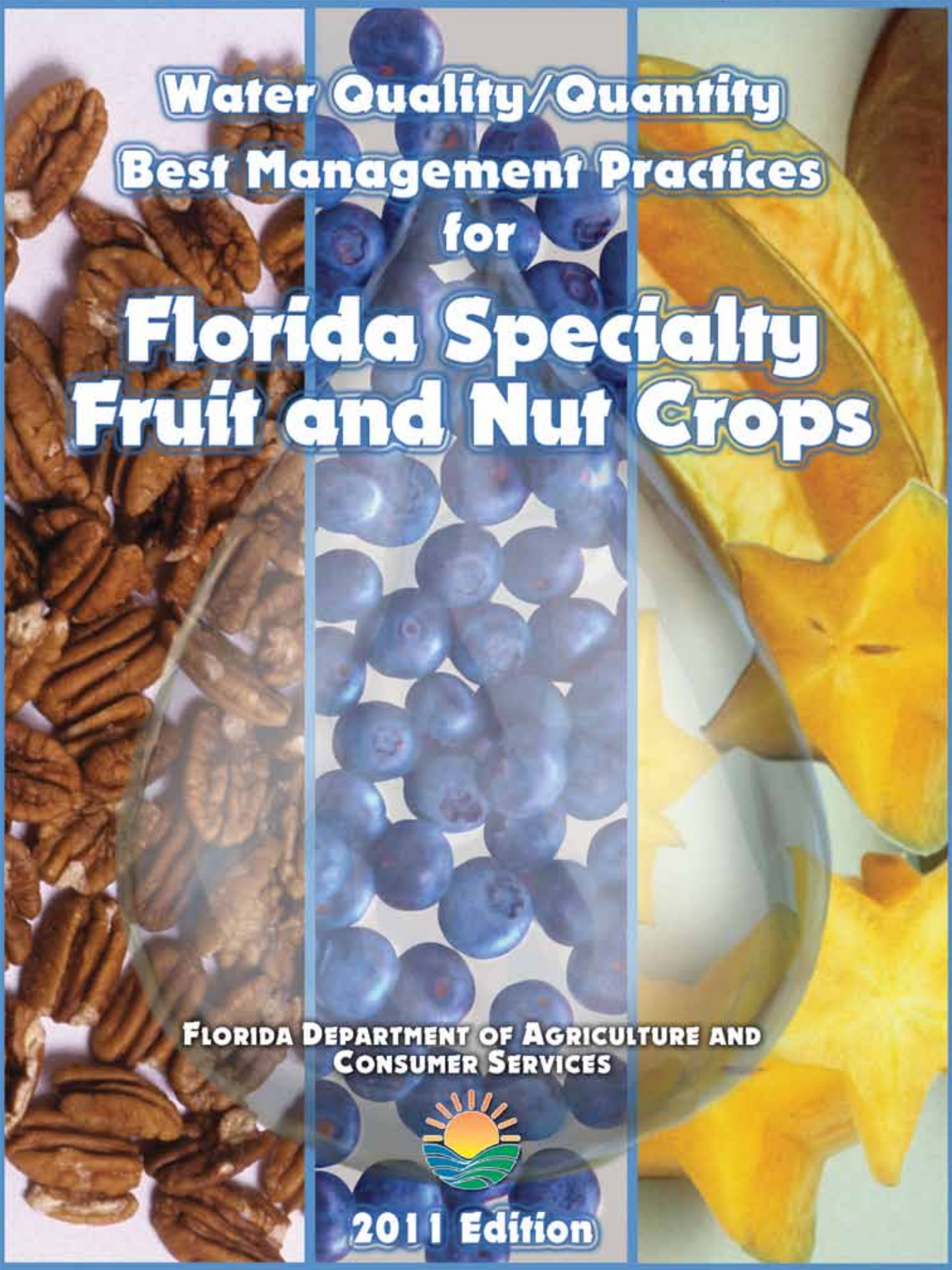


Water Quality/Quantity Best Management Practices for Florida Specialty Fruit and Nut Crops

Florida Department of Agriculture and Consumer Services

2011 Edition

DACS-P-01589

TABLE OF CONTENTS

Office of the Commissioner
(850) 488-3022

The Capitol
400 South Monroe Street
Tallahassee, Florida 32399-0800

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 Specialty Fruit and Nut Crops*, reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. In general, agricultural lands maintain valuable water recharge areas and preserve open spaces. The BMPs in this manual address water quality and quantity impacts from production activities and help maintain the environmental advantages of keeping the land in agriculture.

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.

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

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.

Steering Committee

Bill Bartnick – Florida Department of Agriculture and Consumer Services

Steve Boetger – USDA/Natural Resources Conservation Service

Brian Boman – University of Florida/IFAS

Butch Calhoun – Florida Fruit and Vegetable Association

Jonathan Crane – University of Florida/IFAS

Larry Halsey – University of Florida/IFAS Extension

Louise King – Tropical Fruit Growers of South Florida

Joshua Craft – Florida Farm Bureau

Jessica McCoy Stempien – Florida Department of Agriculture and Consumer Services

Donna Miller – Blueberry Growers Association

Jerry Mixon – Mixon Family Farms

Craig Spanjers – Coldwell Banker Commercial Realty Group

Mike Thomas – Florida Department of Environmental Protection

Reviewers

Glenn Horvath – Suwannee River Water Management District

Lance Laird – Northwest Florida Water Management District

Mark Luchte – Southwest Florida Water Management District

Vince Singleton – St. Johns River Water Management District

Benita Whalen – South Florida Water Management District

Additional Contributors

Jemy Hinton – University of Florida/IFAS

Alicia Whidden – University of Florida/IFAS

Jeffery Williamson – University of Florida/IFAS

James Clements, Holly Stone, and Dale Calhoun – Florida Department of Agriculture and Consumer Services

Editor

Terry Pride – Florida Department of Agriculture and Consumer Services

INTRODUCTION

Operations Intended to Use this Manual

This manual is adopted by the Florida Department of Agriculture and Consumer Services (FDACS), and is designed for use by commercial farm operations that produce either nut crops (e.g., pecans), stone fruit (e.g., peaches, plums, and nectarines), tropical fruits (e.g., avocados, lychees, mamey sapotes, papayas), blueberries, grapes, brambles (e.g., blackberries and raspberries), or similar fruit and nuts. Growers that produce crops other than those covered by this manual should use the appropriate FDACS BMP manual.

Things to Keep in Mind as You Use this Manual

- Italicized words that appear in ***bolded italics*** are defined in the glossary.
- Specific record-keeping requirements are noted using a pencil icon: 
- BMPs or guidance intended for tropical fruit operations only are identified by the following icon: 

You can access this manual electronically at www.floridaagwaterpolicy.com.

Overview of the Industry

Tropical Fruits

Commercial acreage of the tropical fruit industry is about 12,000 acres, with 90 percent of the acreage concentrated in Miami-Dade County. Other counties with commercial acreage include Lee, Collier, Palm Beach, Indian River, St. Lucie, Broward, Martin, Charlotte, Pasco, and Sarasota counties.

Florida has about 11,925 acres specialty fruits, including:

- 7,500 acres in avocado.
- 600 acres in mango.
- 850 acres in longan.
- 700 acres in lychee.
- 504 acres in banana.
- 486 acres in mamey sapote.
- 400 acres in guava.
- 375 acres in papaya.
- 510 acres, collectively, in carambola, jackfruit, kumquat, sapodilla, sugar apple, pitaya, and passion fruit.

No recent industry-wide value estimate is available; however, a gross estimate is $75 million, not taking into account increased production from new plantings and new crops, the economic impact from the commercial tropical fruit production in counties other than Miami-Dade County, and the tropical fruit nursery industry.

Temperate Fruit and Nut Crops

A variety of temperate fruit and nut crops are grown commercially in Florida. Of these only blueberry and pecan are surveyed annually by the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). Where NASS data is not available, gross estimates of acreage are given. Commercial acreage includes:

- 7,500 acres in pecan.
- 3,500 acres in blueberry.
- 920 acres, collectively, in peach, muscadine grape, blackberry, and persimmon.

Of these, blueberry has shown the most growth during the last decade. The value of Florida's blueberry industry has steadily increased, and was valued at $73 million as of 2009 (second behind Michigan in farm gate value). Florida's pecan industry has remained steady for the past several years, and is valued at $2.2 million (2009). Few new pecan groves have been established recently. Peach acreage has expanded during the past three to four years and shows relatively high potential for continued growth in central and north-central Florida. While acreage is small, interest in commercial blackberry production in Florida has increased during the past two years, and a Florida Blackberry Growers' Association was formed in 2009.

Best Management Practices Defined

Best Management Practices 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 or improving water quality. BMPs typically are implemented in combination to prevent, reduce, or treat pollutant discharges. BMPs must be based on sound science, be technically feasible, and be economically viable.

The industry remains committed to protecting water resources through the implementation of BMPs. This manual, which has been endorsed by the

major industry associations, has been developed to promote BMPs for specialty fruit and nut crop operations in Florida. Although these practices are designed primarily to protect water quality, some of the BMPs will also have water conservation benefits.

BMPs and Water Quality

Studies conducted by the Environmental Protection Agency (EPA) 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 (including manure and fertilizer) into lakes, rivers, wetlands, estuaries, and ground water. It is good stewardship and makes good 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 confirming the Legislature's support for this approach.

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.

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 http://www.dep.state.fl.us/water/tmdl/index.htm. To see a map of BMAP areas, go to http://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 presumption of compliance with state water quality standards for the pollutants addressed by the BMPs.
- Release from the provisions of s. 376.307(5), F.S., (fines for damages) for pollutants addressed by the BMPs.
- Technical assistance with BMP implementation.
- Eligibility for cost-share for certain BMPs (as available).
- The Florida Right to Farm Act generally prohibits local governments from regulating an agricultural activity that is addressed through rule-adopted BMPs when farmers implement them.
- Producers who implement FDACS-adopted BMPs might qualify for exemptions from water management district surface water permitting, and/or satisfy other permitting requirements.
- Some BMPs increase production efficiency and reduce costs.
- BMP participation demonstrates agriculture's commitment to water resource protection, and maintains support for this approach to meeting water quality and conservation goals.

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: for example, the construction of a stormwater management system (e.g., retention or detention pond). Check with your water management district 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 impounding or obstructing surface waters. Agricultural activities that meet these criteria may qualify for a statutory exemption from an ERP. Ask your water management district whether there are any notification requirements.

- Under 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 water management district that the proposed activity qualifies for the exemption.

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.

Local Government Regulation

In general, nonresidential farm buildings are exempt from the Florida Building Code and associated county building codes, in accordance with sections 604.50 and 553.73, Florida Statutes (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 (section 823.14, F.S.) provides that, with certain exceptions, 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 and management practices. In addition, the Act provides 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 water management district. Not all activities conducted on a farm are addressed by adopted BMPs.

POTENTIAL WATER QUALITY IMPACTS ASSOCIATED WITH SPECIALTY FRUIT AND NUT CROP FARMS

Most specialty fruit and nut crops are produced on perennial trees, shrubs, or vines. In South Florida, many commodities are cultivated on sandy, high-water-table soils with little relief or slope, thereby requiring drainage infrastructure. South Florida also has well-drained, highly calcareous (rockland) soils, which are unique to the region and support many tropical fruit crops. In contrast, North Florida generally has more relief, and heavier (clay-type), lower-water-table soils. These differences create regional production and water quality challenges.

Nutrients

Excess nitrogen and phosphorus are the most common causes of water quality impairments in Florida. These nutrients can enter surface waters through stormwater runoff or leach through soils into ground water. While there are potential water quality issues associated with the use of other agricultural inputs, such as pesticides, this manual focuses on nutrient-related impacts addressed by many TMDLs.

The nitrogen form most abundant in natural waters is nitrate. Due to its high mobility, nitrate can also leach into ground water. Phosphorus is one of the key elements necessary for growth of plants and animals. In terms of freshwater ecology, it tends to be the (growth) limiting nutrient. Phosphorus is more effectively retained 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.

High levels of nutrients in surface waters can result in abnormal plant growth, including algae. 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, 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. The mass die off and decomposition of these materials lowers the available dissolved oxygen, which can lead to fish kills.

Blue-green algae (***Cyanobacteria***) can become so abundant that they will cause a scum layer to form on the surface, shading the sunlight-dependent life below and disturbing the food chain. Untreated surface water (any water not obtained through a public water system) with increased Cyanobacteria poses a health risk. Livestock and pet deaths have been attributed to consumption of water with an abundance of Cyanobacteria, which produce a toxin known to cause liver and nervous system effects in humans. Potential risks from recreational contact include skin, respiratory, and mucous membrane irritation.

Fecal Coliforms

Fecal coliforms from uncomposted manure or improperly treated or applied ***biosolids*** are another cause of water quality degradation. The likelihood of contamination is increased if these materials are applied in excess of agronomic rates or under wet weather conditions. While high fecal coliform counts do not result in eutrophic conditions, the decomposition of fecal and other organic matter in water can lead to increased biological oxygen demand and lower dissolved oxygen levels. Fecal coliforms also can have health impacts such as dysentery, gastrointestinal infections, ear infections, and skin infections, especially in open wounds.

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 impacts most commonly associated with farm operations come from the erosion of unprotected soils.

Sediments 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 themselves 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 downstream swimming areas.

Deposited sediment also reduces the flow capacity of ditches, streams, rivers, and navigation channels, which can result in more frequent maintenance dredging or 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.

Impervious Areas

Impervious areas (packing houses, parking lots, etc.) can be useful on a farm, and in some cases are necessary, but they should be limited as much as possible. Impervious areas can increase and channelize the runoff (flow) from the farm, which can lead to greater erosion rates. This problem can be compounded downstream, because high flows often cause undercutting and slumping along stream banks, leading to increased stream sedimentation. Check with your water management district before creating any new impervious areas on your property, since this may be a regulated activity.

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 laid out in this manual.

Understand Water Quality Issues on Your Operation

Water quality relates to water's chemical, biological, and physical characteristics. Elevated levels of phosphorus, nitrogen, sediment, bacteria, and organic material all contribute to the degradation of water quality. The potential for discharges from farm 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 karst features. Your farm management practices determine your operation's impact on water quality. For more information on water quality, go to the following link: http://lakewatch.ifas.ufl.edu/LWcirc.html.

Manage Nutrient Sources Properly

You can minimize pollutants that leave your property by controlling the types and uses of materials you use on your farm. Nutrient-related pollutants can come from excess use of commercial fertilizers, manure, and/or biosolids. Managing nutrients carefully is critical to protecting water quality.

Manage Irrigation Carefully

Water is the carrier for nearly all pollutants. Precisely managing irrigation inputs by keeping water (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, ditch and canal maintenance, pasture renovation activities, and cultivating short-term crops can expose soil and lead to erosion that can increase pollutant loading. It is important to take appropriate erosion control measures during these activities.

CONSIDERATIONS FOR ESTABLISHING OR EXPANDING OPERATIONS: SITE SELECTION AND PREPARATION

Proper site selection and preparation are extremely important in successfully establishing specialty fruit and nut crops. Eliminating potential problems through simple design adjustments made before planting can reduce inputs, water quality impacts, and production costs.

Site selection and preparation likely will vary between regions of the state, depending on crop type, soil type(s), seasonal-high groundwater conditions, topography, and climate. New planting sites should be selected based on factors such as climatic conditions, proximity to urban areas, previous agricultural use, drainage characteristics, flooding history, residual pest populations, and whether or not the soil type is suited to the commodity.

When preparing the site, growers should utilize management tools such as soil testing, fumigation, use of soil amendments, bed preparation and spacing, and land leveling. Follow the guidance below as appropriate for your site and crop.

General Guidance for Site Preparation and Planting

- Choose a site that has the climatic and soil characteristics suitable to the crop type, and good air circulation to minimize pest and disease vectors.
- When converting from silviculture to other agricultural uses, it is a good idea to have a wetlands delineation performed prior to site preparation, to establish the boundaries of all onsite wetlands that may be in your planned production area. This will allow you to establish appropriate setbacks and/or buffers pursuant to the BMPs in this manual.
- Follow the proper spacing and bed-height requirements for your particular crop. If unsure, contact your local county extension agent for more information on specific crop spacing.
- If using soil amendments and/or pH-adjusting materials, manage these inputs so that nutrient management and water conservation are optimized.
- Adjust fertilizer and irrigation application amounts to account for the differences in nutrient and water holding capacities as bedding materials age.

See University of Florida Institute of Food and Agricultural Sciences (UF-IFAS), *Water and Environmental Considerations for the Design and Development of Citrus Groves*, CIR-1419, at: http://edis.ifas.ufl.edu/CH163 .

Considerations in Using High Tunnels or Shade-cloth Covered Beds

High tunnels are in-field structures generally consisting of metal, plastic, or wooden frames and polyethylene covers, with no electrical ventilation, mechanical ventilation, or heating systems. High tunnels may be used for frost/freeze protection, extension/expansion of the growing season, pest prevention, and reduction of input loss/transport, among others. They can reduce the use of water, pesticides, and other inputs. However, there is the potential for high tunnels to contribute to erosion and drainage issues, since these structures increase the amount of impervious area in a field and may concentrate runoff. Growers who use high tunnels should follow applicable USDA Natural Resources Conservation Service (USDA-NRCS) standards for these structures. Practices such as cover crops, diversions, and grassed waterways should be used in conjunction with high tunnels when there are related stormwater issues.

Another site preparation practice that is gaining popularity in some segments of the industry is the covering of plant beds with shade-cloth as part of a raised-bed culture system. This bed covering has the potential to concentrate stormwater runoff in fields, thereby contributing to erosion and drainage issues. Growers need to be especially aware of these concerns in areas with highly erodible soils and excessive slope.

Land Leveling for New Plantings

Develop a plan for land leveling, with consultation from a public or private engineer to discuss your site-specific needs. Use laser technology for best results, and balance cut and fill amount for the most efficient use of materials. Periodic grading or floating may be needed to eliminate mounds or depressions that form. Deposit unused ***spoil*** material in a suitable upland location. Consider reusing this material somewhere on-site as road base, etc.

Tropical fruit growers - Preparing rockland soil for planting may include, but is not limited to: clearing and leveling the site; rock-plowing to form a 4- to 8-inch plowed soil layer; leveling the plowed site; forming beds, if needed, from the plowed soil; and/or rock trench to form trenches 12 to 24 inches deep and 18 to 40 inches wide, and/or augur holes into the limestone-based bedrock below the plowed layer.

For more information on land leveling, see the USDA-NRCS, Precision Land Farming, Code 462; and Irrigation Land Leveling, Code 464, FOTG Section IV, http://www.nrcs.usda.gov/technical/efotg.

Rehabilitation of Existing Groves/Orchards

Fruit and nut orchards can develop conditions that require rehabilitation. With pest pressures, inadequate pruning, increasing age, and/or lack of proper management, shrubs or trees may become dwarfed and experience significant decline. Wholesale rehabilitation involves replanting the entire site; however, re-budding of rootstock seedlings or replanting dead or missing shrub or tree sites may be all that is needed.

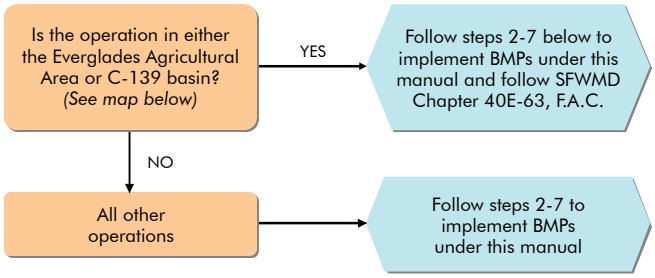
In the case of commercial blueberry production, as plants reach their full production potential in 7 or 8 years and taper off, wholesale orchard rehabilitation is usually needed. Practices that are especially important during the first year of rehabilitation include:

- Instituting proper sediment control measures before and during replanting, especially if farming on highly erodible lands.
- Disking and floating the field to insure that all low spots are filled in as much as possible.
- Evaluating the irrigation system, including applicable filters, lines, hoses and emitters, as they may require unplugging, maintenance, repair, and/or replacement.
- Implementing squirrel control measures, if needed, through baiting and mechanical trapping.
- Pruning shrubs or trees to remove approximately 35 percent of the mass the first year.

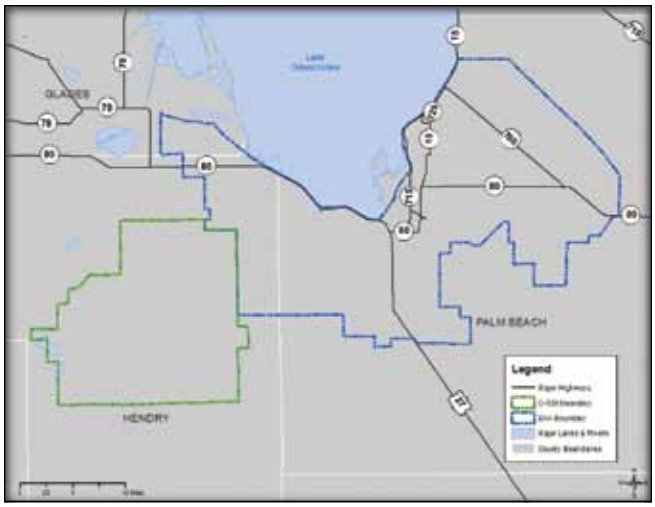
USER'S GUIDE TO BMP ENROLLMENT AND IMPLEMENTATION

The steps below will help you select which BMPs to implement to reduce or avoid 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 either implement applicable FDACS-adopted BMPs or monitor their water quality.*



2. **Request On-farm Technical Assistance, as Needed:** FDACS, UF-IFAS BMP Implementation Teams, Soil and Water Conservation Districts (SWCDs), USDA-NRCS and/or UF-IFAS Extension staff are available to assist with the mechanics of BMP identification and selection. To get 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 farm's natural features, which will help you determine how the operation of your farm may affect environmentally sensitive areas. **When developing the inventory, sketch your farm/facility, noting buildings, pastures, electrical and plumbing lines, and water sources.** 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 farm. To help you conduct your inventory effectively, the following tools are available:

- ✓ Aerial photographs (http://earth.google.com/index.html, or other providers)
- ✓ USDA-NRCS soil survey maps (http://websoilsurvey.nrcs.usda.gov/app/)
- ✓ USGS topographic maps (http://topomaps.usgs.gov)
- ✓ National Wetlands Inventory (http://www.fws.gov/wetlands/data/index.html)
- ✓ Historic rainfall records (http://www.ncdc.noaa.gov/oa/ncdc.html)

4. **Select the Applicable BMPs:** Carefully read BMP sections 1.0 through 6.0 and select all of the **Level I** and **Level II 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 checklist in **Appendix 10** of this manual. The checklist includes a column for you to schedule BMP implementation if a practice is not already in place.

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

   Level II BMPs address water quality risk features that require more attention. Producers may need to implement one or more of these BMPs, based on site-specific needs identified by the Level II assessment questions.

   It is advisable to consolidate your inventory 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, USDA-NRCS staff, or others.

5. **File a Notice of Intent to Implement (NOI) BMPs:** Complete and submit to FDACS an NOI, contained in **Appendix 10** of this manual, along with the BMP checklist. Once received by FDACS, the Notice of Intent formally enrolls your operation under 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 Level I and Level II 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 5M-13.005, F.A.C., requires record-keeping to document BMP implementation. Fertilizer applications and rainfall amounts are two types of record-keeping. Record-keeping requirements are highlighted in the manual using this figure:  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 7**. You must retain the records for at least 5 years. However, it is desirable to retain records for as long as possible, to address any potential future legal issues. All documentation is subject to review.

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. On a staggered schedule by BMP program, FDACS mails surveys to enrollees, which contain questions about BMP-related activities on enrolled operations. FDACS staff also visit selected operations 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 important to the continuing success of agricultural BMP programs in Florida.

BEST MANAGEMENT PRACTICES

1.0 NUTRIENT MANAGEMENT

Nutrient Management *is control of the amount, source, placement, form, and timing of the application of nutrients and soil amendments to ensure adequate soil fertility for plant production and to minimize impacts to water quality.*

Primary Macronutrients

Growers commonly use fertilizer materials that contain nitrogen (N), phosphorus (P), and potassium (K) sources, which are the macronutrients most readily assimilated by plants. A balance needs to be maintained between all major and minor elements to ensure proper plant growth and maintain plant health. In addition, applying macronutrients such as N and P in excess of plant nutrient uptake can result in nutrient-laden runoff to surface waters or leaching to ground water, especially in Florida's sandy soils. Potassium is associated with movement of water, nutrients, and carbohydrates in plant cells and tissue. Excessive K fertilization can contribute to high soil electrical conductivity levels, which may limit root growth and tolerance to drought.

Soils

Understanding the physical, chemical, and colloidal properties of your soil type is important to choosing effective nutrient management practices. For example, at near-neutral soil pH levels, some of Florida's soils naturally provide adequate phosphorous, while some of the sandier, highly leached soils may not contain phosphorus levels that support optimum plant growth. These variations require different management practices to assure adequate phosphorus levels while minimizing adverse environmental impacts.

Nitrogen compounds are readily oxidized to nitrate in most Florida soils, and nitrate does not attach well to mineral soil particles or organic matter. Consequently, growers almost always have to add supplemental N fertilizer to meet a crop's specific nutrient requirement.

A soil test may indicate the need for supplemental P. The addition of P helps to ensure a healthy crop by encouraging root growth, stalk strength, and resistance to root rot diseases. Most soluble P fertilizer materials are in the inorganic form so they can be readily absorbed by plants. Soils predominantly comprised of coarse uncoated sands are very prone to leaching P, and are more common in areas of Central and South Florida. Uncoated soils series where P leaching may be a concern include the following:

Common *Uncoated Soils Series*			
Adamsville	Estero	Neilhurst	Ridgewood
Archbold	Hallandale	Nettles	Satellite
Basinger	Hobe	Oldsmar	St. Lucie
Broward	Immokalee	Orsino	Smyrna
Canaveral	Jonathan	Ortega	Tavares
Candler	Kershaw	Ousley	Valkaria
Dade	Lawnwood	Penney	Wabasso
Deland	Leon	Pomello	Wauchula
Duette	Myakka	Pomona	Waveland
EauGallie	Narcoosee	Pompano	Zolfo

Soil Testing and Interpretation

Soil test-based nutrient recommendations rely on a correlation between nutrient levels in the soil and predicted plant response. However, information to make this correlation for some specialty fruit and nut crops is limited. If this is the case, growers still should use soil testing to monitor soil pH and as a general indication of nutrients in the soil, such as P, calcium (Ca), magnesium (Mg), etc. Soil samples are fairly easy to obtain. **Figure 1** shows a common soil probe used to obtain representative soil samples.

Figure 1

For most mature perennial fruit and nut crops, soil testing should be conducted every three years to monitor soil pH, cation exchange capacity, and percent of organic matter. Annual plant tissue analysis of macro (N, P, K), secondary, and minor essential elements is useful in fine-tuning a nutrient management program. The exception to this is blueberries, which will need to rely solely on tissue testing, as blueberry growers generally use a bed of pure pine bark or pine bark mixed with native soil. Soil and tissue testing records are a critical part of your fertilizer management documentation.

The amount of nutrients extracted from soils through laboratory analysis is not a direct measure of nutrient availability to plants. The levels of extracted P, Ca, and Mg typically are divided into five categories: very low, low, medium, high, and very high. For more information on soil testing, see **Appendix 3** of this manual, or go to http://edis.ifas.ufl.edu/SS186.

Tissue Testing and Interpretation

One of the best tools for measuring plant health and making fertilization decisions is leaf tissue analysis. For perennial fruit and nut crops, past records of leaf tissue composition can be used to fine-tune a fertilization program for optimum plant growth and minimum environmental impact. Leaf tissue analysis, along with observation and soil testing, can help determine the effectiveness of a fertilization program, and is especially useful for detecting micronutrient deficiencies even before visual symptoms appear. In most fruit and nut crops, leaf samples should be taken from mid-shoot areas of fully expanded (mature) leaves from current season growth. **Table 1** below shows recommended leaf nutrient content ranges for some specialty fruit and nut crops.

Timing and Targeting Fertilizer Applications

Because of the cost of fertilizer and the potential for nutrient-related adverse impacts to water quality from over-fertilization, growers should understand the specific crop nutrient requirement (CNR) and the timing factors associated with fertilizing, and should apply fertilizer material to target areas only.

Table 1. Recommended Leaf Nutrient Content for Specialty Fruit and Nut Crops*

Crops	% N	% P	% K	% Mg
Atemoya	2.50-3.00	0.16-0.20	1.00-1.50	0.35-0.50
Avocado	1.70-2.00	0.09-0.14	1.30-1.70	0.39-0.65
Banana	2.00	0.15	2.50	0.25
Blueberry	1.80-2.10	0.12-0.4	0.35-0.65	0.12-0.25
Brambles	2.50-3.00	0.35-0.40	2.00-2.50	0.70-0.90
Carambola	1.70-2.00	0.15-0.25	1.30-1.70	0.92-1.30
Guava	1.60-1.80	0.20-0.30	1.40-1.60	0.20-0.30
Longan	1.40-1.90	-	-	-
Lychee	1.50-1.70	0.15-0.30	0.70-0.80	0.35-0.45
Mamey Sapote	2.10-2.30	0.12-0.15	1.21-1.82	0.25
Mango	1.00-1.50	0.09-0.18	0.30-1.00	0.15-0.40
Muscadine Grape	1.65-2.15	0.12-0.18	0.80-1.20	0.15-0.25
Papaya (petioles)	3.50-5.00	0.17-0.21	2.50-3.00	0.26-0.29
Passionfruit	4.75-5.25	0.25-0.35	2.00-2.50	0.25-0.35
Peach	2.75-3.50	0.12-0.50	1.50-2.50	0.25-0.50
Pecan	2.70-3.50	0.14-0.30	1.25-2.50	0.30-0.60
Persimmon	1.50-2.50	0.10-0.35	1.93-3.70	0.17-0.46

* *Adapted from information from http://trec.ifas.ufl.edu/fruitscapes/, except for Persimmon, which comes from Horticultural Research Center of New Zealand. http://www.hortnet.co.nz/publications/guides/fertmanual/persimon.htm*

Note: *These ranges may vary and are influenced by soil type, leaf age and position, fruiting or non-fruiting, cultivar, and crop load.*

Fertilizer is generally applied during the growing season in multiple applications, based on observation, experience, and leaf tissue sample analysis. Multiple factors affect timing, such as: species, cultivar, region, climate, soil type and pH, and the maturity of the shrub/tree.

Foliar application of micronutrients is common for many fruit crop species; however, this technique should be used only when the probability of rainfall is low, in order to avoid washing nutrients from leaf surfaces.

Nutrient Considerations for Tropical Fruit Crops

In South Florida, tropical and subtropical fruit crops are grown on a variety of soil types, including low- to high-pH sandy soils (e.g., EauGallie sand, Matclacha gravelly fine sand), muck soils, and high-pH ***calcareous*** soils (e.g., Krome gravelly loam, Chekika gravelly loam). Because of the lack of an accurate soil test for calcareous soils, leaf tissue analysis is more important than soil testing for monitoring and managing fertilizer inputs in these soils.

Fertilizer practices vary widely by tropical fruit and nut crop species and by soil type (i.e., pH and organic matter content). The addition of granular fertilizer to tropical fruit crops grown in neutral- to low-pH soil(s) is generally effective. Tropical and subtropical fruit crops grown in muck soils generally do not need additional nitrogen. Tropical and subtropical fruit crops grown in the high-pH (7-8.5) calcareous soils of south Miami-Dade County or calcareous, high-pH sandy soils (some areas of southeastern Florida) require foliar applications of magnesium and minor elements such as manganese, zinc, molybdenum, and boron, and soil-drench applications of chelated-iron materials. An example of this fertilization practice is shown in **Figure 2**.

Figure 2

In general, growers will make a slurry of water and chelated-iron materials and apply it as a soil drench under the tree canopy. For more information on production on calcareous soils, refer to UF-IFAS Extension Publication SL183, *Calcareous Soils in Miami-Dade County* which can be found at: http://edis.ifas.ufl.edu/TR004.

Nutrient Considerations for Temperate Fruit Crops

Temperate fruit crops are grown on a variety of soil types in Florida, ranging from sandy loams with clay subsoils, to deep, well-drained sands, to poorly-drained flatwoods soils. Fertilizer recommendations based on soil test results are for the most part lacking due to the wide variety of climatic and soil-related conditions encountered in Florida. Soil tests are beneficial for monitoring soil pH and the levels of elements that may accumulate over time, such as phosphorus. Leaf nutrient analyses can be used in combination with subjective assessments of plant growth and vigor to make adjustments to fertilizer programs.

Under Florida conditions, most temperate fruit crops are irrigated; therefore, fertilization and irrigation practices should be designed to minimize fertilizer loss through leaching. For most shallow-rooted crops, multiple applications of dry granular fertilizer are probably more efficient than one or two applications per year. Some growers are increasing the relative amount of fertilizer applied via low-volume irrigation systems (fertigation) and/or using slow or controlled-release fertilizers as a portion of their overall nutrient program. Micronutrient sprays are common for some crops, each crop having its own particular nutrient requirements. For example, zinc deficiency is very common with peach trees on sandy soils, and supplemental zinc, either soil-applied or as a foliar spray, is often needed. Blueberries require acidic soil conditions (pH ~ 4.5), and irrigation water (pH ~ 7.0+) is often acidified to prevent an upward drift in soil pH, which can negatively affect the availability of micro-nutrients such as iron, zinc, and manganese.

Nutrient Management BMPs

1.1 Soil and Tissue Testing

Level I BMPs:

✓ **1.** In non-amended mineral soils, base fertilization rates for P on soil test-based recommendations from a lab that uses a method accepted by the UF-IFAS Extension Soil Testing Laboratory. Keep a copy of all laboratory test results. In amended soils or rockland soils of south Miami-Dade County, use tissue testing as an alternative to determine P fertilization needs.

✓ **2.** Use tissue testing to diagnose the effectiveness of a fertilization program and to deter-

mine the need for and appropriate amount of supplemental fertilizer applications. Keep a copy of all laboratory test results.

References:

1. UF-IFAS, Soil pH and Electrical Conductivity: A County Extension Soil Lab Manual, CIR 1081. http://edis.ifas.ufl.edu/SS118
2. UF-IFAS, Plant Tissue Test Information Sheet, SL 131. http://edis.ifas.ufl.edu/SS182

Note: *See Appendix 3 for important information on soil and tissue sampling.*

1.2 General Fertilizer Management

Level I BMPs:

✓ **1.** If available, use the UF-IFAS-recommended fertilization rates for your crop for N, P, and K. If UF-IFAS recommendations are not available, use another credible source, such as U.S. land grant institutions, other recognized universities, or USDA. If using a source other than UF-IFAS, list the source in the comments section at the end of the BMP checklist.

Be aware of soil pH and micronutrient needs. Do not over-apply N in an attempt to cover micronutrient deficiencies.

✓ **2.** Store fertilizers in a manner that protects them from wind and rainfall.

✓ **3.** Calibrate fertilizer application equipment for maximum distribution uniformity.

✓ **4.** When applying soluble fertilizers, use smaller, more frequent (split) applications to minimize the potential for leaching.

✓ **5.** Keep records of all nutrient applications. Include, at a minimum: date of application, total amount applied, acreage covered, fertilizer analysis or grade, % of controlled-release fertilizer (if applicable), rate per acre, and application method.

References:

1. USDA-NRCS, Nutrient Management, Code 590, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg/
2. Procedure for Calibrating Granular Applicators. ASABE EP 371.1
3. UF-IFAS, Calcareous Soils in Miami-Dade County, SL183. http://edis.ifas.ufl.edu/TR004.
4. UF-IFAS, Fruitscapes. http://trec.ifas.ufl.edu/fruitscapes/
5. University of Georgia Horticulture Department, Suggestions for Organic Blueberry Production in Georgia. http://www.caes.uga.edu/Publications/numberedPubs.cfm
6. University of Georgia Extension, Blueberry Fertilization in Soil., Fruit Publication 01-1. http://www.caes.uga.edu/Publications/numberedPubs.cfm
7. University of Georgia Extension, Cultural Management of Commercial Pecan Orchards. Bulletin 1304. http://pubsadmin.caes.uga.edu/files/pdf/B%201304_3.PDF

1.3 Fertigation

Level I BMPs:

✓ **1.** Based on the flow rate of the irrigation system, calibrate the injection system while the irrigation system is operating. Operating pressures and flow characteristics will influence the injection rate.

✓ **2.** Use highly water-soluble fertilizer sources and inject fertilizer on a frequent (e.g., daily or weekly) basis, depending upon your fertilization and irrigation schedule. Application of small amounts more frequently will reduce the potential for leaching beyond the root zone.

References:

1. UF-IFAS, Water Test Information Sheet, SL 133. http://edis.ifas.ufl.edu/SS184
2. UF-IFAS, Fertigation Nutrient Sources and Application Considerations for Citrus, Circular 1410. http://edis.ifas.ufl.edu/CH185
3. UF-IFAS, Field Evaluation of Microirrigation Water Application Uniformity, Bulletin 265. http://edis.ifas.ufl.edu/AE094

1.4 Other Nutrient Sources

Level I BMPs:

✓ **1.** If using reclaimed water, adjust your nitrogen and phosphorus fertilization rates to account for the nutrient content in the reclaimed water, based on the water quality data from the water supplier.

✓ **2.** If using composted manure or biosolids, determine their nutrient concentrations before using them, and adjust fertilization rates accordingly.

References:

1. UF-IFAS, The Basics of Biosolids Application to Land in Florida, SL-205. http://edis.ifas.ufl.edu/SS424
2. FDEP, Biosolids Rule, Chapter 62-640, F.A.C. http://www.dep.state.fl.us/legal/Rules/mainrulelist.htm

Note: *See Appendix 7 for list of record-keeping requirements and example record-keeping forms.*

2.0 IRRIGATION MANAGEMENT

Irrigation Management *involves selecting and maintaining the appropriate irrigation system for your crop; and adjusting irrigation methods, scheduling, and amounts to maximize irrigation efficiency, based on monitoring soil, plant, and weather conditions.*

According to 2005 United States Geological Survey data, there are approximately 1.8 million acres of irrigated farmland in Florida, which comprise about 11% of all the agricultural land uses within the state. Fruit crops, vegetables, field crops, and ornamentals account for most of the irrigated crop acreage to date.

In Florida, irrigation/water management and nutrient management are inextricably linked. The goal of proper irrigation management is to keep both the irrigation water and the fertilizer in the crop root zone. This requires knowledge of the characteristics (particularly rooting depth) of the crop, so that water and fertilizer inputs can be precisely targeted and properly managed. It also requires knowledge of the characteristics of the primary soil type to determine how these influence the availability of water to the plant.

Irrigation System Design and Installation

Irrigation system design involves selecting the irrigation system appropriate for physical characteristics of your site, crop water needs, and water source.

The two main types of irrigation systems used in Florida are semi-closed seepage irrigation, and pressurized systems such as micro-sprinkler, drip, or sprinkler. Irrigation system design depends on factors such as topography, soil type, crop type, and water source. It is important to know the volume and quality of the irrigation water source before designing and installing an irrigation system, especially for micro-sprinkler, sprinkler, or drip irrigation systems.

Irrigation system design requires in-depth technical knowledge, and should be handled by trained professionals. These professionals use existing standards and criteria, as well as manufacturers' recommendations, to design the most appropriate irrigation system for a particular location. For information about professionals who design and install irrigation systems, please visit the Florida Section of the American Society of Agricultural and Biological Engineers (http://www.fl-asabe.org/fasabeweb_006.htm).

Growers who are considering installing new or retrofitting existing irrigation systems should consult the information in **Appendix 5** before making a final design decision.

Semi-Closed Seepage Irrigation Systems

These systems convey water through pipes that discharge water to the field via spigots, to raise

the water table below the crop. Increasingly, semi-closed seepage irrigation systems are being used in combination with drip irrigation systems to best meet crop water and nutrient needs. However, these systems are relatively inefficient; therefore, growers on seep systems should evaluate the feasibility of converting to a pressurized system that is more efficient than seep. USDA-NRCS or UF-IFAS extension agents should be able to assist in this evaluation. In addition, water management district, state, and/or federal cost-share funding may be available.

Pressurized Irrigation Systems

These systems deliver water under pressure via closed pipelines and/or laterals. The most common pressurized systems used in the production of fruit and nut crops in Florida are drip (see **Figure 3**), micro-sprinklers, and high-volume overhead or under-tree solid set irrigation. High-volume guns are used less frequently. A typical irrigation system consists of four main components:

Figure 3

1. **Water Supply Mechanisms** (e.g., a water source, pumps, filters, valves, water gates and/or level controls.)
2. **Water Conveyance Mechanisms** (e.g., canals and main ditches, a main pipe, manifold pipes, lateral hoses or pipes, and/or isolation valves.)
3. **Water Application Mechanisms** (e.g., spigots; sprinkler, micro-sprinkler, or wobbling heads; spaghetti tubes; and/or spray guns.)
4. **Control Mechanisms** (e.g., manual or automatic float switches, computerized control systems, weather stations, and/or soil moisture sensors.)

Irrigation Water Sources

Agricultural irrigation water sources can come from ground or surface water. Ground water can contain high levels of minerals that can form scale, which may plug emitters. Additionally, elevated chloride and total dissolved solids (TDS) concentrations can significantly stress crops, leading to low fruit yield, plant damage, and impacts to both on-site and off-site water resources. Water quality analyses can help determine whether the water is appropriate to use on your crop, and to identify the best type of irrigation system to deliver the water, based on its chemistry.

Algal and bacteria growth can be problems associated with using surface water. Algal cells and organic residues of algae can pass through irrigation system filters and form aggregates that may plug emitters. Surface water can also contain organic debris, which must be filtered to prevent irrigation system plugging.

For more information on irrigation water source issues, go to: http://edis.ifas.ufl.edu/AE032.

Well Construction Permits

Florida's five water management districts have the primary regulatory authority for issuing well-construction and water-use permits for agriculture. Well-construction permits are required prior to the drilling, construction and/or repair of a well. These permits ensure that wells are constructed by qualified, licensed contractors to meet safety, durability and resource protection standards. The water management districts sometimes delegate the issuance of well-construction permits to county governments. For more information about water management district permitting requirements, go to: http://www.dep.state.fl.us/water/waterpolicy/districts.htm.

Alternative Irrigation Water Sources

Alternative irrigation water sources are non-traditional agricultural water supplies, primarily reclaimed and/or onsite surface water sources.

As Florida continues to grow in population, agriculture in the state must compete more and more with the urban sector for water supply. Growers are being asked to use more sustainable sources of irrigation water, such as reclaimed water, tailwater recovery, and rainfall harvesting. Use of alternative sources can also benefit water quality. For instance, tailwater recovery allows nutrients to be re-used on-site and not discharged to downstream waters.

Reclaimed Water

In recent years, the use of reclaimed water has been on the rise in Florida, as shown in **Figure 4**. This is mostly due to the high influx of people to the state over the last twenty years and the resulting increase in treated domestic wastewater available for use. Regulations governing reclaimed water use are contained in Chapter 62-610, Florida Administrative Code. The rule requires that the reclaimed water receive secondary treatment, filtration, and high-level disinfection. Irrigation using reclaimed

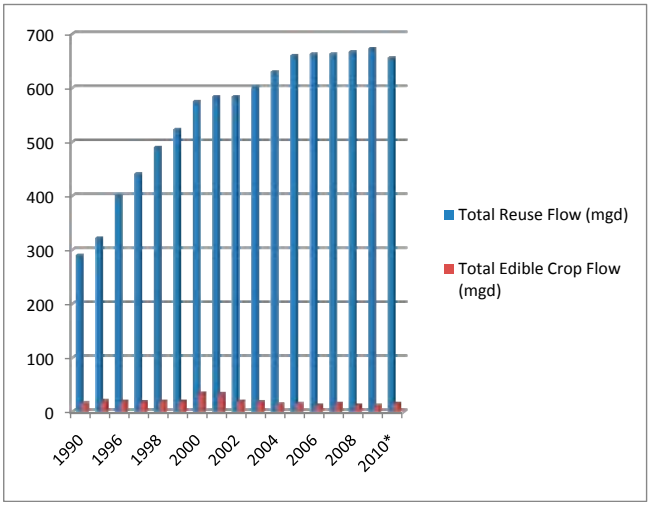


Figure 4: *Please note that the 2010 reuse and edible crop flows are based on the draft 2010 reuse inventory report and may be subject to change.*

water for crops that will not be peeled, skinned, cooked, or thermally processed before human consumption is allowed only if the irrigation method used will preclude direct contact with the reclaimed water. Examples given in the rule are ridge and furrow, drip, and subsurface irrigation. Any type of irrigation system may be used to grow crops that will be peeled, skinned, cooked, or thermally processed before human consumption.

Using reclaimed water involves a contractual arrangement with a wastewater treatment plant. Many wastewater treatment plants have a need to dispose of their water, which often occurs during rainy times when the crop does not need water. It is important to review your contract so that you are not obligated to over-irrigate during wet-weather periods. Over-irrigating wastes water and can damage crops and cause excessive leaching of nitrogen or phosphorus from the soil.

Work with the water management district to arrange for a backup water source in case the reclaimed water source is not sufficient or becomes unavailable or economically unfeasible.

Tailwater Recovery

Tailwater recovery systems have ponds that are installed to collect and re-apply irrigation water and/or rainfall that discharges or seeps from production fields. An example layout is depicted in **Figure 5**. These systems can be constructed also to intercept subsurface lateral flow, which makes them very suitable in high groundwater-table environments. Tailwater recovery systems can also help protect and preserve water resources, since they retain and/or reuse excess nutrients, rather

Figure 5

than allowing them to reach downstream natural systems.

Tailwater recovery systems often are used with semi-closed seepage irrigation systems to recover runoff from a field. This water is then pumped back into the irrigation system for reuse. The use of a combined semi-closed seepage and drip irrigation system along with tailwater recovery has led to significant reductions in water-use and nutrient loss.

Take into consideration the following when determining whether and/or how to implement tailwater recovery:

- You can use tailwater recovery if you have a seepage or flood irrigation system, and site-specific conditions make it practicable.
- Tailwater recovery ponds should be located at the lowest elevation(s) on your farm/field(s), and sized according to runoff volume and rates. In some cases, tailwater cannot be collected by gravity and must be collected via pumps.
- Design the pond(s) to maximize use and minimize impact to your farm and neighboring properties.
- In order to minimize disease risk when growing high-value crops, use chlorine or other approved disinfectants, as applicable, in the collected tailwater.
- Seek technical assistance so that your pond(s) can be appropriately sized and built to maximize use and minimize impacts to your farm or neighboring properties.

Note: *The installation of tailwater recovery ponds may require an Environmental Resource Permit or other type of authorization, so growers should check with their water management district before installing them.*

Horizontal Wells

Based on water quality impacts, there may be permitting limitations to using groundwater. As an alternative, horizontal wells allow access to shallow surficial aquifers as a water source for irrigation, if the soil type and aquifer characteristics are acceptable.

Trenching and the placement of a horizontal well screen in the surficial aquifer create a flow path through impermeable layers, and provide an efficient means of recovering shallow groundwater. This groundwater source is recharged by rain. However, horizontal wells are best used as a supplemental irrigation source because of the relatively low amount of water produced. Consider using horizontal wells if you are in an area with a high water table and other irrigation water sources are not sufficient.

Protecting the Water Source

Backflow Prevention

It is important to ensure that the irrigation water source does not become contaminated through the backflow of chemicals being injected into the irrigation system. Florida law requires backflow prevention (antisiphon) devices on all irrigation systems used for the application of pesticides or fertilizers (i.e., fertigation) (see **Appendix 6**). An example of such a device is shown in **Figure 6**.

Figure 6

Backflow prevention should include a check valve between the irrigation pump and the injection device to prevent backward flow; a low-pressure drain to prevent seepage past the check valve; a vacuum relief valve to ensure that a siphon cannot develop; and a check valve on the injection line. For more information on backflow prevention, go to: http://edis.ifas.ufl.edu/AE032.

Saline Water

All natural waters contain soluble salts; however, the amount and type of salts they contain vary greatly. Irrigation water can degrade when wells are pumped at high rates or for prolonged periods. Sometimes "up-coning" can occur from pumping, whereby saline water, rather than fresh water, is drawn into the well. Similarly, salt water intrusion from ground water pumping near coastal areas can create a problem with some irrigation wells. During the dry season salinity levels in ditches, canals, and reservoirs can increase through evaporation and irrigation water re-use (tailwater recovery).

Saline water typically is unsuitable for irrigation because of its high content of total dissolved solids (TDS). Saline irrigation water remediation consists of a few options:

- **Back-Plugging** – If fractures of flow zones in the well casing can be identified through well logging instrumentation, then the well may be a candidate for back-plugging. In this case, a cement type material is injected into the well casing and sealed to a particular depth.
- **Surface Water Augmentation** – If a surface water reservoir exists, then saline groundwater can be mixed with the reservoir water to lower the total salt concentration. If using augmentation, water quality monitoring is important.
- **Fertilizer Selection and Split Application** – A fertilization program that uses soluble fertilizers with a relatively low concentration of salts in frequent applications (more than 2-3 times per year), and/or that incorporates controlled-release fertilizer, normally results in less potential for salt injury. Refer to http://edis.ifas.ufl.edu/ae171 to assist you in selection of fertilizer materials with a low salt index.

Irrigation System Maintenance

Maintenance is necessary on any irrigation system to keep the system operating at peak efficiency according to manufacturer's recommendations. The benefits of maintaining irrigation systems in good working condition include water conservation, uniform plant growth and production, and reduced operation and maintenance costs.

Irrigation system maintenance involves: (1) calibration, (2) preventive maintenance, (3) corrective maintenance, and (4) recordkeeping. All farms should follow a regular, well-documented maintenance program. Regular calibration of each irrigation system and water meter is needed to ensure

that the correct amount of water is delivered. Regular visual inspections should be conducted to identify any necessary repairs or corrective actions. In some parts of the state, Mobile Irrigation Laboratories (MILs) are available, free of charge, to perform irrigation system evaluations and propose system improvements and basic maintenance recommendations.

For traditional open-ditch seepage irrigation systems, water control structures (such as risers and culverts) should be kept clean and operational. Maintenance of semi-closed seepage irrigation systems includes operational checks of pump stations (pump and engine/motor), and cleaning and maintaining all pipes, spigots, and valves in working order. Maintenance of pressurized pipe systems includes operational checks of pump stations, valves, and irrigation emitters, and maintenance of irrigation lines through chlorination/acidification and flushing. ***Chelating*** and ***sequestering agents*** are available to prevent plugging caused by scale deposition. Malfunctioning or worn-out nozzles need to be replaced with similar ones that have the same flow and pressure characteristics.

Tracking Irrigation System Performance

It is also important to measure the amount of water that is actually delivered through the irrigation system, via a water meter or a calibrated flow measurement device. Knowing the flow or volume will help you determine how well your irrigation system and irrigation schedule are working.

Keeping irrigation records (amount applied, duration of irrigation events, etc.) will help you track and minimize the amount of water used and the costs associated with running the irrigation system.

Managing Irrigation

Efficient irrigation provides greater water resource protection and reduced operational costs through more efficient water use. It conserves water, reduces the chances of over- or under-irrigating, and reduces leaching of agrichemicals in areas that are prone to such losses.

Inefficient irrigation can result in over-applying or under-applying water to a crop, as well as inadvertently irrigating a non-production area. Over-irrigation wastes water and promotes nutrient leaching. Efficient irrigation targets the application of water to the plant's root zone, using only the amount needed for proper plant growth.

Ensuring efficient irrigation requires development of a site-specific irrigation management plan that incorporates the use of information on soil properties, topography, crop types, ***evapotranspiration*** (ET), and seasonal climatic conditions in order to generate customized irrigation methods and schedules. This can be part of an overall BMP implementation plan.

Precision Irrigation

One way to ensure efficient irrigation is through "precision irrigation," which is equipment-based and can involve high-technology methods employing computers, geographic information systems, remote-sensing equipment, etc. At its most sophisticated level, it allows irrigation events to be adjusted in real time for location, frequency, and duration, based on soil properties and weather conditions. At present these systems are too costly for most small- to medium-size grove operations. However, you may want to explore the feasibility of installing equipment and computer software that will provide you with real-time, site-specific irrigation and/or weather information for your farm. You may contact FDACS, UF-IFAS Extension, or an independent contractor for help.

Irrigation Scheduling

Irrigation scheduling consists of determining when to start irrigating, at what intervals to irrigate, and how long to irrigate. In order to develop an irrigation schedule, you should:

- Estimate irrigation water requirements.
- Adjust the estimate based on available soil moisture content, soil water tension, or historic or real-time ET and appropriate crop factors.
- Make further adjustments based on replenishment of soil moisture through rainfall.

Irrigation Water Amounts

Irrigation water amounts are primarily determined by the crop's water requirements, the water-retention characteristics of the soil, the chemical characteristics of the irrigation water, and type and efficiency of the irrigation system.

Crop water requirements refer to the actual water needs for plant growth, taking into account ET and other climatic factors. Enough water should be applied only to wet the entire root zone. Irrigating too often encourages shallow rooting, increases soil compaction, and favors disease outbreaks.

Irrigation Scheduling Considerations

Table 2. Potential Evapotranspiration Rates (ETp) - From UF IFAS Circular 825

Month	North Region ETp (inches/day)	South Region ETp (inches/day)
Jan	0.07	0.09
Feb	0.10	0.12
Mar	0.13	0.15
Apr	0.17	0.19
May	0.19	0.2
June	0.19	0.19
July	0.18	0.19
Aug	0.17	0.17
Sept	0.15	0.16
Oct	0.12	0.14
Nov	0.09	0.11
Dec	0.06	0.09

Irrigation scheduling should be based on information such as: potential ET rates, as noted in **Table 2**; rainfall total, which can be determined by rain gauges; and soil moisture, which can be determined by sensors. More refined ET rates can be obtained from FAWN and the National Weather Service. Coupled with this technology, the observation of visual symptoms, such as wilting, will enhance the efficiency of irrigation scheduling.

Irrigation system water loss rates are affected by sunlight, wind speed, relative humidity, and air temperatures. Water loss can be reduced by irrigating when conditions do not favor excessive evaporation, especially when overhead irrigation systems are used. Irrigation should occur in the early morning hours before air temperatures rise and relative humidity drops. Irrigating at this time also allows sufficient time for infiltration into the soil, and allows the plant canopy to dry, thereby reducing disease development.

Prior to implementing an irrigation schedule, the irrigation system must be evaluated to determine the system's rate of application per acre. MILs can help with this.

Weather-Related Information

The University of Florida operates the Florida Automated Weather Network, known as the FAWN system, which maintains weather stations throughout most of the state. FAWN provides growers accurate, real-time weather data, which can be accessed via the internet or by phone. A FAWN station is depicted in **Figure 7**. Each station measures air temperature, soil temperature, evapotranspiration, wind speed and direction, rainfall, relative humidity and solar radiation. These parameters are critical to calculate supplemental irrigation requirements for your crop. FAWN also provides information on other irrigation tools. You can access this information at: http://fawn.ifas.ufl.edu.

Figure 7

Special-Case Irrigation Measures

Frost/Freeze Protection

Protecting specialty crops from frost and freezes is a challenge for growers. Options include sprinkler irrigation, application of foam material, use of synthetic row covers for young plants, and soil banking, among others. Each method has application in certain areas for specific crops.

Most growers use irrigation water and/or site selection to protect crops. When using the irrigation system as the main source of cold protection, the proper application and timing of water is critical. FAWN has developed tools to help determine

under what climatic conditions to use your irrigation system for frost and freeze protection (see http://fawn.ifas.ufl.edu/tools/). It is also critical that you adhere to any frost/freeze protection provisions in your consumptive use/water use permit.

Drought

Droughts can be devastating to crops. The National Drought Mitigation Center maintains a number of tools to assist growers in monitoring the intensity level of a drought. You can access these tools at http://drought.unl.edu/dm/monitor.html. Growers should closely monitor soil moisture levels, and irrigate at night or at other times when the least amount of evaporative loss will occur. Irrigation frequency and duration should be based on rooting depth to provide adequate moisture to the crop root zone. If starting a new orchard, consider using drought resistant varieties, if available. As always, growers should contact their water management district to inquire about water shortage requirements.

Irrigation Management BMPs

2.1 Irrigation Decision-Making and Management Practices

Using the practices below, maintain soil moisture within the recommended range for the crop and soil type. Base your irrigation amounts and timing on crop water demands, soil moisture availability, and weather conditions. Contact your local UF-IFAS Extension or USDA-NRCS office to obtain specific information (i.e., water-holding capacity, depth to water table) about the soils on your farm, and to determine what the water demand is for your particular crop(s). This is usually expressed as an inch-per-acre or gallons-per-plant application amount.

Level I BMPs:

✓ **1.** Use available tools and data to assist in making irrigation decisions, such as on-site soil moisture sensors to determine available soil moisture, crop water use information, and weather data pertinent to your farm. Real-time weather data is available by visiting FAWN, USGS, and water management district websites. If one is available, get a Mobile Irrigation Lab evaluation to assist you.

✓ **2.** Keep records of total rainfall received, using on-site rain gauges.

✓ **3.** Install rain shutoff devices on irrigation systems.

✓ **4.** Minimize application losses due to evaporation and wind drift by irrigating early in the morning, late in the afternoon, at night, and/or when cloud cover is abundant and wind speed is minimal.

✓ **5.** Do not irrigate beyond field capacity. When irrigation needs are greater (during long, warm days when the crop is near harvest) or when plants are flowering or developing fruit, splitting irrigation events into 2 or 3 daily applications may be of benefit.

✓ **6.** When sub-surface irrigation is used, maintain the water table at a level no higher than necessary to reach plant roots.

References:

1. UF-IFAS, Using Tensiometers for Irrigation Scheduling in Tropical Fruit Groves, TR-002. http://edis.ifas.ufl.edu/TR002
2. UF-IFAS, Tensiometers for Soil Moisture Measurement and Irrigation Scheduling, CIR-487. http://edis.ifas.ufl.edu/AE146
3. Food and Agricultural Organization, Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements, FAO Paper 56. http://www.fao.org/docrep/X0490E/X0490E00.htm
4. UF-IFAS, Field Evaluation of Micro-irrigation Water Application Uniformity, BUL-265. http://edis.ifas.ufl.edu/AE094
5. UF-IFAS, Field Devices for Monitoring Soil Water Content, BUL-343. http://edis.ifas.ufl.edu/AE266
6. USDA-NRCS, Irrigation System-Sprinkler, Code 442; and Irrigation Water Management, Code 449, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg/

2.2 General Irrigation System Maintenance

Level I BMPs:

✓ **1.** Test irrigation source water quality to detect issues with water chemistry that may affect maintenance needs (e.g., related to chemical precipitation and clogging) and fertilization requirements. Adjust your maintenance actions as needed.

✓ **2.** Maintain pump stations and wells, and related components, in good working order. Check them at least annually, and more frequently during periods of high use. Replace parts as needed.

✓ **3.** Use water meters (flow or volume) or other measuring devices/calculations to determine how much water is applied to the irrigated area. Document this information and use it to help you determine how well your irrigation system and irrigation schedule are working, and make any needed schedule adjustments or system repairs.

✓ **4.** Monitor water meters or other measuring devices for unusually high or low readings to detect possible leaks or other problems in the system. Make any needed repairs.

✓ **5.** If one is available, get an MIL to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years.

✓ **6.** Maintain a record-keeping system for inspection and maintenance of all irrigation system components. Records should be compared over time for any changes that would indicate problems with the system.

References:

1. UF-IFAS, Potential Impacts of Improper Irrigation System Design, Agricultural Engineering Fact Sheet 73. http://edis.ifas.ufl.edu/AE027
2. National Center for Appropriate Technology, Equipment Maintenance: The Florida Irrigator's Pocket Guide. www.ncat.org

2.3 Pressurized Irrigation Systems

Level I BMPs:

✓ **1.** Examine sprinkler nozzles or emitters for wear and malfunction, and replace them as necessary.

✓ **2.** Clean and maintain filtration equipment so it will operate within the recommended pressure range.

✓ **3.** Flush irrigation lines regularly to prevent emitter clogging. To reduce sediment build up, make flushing part of a regular maintenance schedule. If fertigating, prevent microbial growth by flushing all fertilizer from the lateral lines before shutting down the irrigation system.

If you find that there is a significant pressure difference across the irrigation laterals or across any main pipe, you can use pressure-compensating emitters or valves to correct for pressure differences.

References:

1) UF-IFAS, Evaporation Loss During Sprinkler Irrigation, BUL290, http://edis.ifas.ufl.edu/pdffiles/AE/AE04800.pdf
2) UF-IFAS, Causes and Prevention of Emitter Plugging in Micro-Irrigation Systems, BUL 258. http://edis.ifas.ufl.edu/ae032

2.4 Non-pressurized Irrigation Systems

Level I BMPs:

✓ **1.** Clean debris and control weeds in irrigation ditches and canals, to maintain water flow and direction.

✓ **2.** Keep water-level-control structures (such as culverts and risers) in irrigation ditches in good working order.

References:

1) USDA-NRCS, Irrigation Systems, Surface and Subsurface, Code 443. http://www.nrcs.usda.gov/technical/efotg/

2.5 Reclaimed Water

Level I BMPs:

If you are using reclaimed water:

✓ **1.** As needed, design or retrofit irrigation systems to handle reclaimed water, taking into account source water quality and delivery pressures.

✓ **2.** Separate reclaimed water supplies from existing ground or surface water sources to prevent cross-contamination.

References:

1. FDEP, Water Reuse for Florida: Strategies for Effective Use of Reclaimed Water. http://www.dep.state.fl.us/water/reuse/docs/valued_resource_Final-Report.pdf
2. FDEP, Reuse of Reclaimed Water and Land Application, Rule Chapter 62-610, F.A.C. http://www.dep.state.fl.us/legal/Rules/mainrulelist.htm

2.6 Special-Case Irrigation Measures

Level I BMPs:

✓ **1.** When using irrigation for frost/freeze protection, monitor wet-bulb temperatures to conserve water as much as possible. You can find this information at: http://fawn.ifas.ufl.edu/tools/.

✓ **2.** If practicable for your operation, use alternative frost/freeze protection measures, such as application of foam material, synthetic row covers, and/or soil banking, among others.

✓ **3.** During a drought, closely monitor soil moisture levels. Whenever practicable, irrigate at times when the least amount of evaporative loss will occur.

During drought or freeze events, contact your water management district to inquire about water shortage requirements. It is critical that you adhere to any frost/freeze protection provisions in your consumptive use/water use permit.

Note: *See Appendix 7 for list of record-keeping requirements and example record-keeping forms.*

3.0 SEDIMENT AND EROSION CONTROL

Sediment and Erosion Control Measures *are permanent or temporary practices that prevent sediment loss from fields, slow water flow, and/or trap and collect debris and sediments in runoff water.*

The first principle of erosion control is to maintain vegetation to hold soil and decrease the velocity of runoff water. Runoff containing sediments with nutrients and pesticides attached can adversely affect surface waters or ground water. Site characteristics such as clay-type soils and/or sloped terrain can significantly increase the risk of erosion and off-site sediment transport.

Erosion control begins with limiting the loss of soil from crop areas 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 crop areas, re-vegetation should occur as quickly as possible. Vegetation on row middles should be maintained, unless plant health or other over-riding issues prevent it. 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.

Water and Wind Erosion

In Florida, water-caused erosion in agricultural areas is generally characterized as sheet erosion, a process in which soil particles are moved across the surface by sheet flow, often a result of stormwater runoff. It can remove the topsoil layer, which reduces overall soil fertility. Rill erosion occurs as water flow increases, concentrating in small channels, or rills (see **Figure 8**). Rills are usually only a fraction of an inch deep, and can be removed during mechanical tillage. However, rill erosion can remove substantial amounts of soil by allowing water to move faster, thereby increasing its erosive potential. Sheet and rill erosion carry finer, smaller soil particles with higher proportions of nutrients and pesticides. Rills can enlarge into gully erosion, which can be difficult to control and can render parts of a field worthless. Waterways can also be affected through streambank erosion where the waterway channel may erode, or the banks may be undercut and cave in, particularly during higher than normal flows.

Figure 8

Wind erosion is generally less of a problem in Florida because of a predominance of sandy soils.

It occurs when wind velocity exceeds 12 mph (one foot above the ground) on soils with little to no vegetative cover. Most wind-borne particles are composed of silt and clay.

Ditch Construction and Maintenance

Agricultural ditches and/or grassed waterways are essential components of the field site plan and layout. They can vary from field ditches to laterals and mains, which are sometimes connected to larger canal systems. Ditches have an engineered limit (***conveyance capacity***) that governs how much water the ditch can store or convey. It is important to know the specific water requirements of the crop you are growing, so that you can factor in existing soil moisture conditions before designing ditches.

An effective field ditch network functions primarily to distribute water without causing excessive erosion, water losses, and/or degradation of water quality to the downstream receiving system. Properly designed and constructed agricultural ditches are very important; however, equally important is the implementation of an appropriate maintenance program to ensure that the ditches function as designed. This includes maintaining adequate vegetative cover to prevent erosion.

Groundwater Protection

Sediment movement into ground water is generally not an issue in most locations in Florida. However, areas of karst topography, where sediment and sediment-borne pollutants can enter groundwater through direct underground links (caves, conduits, sinks), are a concern in certain parts of the state. These sediments can re-emerge through a spring vent and affect water clarity and turbidity.

Sediment and Erosion Control BMPs

3.1 Road Maintenance

Minimize the amount of vegetation that is cleared when constructing roads, buildings, etc. Use silt fences when protection under sheetflow conditions is needed for up to 6 months during construction activities. Properly trench in, backfill, and compact silt fences in accordance with the Florida Stormwater, Erosion, and Sediment Control Inspector's Manual referenced below.

Level I BMPs:

✓ **1.** Stabilize access roads that cross streams and creeks, using rock crossings, culverts, or bridges.

✓ **2.** Maintain vegetative cover on road banks.

✓ **3.** When constructing above-grade access roads, follow USDA-NRCS FOTG Conservation Practice No. 560, and locate the road(s) a minimum of 25 feet from regulated wetlands.

Check with your water management district to see whether a permit is needed for above-grade access road construction.

References:

1. Farming for Clean Water in South Carolina: A Handbook of Conservation Practices. http://www.epa.gov/owow/nps/bestnpsdocs.html#agriculture
2. The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, FDEP. http://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://www.epa.gov/nps/agmm/

3.2 Ditch Maintenance

Level I BMPs:

✓ **1.** As needed, use selective control of broadleaf vegetation to maintain a permanent grass cover on ditch banks.

✓ **2.** In areas subject to high water velocities, protect ditch banks from erosion using ***rip-rap***, concrete, headwalls, or other buffering materials.

✓ **3.** Keep riser board control structures free from obstructions.

✓ **4.** Do not remove sediments below the ditch's original invert elevation, which can be determined by permit drawings, basic survey drawings, and/or changes in soil characteristics and color. Keep drawings of the design cross-sectional area.

Level II BMPs:

If your answer to the question below is "yes," implement Level II BMP 3.2.5.

Question: *Under normal hydrologic conditions, have you observed a sand bar or significant gully erosion where your drainage ditches/canals meet, or at a point where runoff exits your property?*

☐ *Yes* ☐ *No*

✓ **5.** Contact the USDA-NRCS County Office for assistance in correcting existing ditch or field erosion, and to prevent future erosion.

References:

1. USDA-NRCS, Irrigation Field Ditch, Code 388; Surface Drainage-Field Ditch, Code 607, and Surface Drainage-Main or Lateral, Code 608, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg
2. USDA-NRCS, Sediment Basin, Code 350; Structure for Water Control, Code 587; and Water and Sediment Control Basin, Code 587, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg

3.3 Middles Management

Level I BMPs:

✓ **1.** As practicable, maintain vegetative cover in row middles.

4.0 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, urban and agricultural structures) increases 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 a stormwater management system (e.g., retention or detention pond) may alter on-site hydrology, and therefore may require an ERP or other WMD surface water management permit. Check with your water management district before beginning construction of any stormwater management system.

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

4.1 Stormwater Management

Level I BMPs:

✓ **1.** Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure they perform their intended function.

Level II BMPs:

If your answer to the following question is "yes," implement Level II BMPs 4.1.2 and 4.1.3:

Question: *Does your operation have flooding issues that have not been addressed by an ERP or other WMD surface water management permit?*

☐ *Yes* ☐ *No*

✓ **2.** Develop and implement a written stormwater management plan that specifically addresses various levels of rainfall, with the goal of reducing the volume of off-site discharge. Include guidelines for regular inspection of BMPs, and steps to implement operation and maintenance provisions.

✓ **3.** Evaluate the plan's effectiveness, and make adjustments as needed.

In developing a stormwater management plan:

- Contact your local USDA-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: http://www.fema.gov/hazard/map/firm.shtm.
- 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. http://www.nrcs.usda.gov/technical/efotg
2. Water Management Districts, ERP Stormwater Quality Applicant's Handbook.
3. ANSI/ASABE, Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas, EP302.4. http://www.asabe.org/standards/index.html

5.0 WATER RESOURCES PROTECTION

Water Resources *are distinct hydrologic features, including wetlands, springs, streams, and aquifers.*

Wetlands, Springs, and Streams Protection

Under Florida Law, wetlands are areas that are 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 USDA-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 9**. 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 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

Figure 9

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 field borders, filter strips, grassed waterways, and ***riparian*** buffers, and are particularly effective in providing water quality treatment near sensitive discharge areas.

- *Field borders* are strips of permanent vegetation, either natural or planted, at the edge or perimeter of fields. They function primarily to help reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Install or maintain field borders when creating new fields adjacent to highly urbanized areas. Consider installing field borders in existing fields, based on the intensity of your operation and surrounding properties.
- *Filter strips and grassed waterways* are areas of permanent vegetation between crop field 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 in order 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 DOF 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 that agricultural operations help protect wellheads from contamination. Successful wellhead protection includes complying with regulatory requirements and using commonsense 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

5.1 Wetlands Protection

Do not dredge or fill in wetlands. Consult with the water management district and the USDA-NRCS prior to conducting activities in or near wetlands to ensure that you are complying with any permitting or USDA 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 a USDA county soil survey map to help identify the location of wetlands, hydric soils, or frequently flooded areas. If you do not have an environmental resource permit (which provides a wetlands delineation), seek technical assistance from the water management district or USDA-NRCS to determine the landward boundary of wetlands on your operation.*

Level I BMPs:

✓ **1.** Install and/or maintain a minimum 25-foot non-fertilized ***vegetated buffer*** upland of the landward boundary of all wetlands, unless you have an existing water management district permit (ERP, MSSW) that specifies a different buffer.

✓ **2.** For existing operations without an ERP that are unable to meet the 25-foot vegetated buffer, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (see BMP checklist).

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

Level II BMPs:

If your answer to the following question is "yes," implement Level II BMP 5.1.3:

Question: *Do you have ditches that discharge directly into wetlands?* ☐ *Yes* ☐ *No*

✓ **3.** Use spreader swales (or other means as needed) to intercept water discharging from the ditch(es), in order to reduce flow velocities and provide sheetflow through vegetative buffers prior to reaching the wetlands. Provide to FDACS a written description of the means you will use (see BMP checklist).

References:

1. USDA-NRCS, Wetland Enhancement, Code 659, Nutrient Management, Code 590, FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg
2. EPA, National Management Measures for the Control of Nonpoint Pollution from Agriculture. http://www.epa.gov/nps/agmm/chap4c.pdf

5.2 Streams Protection

Level I BMPs:

✓ **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, USDA-NRCS, or a Technical Service Provider for assistance in properly designing the riparian buffer in accordance with USDA-NRCS Codes 390 and/or 391 in Reference (1) below.

✓ **2.** Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function. Refer to USDA-NRCS Stream Crossing, Code 578 for design criteria.

References:

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

5.3 Protection for First- and Second-Magnitude Spring Recharge Basins

Level I BMPs:

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

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

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

References:

1. Department of Community Affairs, Protecting Florida's Springs, Land Use Planning Strategies and Best Management Practices. http://www.dca.state.fl.us/fdcp/DCP/publications/Files/springsmanual.pdf

5.4 Well Operation and Protection

When installing a new well, contact your regional water management district 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 water management district well construction permit requirements.

 Agricultural operations located in South Miami-Dade County should refer to and follow Chapter 40E-30.302, F.A.C., for general well permitting information and to determine whether they are subject to special regulations for this region. Consult Reference 4 below for more information.

Level I BMPs:

- ✓ **1.** Use backflow-prevention devices at the wellhead to prevent contamination of the water source.
- ✓ **2.** Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.
- ✓ **3.** Cap or valve wells in accordance with water management district requirements.
- ✓ **4.** Exclude crop production activities within a 75-foot radius of drinking water wellheads. This radius can be reduced to 25 feet if well-construction records show well-casing depths that extend through ***confining layers***.
- ✓ **5.**  Maintain records of new well construction and modifications to existing wells.

References:

1. USDA-NRCS Water Well, Code 642, FOTG-Section IV. http://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/rulelistnum.htm
3. SFWMD, General Permits for Water Wells within SFWMD; Thresholds for South Dade County, Rule 40E-30.302, F.A.C. https://my.sfwmd.gov/pls/portal/docs/PAGE/PG_GRP_SFWMD_ENVIROREG/PORTLET_RULESSTATUTESAND/TAB383534/40E-30.PDF
4. Florida Water Permits. http://flwaterpermits.com/

Note: *See Appendix 7 for list of record-keeping requirements and example record-keeping forms.*

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 (section 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."*

Most cultural control methods are designed to help plants avoid contact with pests, create unfavorable or avoid unfavorable conditions for pests, and eradicate or reduce the incidence of pests in a plant or field. Biological controls (and some cultural controls) aim to improve plant resistance to pests or to utilize organisms that prey upon pests. Physical methods generally are used to deter, trap, destroy, or provide barriers to pests. Chemical methods involve the use of chemical pesticides or repellants.

The basic steps of an IPM program are as follows:

- Identify key pests.
- 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).
- 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.
- Decide which pest management practices are appropriate, and implement associated corrective actions.
- 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 crop damage and what pest control method is necessary.

In Florida, migratory birds can destroy a mature fruit or nut crop. These birds can adversely affect crop yield, crop quality, and can create food safety issues through the possible transmission of bacterial and viral diseases to humans through fecal droppings.

Pests may be present for some time before they are observed or actual crop damage occurs. Therefore, it is essential to record the results of scouting in order to develop historical information, document patterns of pest activity, and document the treatment's success or failure. It is also important to determine whether the "corrective actions" actually reduced or prevented pest populations, were economical, and minimized risks. It is recommended that growers record this information, and use it when making similar decisions in the future.

Cultural Controls

Site selection, plant selection and establishment, and production techniques are 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 air circulation, which reduces the incidence of disease.

Crops near resting areas, wooded areas, power lines, and ponds are generally vulnerable to pests. Managing the habitat around crop production areas to encourage predator species of nuisance animals or reducing the habitat of the nuisance animals is another control method option. However, simply altering the habitat may not provide complete control of nuisance animals, because birds can fly 10 to 15 miles from a resting site to feed.

Biological Controls

Biological controls involve the use of natural enemies to control or suppress pests, 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.

Predators and parasites (insects, mites, and microbes) are the most commonly used biological control agents, and are known as "beneficials." These alone will generally not prevent damage from pests, but can reduce the severity. A management plan for the use of beneficials must be closely adhered to in order for it to be technically and economically effective over the long-term.

In falconry, the practice of "abatement flights" (using predator birds to chase or scare nuisance birds), is an emerging control option and has been used by California grape and cherry growers since 1995. Falcons are generally flown during morning and evening hours. One falcon can patrol anywhere from 20 to 100 acres. Use of native vegetation in borders and buffers may encourage native hawks (and owls) to reside and hunt in the area. Growers interested in finding out more about abatement flights are encouraged to contact the Florida Hawking Fraternity, or visit their website at http://www.f-h-f.org/

Physical Controls

The Environmental Protection Agency (EPA) regulates various mechanical devices and allows their use in order 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 the website http://www.epa.gov/pesticides/factsheets/devices.htm.

Restrictions Related to Controlling Migratory Bird Populations

Migratory birds are protected by the Federal Migratory Bird Treaty Act of 1918. It is illegal to take, kill or possess migratory birds, pursuant to 16 U.S.C.A. §703 and associated federal regulations. Under certain circumstances, federal depredation permits may be obtained from the United States Fish and Wildlife Service (USFWS) for the lethal control of

certain species, where non-lethal control cannot reduce the damage to acceptable levels.

It is illegal to shoot migratory birds without a federal depredation permit; therefore, growers should consult with the USFWS before taking this level of intervention. Furthermore, there can be unintended consequences in using shot. Fired shot can lodge within fruit and pose unacceptable food safety hazards. Lead shot can also contaminate acidic soil/water environments and create unintended hazardous waste issues. If shot is used, steel and other non-toxic shot are alternatives.

Non-lethal physical controls for nuisance animals include physical barriers to prevent the targeted species from getting to the crop, and sensory devices designed to frighten or disturb the targeted species (scare tactics). Affected growers should use the more passive control measures first (barriers), subsequently employing more aggressive measures as crop damage warrants.

Physical Barriers

Netting is an effective way to reduce bird damage in high-value crops. In most cases, netting is placed directly over plants or bushes, but for some fruits, such as blueberries, a framework is built and the netting is suspended from it. Fencing may offer some relief from other nuisance animals. Electric fence constructed 5 to 6 feet high may be used as a physical barrier to control deer problems.

Sensory Devices

Scare tactics generally include audible and visual sensory devices. Visual deterrents such as whirlers, streamers, scare-eye balloons, lasers, reflectors, and predator models are seldom effective if used alone. Their efficacy is increased if supplemented with sound devices such as alarms, recorded (bird) distress calls, or fireworks (which includes exploders and propane cannons). In Florida, fireworks are governed by Chapter 791, F.S.

The Occupational Safety and Health Administration regulates allowable exposure times for sound, and has determined that it is safe for humans to listen to a 100-decibel sound for up to two hours a day. High-decibel sound devices for nuisance animal control usually consist of bio-acoustics, acoustics, ultrasonics, and propane cannons as shown in **Figure 10**.

For sound devices to be effective in deterring nuisance birds, they must be managed according to the habits and characteristics of the nuisance bird species. In general, best results are obtained

Figure 10

when sounds are presented at random intervals, a range of different sounds is used, the sound source is moved frequently, and sounds are supported by other methods, such as distress calls and/or visual deterrents. Otherwise, birds will usually become accustomed to these devices. Refer to the website http://icwdm.org/handbook/birds/Dispersal.asp for more information about bird behavior and related dispersal techniques.

When using high-decibel sound devices, especially propane cannons, growers should first communicate with and inform adjacent (residential) neighbors as to the reasons for using the devices. Growers using high-decibel sound devices on lands classified as agriculture pursuant to section 193.461, F.S., that are adjacent to residential areas, must employ the following measures to mitigate the disturbance to neighbors.

- Only use sound devices when bird predation has been corroborated.
- Start control no sooner than 15 days before the crop ripens.

- Use electronic timers or sensors to activate devices during peak feeding times.
- Shut off devices 30 minutes after sunset; do not resume activities sooner than 30 minutes before sunrise.
- Use the devices in accordance with manufacturers' recommendations, paying particular attention to the recommended number of devices per acre.
- Alternate or relocate devices at least every 4 days to avoid habituation.
- If using propane cannons:
  - When using hay bales placed directly behind the cannon to muffle the sound, devices can be located within 300 feet from the nearest residence. Otherwise, locate them no closer than 450 feet from the nearest residence.
  - If the device is adjustable, use the lowest decibel-level setting effective in controlling pests.
  - Set each cannon's blast intervals to not less than three minutes apart. If using more than one cannon in the vicinity of residential areas, increase the blast intervals so that sequential firing of multiple cannons meets this restriction as much as possible.
  - Aim the devices away from adjacent residences. Employ directional noise baffle barriers if feedback from neighbors warrants.
  - Ensure that propane tank valves do not leak, causing inadvertent blasts. For updates on recalled valves and/or tanks refer to the website http://www.doacs.state.fl.us/standard/lpgas/industryupdates.html.
  - Regularly monitor bird activity to ensure the cannon's effectiveness.

Chemical Controls

The EPA and the FDACS regulate the use of pesticides in the U.S. 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 include:

- The product's registration status within Florida.
- The effectiveness of the product against the target pest.
- The potential risk of a particular pesticide for beneficial organisms (e.g., honey bees).
- The product's cost effectiveness.
- The potential hazards to applicators, bystanders (e.g., residents, nearby businesses), the environment (i.e., non-target organisms, water quality), food safety, and the viability of an orchard or fruit crop.
  - Certain pesticides may be of concern because of the potential toxicity to non-target plant, invertebrate, fish, and wildlife species.
  - Pesticide use may result in ***phytotoxicity*** to trees, foliage and/or the crop. Some combinations of pesticides or overlapping applications of incompatible materials can cause phytotoxicity.
  - Limitation of or restrictions on application areas - Product selection may be influenced by a farm's location relative to residential areas, human traffic in the vicinity, and weather conditions favoring drift of materials to non-target sites.
- Impact on development of pest resistance - Resistance develops because one or more individuals in any given pest population may tolerate or resist effects of exposure to a specific pesticide active ingredient. When used consecutively for several applications, the offspring of resistant individuals multiply, and eventually establish a resistant population. Consequently, management decisions need to consider the known impacts of a pesticide on pest resistance development. In general, repeated use of any pesticide over a short period of time should be avoided.

Repellent Pesticides

Even though the use of repellents is somewhat limited in Florida, it may be a viable option to consider. Repellents have been demonstrated to be effective on certain species. Below is a list of the registered active ingredients for repellent use in Florida:

- 4-Aminopyridine
- Capsaicin
- Denatonium saccharide
- Methyl Anthranilate
- Naphthalene
- Nicarbazin
- Polybutene
- Thiram
- Thymol

When using a repellant (or any other pesticide) on a specific fruit or nut crop, the label must be followed to ensure legal application. Growers should contact the FDACS, Division of Agricultural Environmental Services at 850-617-7940 to ensure that a particular pesticide product is registered for sale, distribution, and use in Florida.

Lethal Pesticides

Choosing the proper pesticide in this class also 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, and state and federal pesticide laws require strict adherence to label directions.

Proper records of all pesticide applications should 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: http://www.freshfromflorida.com/onestop/forms/13340.pdf.

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.

Use of native vegetation in field borders and buffers can attract beneficial insects and help reduce the imbalance in which crop pests thrive. 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 http://www.flaes.org.

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 Use

Level I BMPs:

- ✓ **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 and/or surface waters. Where permanent facilities are not practicable, use portable mix/load stations.
- ✓ **3.** When field mixing is necessary, conduct loading activities at random locations in the field, with the aid of nurse tanks if applicable. Use a check valve or air gap separation to prevent backflow into the tank when filling a sprayer.

References:
(See Appendix 2 for additional references)

1. FDACS/FDEP, Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance Manual. http://www.floridaagwaterpolicy.com/BestManagementPractices.html
2. UF-IFAS, Integrated Pest Management Program. http://ipm.ifas.ufl.edu/
3. Southern Region Integrated Pest Management Center. http://www.sripmc.org/
4. UF-IFAS, Protecting Water Resources from Agricultural Pesticides, CIR PI-1. http://edis.ifas.ufl.edu/PI001

APPENDICES

APPENDIX 1: ACRONYM LIST AND GLOSSARY

Advective Freezes: Occurs when a cold air mass ranging from 500 to more than 5,000 feet above land moves into an area bringing freezing temperatures. Wind speeds are usually above 5 mph and clouds may be present. Attempts to protect crops by modifying the environment are very limited under these conditions

Aquifer: Soil or rock formation that contains ground water 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

BMAP: Basin Management Action Plan

Calcareous: Mostly or partly composed of calcium carbonate, in other words, containing lime or being chalk-like

Chelation: Process by which a molecule can form several bonds to a single metal ion.

CNR: Crop Nutrient Requirement

Conveyance Capacity: The amount of flow (generally expressed in cubic feet per second) that a canal/ditch can carry based on the size, shape, slope, and condition of the canal/ditch

Confining Layer: A layer of earth material, usually clay, which does not readily transmit water; thus restricting the vertical movement of water into and out of an aquifer

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

Deciduous Crops: These include trees, shrubs and herbaceous perennials, which lose all of their leaves for part of the year

Dew Point Temperature: The temperature to which air must be cooled, at constant barometric pressure, for water vapor to condense into water. When the dew point temperature falls below freezing, it is often called the frost point, as the water vapor then becomes frost

DOF: Division of Forestry

EDIS: Electronic Document Information System

EPA: Environmental Protection Agency

ERP: Environmental Resource Permit

Evapotranspiration (ET): The combined loss of water through evaporation and emission of water vapor 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

FEMA: Federal Emergency Management Agency

FIRM: Flood Insurance Rate Map

FOTG: Field Office Technical Guide

F.S.: Florida Statutes

GIS: Geographical Information Systems

IPM: Integrated Pest Management

MGD: Million Gallons Per Day

MIL: Mobile Irrigation Lab

MPH: Miles per Hour

MSSW: Management and Storage of Surface Waters

N-P-K: Nitrogen, Phosphorus and Potassium

NOI: Notice of Intent

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

Permanent Wilting Point: The level of soil moisture at which plants wilt and fail to recover their turgidity

Phytotoxicity: The toxic effect of a compound on plant growth. Such damage may be caused by a wide variety of compounds, including trace metals, pesticides, or salinity

PSI: Pounds per Square Inch

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

Rip-rap: Large, loose angular stones that serve as a permanent erosion-resistant ground cover

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

Septage: A mixture of sludge, fatty materials, human feces, and wastewater removed during the pumping of an onsite sewage treatment and disposal system

Sequestering Agents: A chemical compound used to tie up undesirable ions, keep them in solution, and eliminate or reduce their effects

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

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.

USDA-NRCS: United States Department of Agriculture, Natural Resources Conservation Service

USFWS: United States Fish and Wildlife Service

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

Wet Bulb Temperature: The lowest temperature that can be reached by the evaporation of water only; it is an indication of the amount of moisture in the air

Wetlands: As defined in section 373.019(25), F.S., wetlands means those areas that are inundated or saturated by surface water or ground water 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.

WMDs: Water Management Districts

APPENDIX 2: ADDITIONAL BMP REFERENCES

General BMP References

1. *The Florida Irrigator's Pocket Guide*

This guide, developed by the National Center for Appropriate Technology, lists both water management and equipment management practices, and includes a schedule of common maintenance tasks. The guide also focuses on conserving and protecting water, soil, energy and natural resources. Currently, this guide does not reside on any website.

2. *Southern Region Small Fruits Consortium*

The Consortium has developed integrated management guides for blueberries, brambles, and grapes. The guides focus on sprayer calibration and integrated pest management strategies. They can be found at:

http://www.smallfruits.org/SmallFruitsRegGuide/index.htm

3. *The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual*

To improve the lack of compliance with BMPs for Florida's stormwater regulatory program, the Department of Environmental Protection has developed a training program curriculum on the use, installation, and maintenance of erosion, sedimentation, and stormwater BMPs. The training program is primarily directed towards inspectors and contractors, however, permit reviewers and public works personnel will also benefit from this program. The manual can be found at: http://www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

4. *Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops*

This publication, developed by University of Minnesota Extension addresses differences between the composition of fresh and composted manure, nutrient availability from manure/compost, and a calculation method of how much manure/compost to apply. The publication can be found at: http://www.extension.umn.edu/distribution/horticulture/M1192.html

University of Florida – Institute of Food and Agricultural Sciences References

1. *Integrated Pest Management Strategies, UF-IFAS Circular 1149*

This circular describes the principles of integrated pest management (IPM) and recommends strategies for implementation. This publication is no longer available on the internet. Contact your local county extension agent.

2. *South Florida Tropical Fruit Growers Perspectives: Water Conservation Management Practices, UF-IFAS.*

This publication summarizes research done on Miami-Dade's tropical fruit production and provides general information on the most common water quality and quantity Best Management Practices done by growers.

http://edis.ifas.ufl.edu/pdffiles/AE/AE39600.pdf

3. *Electronic Data Information Source*

This is an electronic publication database with thousands of publications on agricultural practices for nearly any agricultural enterprise in the state of Florida, including specialty fruit and nut crops. http://edis.ifas.ufl.edu

4. *Fruitscapes*

This website is an extension of UF-IFAS and provides information on temperate, subtropical, and tropical fruit. It has links for each individual fruit or nut and connects recent research to appropriate management and growing strategies. The website can be found at http://trec.ifas.ufl.edu/fruitscapes/

5. *The Pecan Tree, UF-IFAS Publication HS229*

This publication describes strategies for production of pecans in Florida, and can be found at http://edis.ifas.ufl.edu/HS229

USDA – Natural Resources Conservation Service References

All references below accessed at:
http://www.nrcs.usda.gov/technical/eftog

1. Conservation Practice Standard No. 342 (Critical Area Planting)
2. Conservation Practice Standard No. 362 (Diversion)

3. Conservation Practice Standard No. 464 (Irrigation Land Leveling)
4. Conservation Practice Standard No. 460 (Land Leveling)
5. Conservation Practice Standard No. 412 (Grassed Waterway)
6. Conservation Practice Standard No. 393 (Filter Strip)
7. Conservation Practice Standard No. 441 (Micro-Irrigation)

Additional References on Integrated Pest Management

1. Southeast Regional Blueberry Integrated Management Guide.
2. USDA, Booth, Thurman. 1994. Bird Dispersal Techniques.Animal and Plant Health Inspection Service.
3. Connecticut Department of Agriculture. 2004. Crop Protection Permit Application.
4. Curtis, Paul., Fargione, Michael. Birds. Cornell University, College of Agriculture and Life Sciences.
5. Curtis Nelms, et.al., 1990. Assessment of Bird Damage to Early-Ripening Blueberries in Florida. Vertebrate Pest Conference Proceedings, pgs. 302-306.
6. Florida Department of Environmental Protection. 2004. Best Management Practices for Environmental Stewardship of Florida Shooting Ranges. Bureau of Solid and Hazardous Waste.
7. Fraser, et.al. 1998. Bird Control on Grape and Tender Fruits. Ontario Ministry of Agriculture, pgs.1-14.
8. International Commission on Biological Effects of Noise. 2001. Calculations with Sound Power Level for Industrial Areas.
9. Michigan Department of Agriculture. 2008. Generally Accepted Agricultural and Management Practices for Pesticide Utilization and Pest Control, pg.7.
10. Midwest Small Fruit Pest Management Handbook. Reducing Bird and Other Wildlife Damage in Berries and Grapes, pgs. 192-194.
11. UF-IFAS, Smith, Hugh., Capinera, John. 2005. Natural Enemies and Biological Control. ENY-822.
12. Gary D., Zon Manufacturing Representative, 1-800-657-8214, Personal Conversation 1/26/09
13. National Farmers' Union. 2006. Bird Scarers Code of Practice.
14. Bishop, J., et.al., 2003. Review of International Research Literature Regarding the Effectiveness of Auditory Bird Scaring Techniques and Potential Alternatives. England Department for Environment, Food and Rural Affairs, pgs. 2-52.

APPENDIX 3: 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:

- soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

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 is. Samples collected from areas that differ from typical characteristics of the farm should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area on the farm that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the UF-IFAS Extension Fact Sheet SL181 for further information on soil sampling strategies and/or to obtain the appropriate soil test sheet which can be found at: http://soilslab.ifas.ufl.edu/ESTL%20Tests.asp

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 UF-IFAS Soil Testing Laboratories for different soils in Florida:

a) Mehlich-1 extraction - this method is performed on all acid-mineral soils up to a soil pH of 7.3.

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

3) Water extraction - this method is used for extraction of P in all organic soils.

4) Acetic acid extraction - this method is performed on all organic soils for extraction of K, Mg, Ca, Si, and Na.

It is extremely important that procedures used at the laboratories are well understood before submitting the samples since most BMPs are tied to the standardized procedures used by the labs at the land-grant universities in the state such as UF-IFAS. Similarly, it is also very important to note that the UF-IFAS laboratory does not offer any test for N since 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 UF-IFAS Extension Soil Testing Laboratory in Gainesville can be found in the extension publication, Circular 1248.

Interpretation of Test Results: The primary goal of state laboratories in offering the soil testing service is to provide interpretation of the soil test results based on soil test-crop response trials and field calibration of the test results with the optimum economic yields of the various plant species. 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. Current interpretation tables can be obtained from SL 189, UF-IFAS extension fact sheet.

Nutrient Recommendations: To reiterate, nutrient recommendations based on soil test results are formulated based on the optimum economic crop response to an added nutrient to the soil.

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 blades, leaves or dried petioles or on sap from fresh petioles, with results compared to recommended nutrient ranges.

Efficient fertilizer management is important to reduce costs, conserve natural resources, and to minimize potential impacts on the environment. These goals can be achieved through optimum management of the fertilizer component. Timely tissue testing is an important tool used in fertilizer management through monitoring the plant's nutritional status, and such testing is also used in diagnosing suspected problems like nutritional deficiency, toxicity or imbalance. As a management

tool, tissue testing can increase your return by preventing deficiencies that can reduce yield(s), market quality, and profitability.

Methodology: Begin sampling soon after the crop is established and continue at regular intervals (weekly or biweekly). Individual plants, even side-by-side, may have different nutritional status. Therefore, by sampling a sufficiently large number of plants, the effect of this error due to inherent variability should be minimized. It is preferable to include a soil sample together with a tissue sample when submitting samples to a diagnostic lab, since the soil sample may indicate other factors - such as pH - that may influence crop growth, nutrient availability, and uptake. Avoid plant tissue testing if the field has received foliar nutrient sprays containing micronutrients or nutrient-containing pesticides. Also, avoid sampling plants damaged by pests, diseases, or other chemicals when trying to monitor the nutritional status of the sod.

Whole-leaf sampling will be most useful early in the season, while later in the season, it can help to point to changes in fertilization practices that are needed for the next season. Fresh petiole sap testing for N and K, practiced regularly throughout the season, can help manage the current crop as well as provide guidance for the next crop. Sample a recently matured leaf blade. Collect enough leaf material so that the sample is representative of the crop stand, and that the sample is large enough to perform the required analyses.

If a deficiency is suspected, collect one *composite sample* from the area exhibiting the disorder and a second sample from an otherwise "normal" section for comparison when trying to diagnose a nutrient deficiency. Separate and properly label the "disorder" sample and the "normal" sample in order to make a valid comparison after analyses. Keep notes on condition of the sod and stage of growth, weather, and other variables for future reference.

Be careful not to crush or damage samples during cleansing. Avoid using tap water to rinse blade samples, since it can be high in nutrients such as calcium, iron, magnesium, or sulfate sulfur. Use distilled water instead. In most situations, cleansing is not needed. Blot the samples dry with absorbent paper after rinsing, and air-dry the samples several hours before shipment. Wrap the samples in absorbent paper and place them in a large envelope if a plant analysis kit is not available, and mail immediately.

Select a reputable laboratory that provides interpretations and recommendations based upon test results, which are appropriate for your growing region. Interpretation guidelines should be based on actual field research, not on "typically observed" or historical lab databases. The laboratory should be reliable and accredited and also offer a routine turnaround of less than 48 hours.

For more information please see SL 131, Plant Tissue Information Sheet, Soil and Water Science Department, at: http://edis.ifas.ufl.edu/SS182.

References:

1. Sartain, J.B. 2001. Soil Testing and Interpretation for Florida Turfgrasses. SL181. Soil and Water Science, Cooperative Extension Service. IFAS, p. 2. http://edis.ifas.ufl.edu/SS317.
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. Mylavarapu, R.S. 2002. The Process of Standardized Nutrient Recommendation Development for Successful Crop Production and Environmental Protection. SL 189, Soil and Water Science, Cooperative Extension Service, IFAS. http://edis.ifas.ufl.edu/SS401.

APPENDIX 4: INCENTIVE PROGRAMS FOR QUALIFYING FARMS

The 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 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 farmers 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 farmers and operators for the restoration of farmlands on which normal farming 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 USDA-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 USDA-NRCS FOTG. Because not all the specific BMPs in this manual may be contained in the FOTG, Conservation Plans developed under this manual must also include the applicable Level I and II BMPs. Assistance in developing a plan can be obtained through the local Soil and Water Conservation District (SWCD), the USDA-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 USDA-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 USDA-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: In order to assist agricultural producers 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 water management districts 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, the Water Management District, or the Florida Department of Agriculture and Consumer Services. Information and links to other sites are also available on the Internet at the following web site: www.floridaagwaterpolicy.com

APPENDIX 5: INSTALLING NEW IRRIGATION SYSTEMS: DESIGN CONSIDERATIONS

Drip Irrigation (Grove, Orchard)

Drip irrigation involves a low-volume, low-pressure system and is generally considered a desirable option for grove/orchard irrigation. The system consists of buried PVC pipe mains and sub-mains with ½" to ¾" polyethylene laterals. Water application is controlled by drip emitters, which either are attached to the laterals or are an integral part of the system. Laterals may be on the ground surface, totally buried, or buried with emitters pointed to the surface. The output rate (usually 1 to 2 gallons/hour) and number of emitters per tree depends on the type of tree, the tree size, and tree-spacing requirements. Pressure-compensating emitters are preferred; however, if non-pressure compensating emitters are used, the system should be designed such that emitter pressures do not significantly vary from the design operating pressure.

Seepage Irrigation

Seepage irrigation artificially raises the water table. It is a fundamental irrigation method for "top-down" irrigation of crops that cannot tolerate saturated growing conditions. Depending on the crop type, seepage irrigation may be employed as a semi-closed or flood system. Growers should note that water management district, state, and/or federal cost-share funding may be available to convert seepage irrigation to a more efficient system.

- A semi-closed system utilizes a series of rows and spigots, allowing water to run down the field through furrows to saturate the field and raise the water table. While still effective, this method can result in the offsite discharge of irrigation water. This not only wastes water, but also leaches fertilizers more quickly.
- Flood irrigation is used more typically in regions with very little or no topographic relief. Using this technique, a great deal of water is required to hydrate large areas by filling perimeter ditches. This method is highly inefficient, costly, and difficult to manage.

Micro-sprinklers (Grove, Orchard)

Micro-sprinklers are commonly used in groves/orchards as an alternative to drip irrigation. These systems are commonly used on citrus, pecans, peaches and other tree fruits.

Micro-sprinkler systems are very similar to drip systems, with buried PVC mains and sub-mains and polyethylene laterals. Water application is controlled by a small plastic sprinkler attached to a plastic stake, and water is supplied from the lateral by a small diameter supply tube. Output rates can vary from 5 to 50 gallons per hour, and sprinkler heads can be changed to accommodate different spray patterns. Depending on tree size and spacing, there will usually be either one or two micro-sprinklers per tree. To ensure uniform water distribution, the system should be designed so that micro-sprinkler pressures do not vary more than plus or minus 10 percent from the design operating pressure.

Some reasons for using micro-sprinklers include:

- Water quality concerns can be minimized by using less water.
- Sites with deep sandy soils will produce a better wetted perimeter.
- Ease of detecting problems such as leaks and clogged emitters.

Traveling Gun

This term refers to either cable-tow or hard-hose traveling sprinkler systems. The primary advantage of traveler systems is that they can be easily moved from field to field and are well suited to fields of irregular size and shape. While travelers tend to have the poorest overall water-use efficiency among sprinkler alternatives, they are easy to move around.

Regardless of the drive mechanism, new traveler systems should be equipped with hard-hose systems so that the sprinkler cart travels at a uniform speed from the beginning of the pull until the hose is fully wound onto the hose reel. Nozzle sizes on gun type travelers are typically ½ to 2 inches in diameter and require high operating pressures of 75 to 100 PSI at the gun for uniform distribution. Nozzle type (ring versus taper bore) should be selected to match irrigation application rates to soil infiltration rates.

Solid Set

Solid-set systems include both portable-pipe and buried systems. These systems may be preferable for high-value crops. For maximum water savings, sprinklers should have a reduced angle that is below 23 degrees trajectory. A solid-set system should be designed to maintain adequate pressure and provide overlap. Solid-set systems with automatic controllers are well suited for irrigating during non-peak evapotranspiration periods, although larger nozzles or additional system components may be needed to compensate for peak periods.

 High-volume solid-set irrigation systems are very common in the tropical/ subtropical fruit crop industry of south Florida. Generally, these systems are designed to put out 0.2 to 0.4 inches of water per acre per hour. Properly managed, these systems are useful for irrigating to meet crop water needs and for freeze protection.

For more information about irrigation systems and related water conservation practices, go to: http://www.nespal.org/SIRP/IWC/Report/conserv.rpt980728.pdf.

APPENDIX 6: CHEMIGATION/FERTIGATION STATUTORY REFERENCES

487.064 Antisiphon requirements for irrigation systems.

(1) Any irrigation system used for the application of pesticides must be equipped with an antisiphon device adequate to protect against contamination of the water supply. The requirements of this section shall also apply to water supply lines to pesticide mixing-loading equipment other than those systems which incorporate a physical gap between the water source and the application equipment.

(2) It is unlawful for any person to apply chemicals through an irrigation system which is not equipped with an antisiphon device as required by this section, or to mix and load pesticides for application unless there is a physical gap or its equivalent between the line from the water source and the application equipment.

(3) The department may establish by rule specific requirements for antisiphon devices and for sites where pesticide mixing-loading occurs.

(4) Any governmental agency which requires antisiphon devices on irrigation systems used for the application of chemicals shall use the specific antisiphon device requirements adopted by the department.

576.087 Antisiphon requirements for irrigation systems.

(1) Any irrigation system used for the application of fertilizer must be equipped with an antisiphon device adequate to protect against contamination of the water supply.

(2) It is unlawful for any person to apply fertilizer through an irrigation system which is not equipped with an antisiphon device as required by this section.

(3) The department shall establish specific requirements for antisiphon devices.

(4) Any governmental agency which requires antisiphon devices on irrigation systems used for the application of fertilizer shall use the specific antisiphon device requirements adopted by the department.

Note: *The FDACS Bureau of Compliance Monitoring is responsible for antisiphon requirements. Go to their website for more information at: http://www.flaes.org/complimonitoring/index.html*

APPENDIX 7: EXAMPLE RECORD-KEEPING FORMS

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

1.2.5 Keep records of all nutrient applications. Include, at a minimum: date of application, total amount applied, acreage covered, fertilizer analysis or grade, rate per acre, and application method.

2.1.2 Keep records of total rainfall received, using on-site rain gauges.

2.2.6 Maintain a record-keeping system for inspection and maintenance of all irrigation system components.

3.2.4 Keep drawings of the design cross-sectional area of ditches.

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

The tables below serve as a set of templates to develop your own record-keeping system. You may maintain your records as hard copies or in an electronic format, depending on your preference. You may use these tables, develop your own, or choose commercially available record-keeping software suited to your commodity.

Soil Sample Records *(Retain all Lab Results)*				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Tissue Sample Records				
Sample Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Fertilization/Nutrient Records *(Retain all Receipts)*						
Date	**Location**	**Acreage Covered**	**Type**[1]	**Formulation**[2]	**Grade**[3]	**Rate (Lbs/Acre)**

Rainfall *(in.)*											
Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**

Well Records					
Location	**Year Constructed**	**Constructed By**	**Last Modified**	**Modified By**	**Records Location**

[1] Organic, Inorganic, Chemical
[2] Granular, Water Soluble, etc.
[3] e.g. 10-10-10

APPENDIX 8: CONTACT INFORMATION

Emergency Information

Emergency Reporting Numbers

State Warning Point *(24 hours/Toll-Free)* 1-800-320-0519
Division of Emergency Management - contact in case of oil or hazardous substance spill.

Emergency Information and Follow-Up Numbers

State Warning Point Information Line *(Monday – Friday 8:00 am - 5:00 pm)* 850-413-9900

DEP Emergency Response *(Monday – Friday 8:00 am - 5:00 pm)* 850-245-2010

State Emergency Response Commission 1-800-635-7179
For follow-up reporting only.

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) 488-3731	
Bureau of Pesticides	(850) 487-0532	
Bureau of Compliance Monitoring	(850) 488-8731	
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) 807-3300	
Central District Office (Orlando)	(407) 894-7555	
Southeast District Office (West Palm)	(561) 681-6600	
Southwest District Office (Tampa)	(813) 632-7600	
South District Office (Ft. Myers)	(941) 332-6975	
Water Management Districts	**www.flwaterpermits.com**	
Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. John's 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

USDA-NRCS - Florida Office (Gainesville) ..... (352) 338-9500

UF-IFAS Extension Administration ..... (352) 392-1761

Association of Florida Conservation Districts ..... (407) 321-8212
Soil and Water Conservation Districts

Florida Fruit and Vegetable Association ..... (321) 241-5200

APPENDIX 9: RULE 5M-13

CHAPTER 5M-13
BEST MANAGEMENT PRACTICES FOR FLORIDA SPECIALTY FRUIT AND NUT CROP OPERATIONS

5M-13.001 Purpose.

The purpose of this rule is to effect pollutant reduction through the implementation of agricultural Best Management Practices (BMPs) that may be determined to have minimal individual or cumulative adverse impacts to the water resources of the state.

Rulemaking Authority 403.067(7)(c)2., 570.07(10), 570.07(23) FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-25-11.

5M-13.002 Approved Best Management Practices.

The manual titled Water Quality/Quantity Best Management Practices for Florida Specialty Fruit and Nut Crops (2011 Edition), DACS P-01589, is hereby adopted and incorporated by reference. Copies of the manual may be obtained from the University of Florida Cooperative Extension Service county office or from the Florida Department of Agriculture and Consumer Services (FDACS), Office of Agricultural Water Policy, 1203 Governor Square Boulevard, Suite 200, Tallahassee, FL, 32301 or accessed online at http://www.flrules.org/Gateway/reference.asp?No=Ref-00258

Rulemaking Authority 403.067(7)(c)2., 570.07(10), 570.07(23) FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-25-11.

5M-13.003 Presumption of Compliance.

Pursuant to Section 403.067(7)(c)3., F.S., agricultural operations that implement 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 are presumed to comply with state water quality standards, and are released from the provisions of Section 376.307(5), F.S., for those pollutants. In order to meet the requirements for a presumption of compliance and release from Section 376.307(5), F.S., the producer must:

(1) Submit a Notice of Intent to Implement, as provided in Rule 5M-13.004, F.A.C., that identifies the applicable BMPs;

(2) Implement all applicable BMPs in accordance with the timeline requirements in Rule 5M-13.004, F.A.C.; and

(3) Maintain records to document the implementation and maintenance of the identified BMPs, in accordance with Rule 5M-13.005, F.A.C.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23) FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-25-11.

5M-13.004 Notice of Intent to Implement.

A Notice of Intent to Implement (NOI) and the accompanying BMP Checklist, both of which are in the Appendix of the manual referenced in Rule 5M-13.002, F.A.C., shall be submitted to the FDACS Office of Agricultural Water Policy, 1203 Governor Square Boulevard, Suite 200, Tallahassee, Florida 32301. The Notice of Intent to Implement Water Quality/Quantity BMPs for Florida Specialty Fruit and Nut Crops (DACS-01548, Rev. 06/10), hereby adopted and incorporated by reference, may be obtained from FDACS or accessed online at http://www.flrules.org/Gateway/reference.asp?No=Ref-00266

(1) The NOI shall include:

(a) The name of the property owner, the location of the property, and the property tax ID number(s) or other 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 land owner, lease holder, or an authorized agent; and

(e) A BMP Checklist with a schedule for implementation, as contained in the manual. The producer shall select the applicable BMPs by following the instructions in the manual. Except as provided in the manual, all applicable Level I BMPs must be implemented as soon as practicable, but no later than 18 months after submittal of the Notice of Intent to Implement.

(2) Submittal of the NOI enables the producer to receive assistance with BMP implementation.

Rulemaking Authority 403.067(7)(c)2., 570.07(10), 570.07(23) FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-25-11.

5M-13.005 BMP Record Keeping.

Participants must keep records as directed in the manual to document implementation and maintenance of the practices submitted to FDACS. Records must be retained for at least 5 years. All records are subject to inspection.

Rulemaking Authority 403.067(7)(c)2., 570.07(10), 570.07(23) FS. Law Implemented 403.067(7)(c)2. FS. History–New 5-25-11.

APPENDIX 10

Notice of Intent to Implement Form 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 BMPs FOR
FLORIDA FLORIDA SPECIALTY FRUIT AND NUT CROPS

Rule 5M-13.004, F.A.C.

- **Complete all sections of the Notice of Intent** (NOI). Each NOI may list only properties that are within the same county and are owned or leased by the same person or entity, and on which applicable BMPs will be identified and implemented under this manual.
- Submit the **NOI**, along with 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 http://www.freshfromflorida.com/onestop/forms/01548.pdf to obtain an electronic version of this Notice of Intent to Implement (NOI) form.

If you would like assistance in completing this NOI form or the BMP Checklist, or in 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: _____

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: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

FLORIDA SPECIALTY FRUIT AND NUT CROP BMP CHECKLIST

Checklist Instructions

Note: Before you fill out this checklist, follow the section on BMP Enrollment and Implementation, which begins on page 9 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.

1. Check "In Use" for each BMP that you are currently practicing and will continue to practice.

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. However, if you need more time to implement practice 5.2.1, you must provide justification in the section provided at the end of the checklist.

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.

		In Use/CP#	Planned	Will not implement *(check reason below)*			
BMP #	**BMP Group** (See body of manual for full description)	**Check/ or AMU**	**Month/ Year**	**NA**	**TNF**	**ENF**	**Other**
	1.0 Nutrient Management						
	1.1. Level I – Soil and Tissue Testing						
	1. In non-amended mineral soils, base fertilization rates for P on soil test-based recommendations from a lab that uses a method accepted by the UF/IFAS Extension Soil Testing Laboratory. Keep a copy of all laboratory test results. In amended soils or rockland soils of south Miami-Dade County, use tissue testing as an alternative to determine P fertilization needs.						
	2. Use tissue testing to diagnose the effectiveness of a fertilization program and to determine the need for and appropriate amount of supplemental fertilizer applications. Keep a copy of all laboratory test results.						
	1.2. Level I – General Fertilizer Management						
	1. If available, use the IFAS-recommended fertilization rates for your crop for N, P, and K. If IFAS recommendations are not available, use another credible source, such as U.S. land grant institutions, other recognized universities, or USDA. If using a source other than IFAS, list the source in the comments section at the end of the BMP checklist.						

BMP #	BMP Group (See body of manual for full description)	In Use/CP# Check/ or AMU	Planned Month/ Year	Will not implement *(check reason below)* NA	TNF	ENF	Other
	2. Store fertilizers in a manner that protects them from wind and rainfall.						
	3. Calibrate fertilizer application equipment for maximum distribution uniformity.						
	4. When applying soluble fertilizers, use smaller, more frequent (split) applications to minimize the potential for leaching.						
	5. Keep records of all nutrient applications. Include, at a minimum: date of application, total amount applied, acreage covered, fertilizer analysis or grade, % of controlled-release fertilizer (if applicable), rate per acre, and application method.						
	1.3. Level I – Fertigation						
	1. Based on the flow rate of the irrigation system, calibrate the injection system while the irrigation system is operating. Operating pressures and flow characteristics will influence the injection rate.						
	2. Use highly water-soluble fertilizer sources and inject fertilizer on a frequent (e.g., daily or weekly) basis, depending upon your fertilization and irrigation schedule. Application of small amounts more frequently will reduce the potential for leaching beyond the root zone.						
	1.4. Level I – Other Nutrient Sources						
	1. If using reclaimed water, adjust your nitrogen and phosphorus fertilization rates to account for the nutrient content in the reclaimed water, based on the water quality data from the water supplier.						
	2. If using composted manure or biosolids, determine their nutrient concentrations before using them, and adjust fertilization rates accordingly.						
	2.0 Irrigation Management						
	2.1. Level I – Irrigation Decision-Making and Management Practices						
	1. Use available tools and data to assist in making irrigation decisions, such as on-site soil moisture sensors to determine available soil moisture, crop water use information, and weather data pertinent to your farm. Real-time weather data is available by visiting FAWN, USGS, and water management district websites. If one is available, get a Mobile Irrigation Lab evaluation to assist you.						
	2. Keep records of total rainfall received, using on-site rain gauges.						
	3. Install rain shutoff devices on irrigation systems.						
	4. Minimize application losses due to evaporation and wind drift by irrigating early in the morning, late in the afternoon, at night, and/or when cloud cover is abundant and wind speed is minimal.						

BMP #	BMP Group (See body of manual for full description)	In Use/CP# Check/ or AMU	Planned Month/ Year	Will not implement *(check reason below)* NA	TNF	ENF	Other
	5. Do not irrigate beyond field capacity. When irrigation needs are greater (during long, warm days when the crop is near harvest) or when plants are flowering or developing fruit, splitting irrigation events into 2 or 3 daily applications may be of benefit.						
	6. When sub-surface irrigation is used, maintain the water table at a level no higher than necessary to reach plant roots.						
	2.2. Level I – General Irrigation System Maintenance						
	1. Test irrigation source water quality to detect issues with water chemistry that may affect maintenance needs (e.g., related to chemical precipitation and clogging) and fertilization requirements. Adjust your maintenance actions as needed.						
	2. Maintain pump stations and wells, and related components, in good working order. Check them at least monthly, and more frequently during periods of high use. Replace parts as needed.						
	3. Use water meters (flow or volume) or other measuring devices/ calculations to determine how much water is applied to the irrigated area. Document this information and use it to help you determine how well your irrigation system and irrigation schedule are working, and make any needed schedule adjustments or system repairs.						
	4. Monitor water meters or other measuring devices for unusually high or low readings to detect possible leaks or other problems in the system. Make any needed repairs.						
	5. If one is available, get an MIL to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years.						
	6. Maintain a record-keeping system for inspection and maintenance of all irrigation system components. Records should be compared over time for any changes that would indicate problems with the system.						
	2.3. Level I – Pressurized Irrigation Systems						
	1. Examine sprinkler nozzles or emitters for wear and malfunction, and replace them as necessary.						
	2. Clean and maintain filtration equipment so it will operate within the recommended pressure range.						
	3. Flush irrigation lines regularly to prevent emitter clogging. To reduce sediment build up, make flushing part of a regular maintenance schedule. If fertigating, prevent microbial growth by flushing all fertilizer from the lateral lines before shutting down the irrigation system.						
	2.4. Level I – Non-Pressurized Irrigation Systems						
	1. Clean debris and control weeds in irrigation ditches and canals, to maintain water flow and direction.						

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
2.	Keep water-level-control structures (such as culverts and risers) in irrigation ditches in good working order.						
2.5.	**Level I – Reclaimed Water**						
1.	As needed, design or retrofit irrigation systems to handle reclaimed water, taking into account source water quality and delivery pressures.						
2.	Separate reclaimed water supplies from existing ground or surface water sources to prevent cross-contamination.						
2.6.	**Level I – Special-Case Irrigation Measures**						
1.	When using irrigation for frost/freeze protection, monitor wet-bulb temperatures to conserve water as much as possible. You can find this information at http://fawn.ifas.ufl.edu/tools/.						
2.	If practicable for your operation, use alternative frost/freeze protection measures, such as application of foam material, synthetic row covers, and/or soil banking, among others.						
3.	During a drought, closely monitor soil moisture levels. Whenever practicable, irrigate at times when the least amount of evaporative loss will occur.						
3.0	**Sediment and Erosion Control Measures**						
3.1.	**Level I – Road Maintenance**						
1.	Stabilize access roads that cross streams and creeks, using rock crossings, culverts, or bridges.						
2.	Maintain vegetative cover on road banks.						
3.	When constructing above-grade roads, follow USDA-NRCS FOTG Conservation Practice No. 560, and locate the road(s) a minimum of 25 feet from regulated wetlands.						
3.2.	**Level I – Ditch Maintenance**						
1.	As needed, use selective control of broad leaf vegetation to maintain a permanent grass cover on ditch banks.						
2.	In areas subject to high water velocities, protect ditch banks from erosion using rip-rap, concrete, headwalls, or other buffering materials.						
3.	Keep riser board control structures free from obstructions.						
4.	Do not remove sediments below the ditch's original invert elevation, which can be determined by permit drawings, basic survey drawings, and/or changes in soil characteristics and color. Keep drawings of the design cross-sectional area.						
5.	**Level II – Check Dams / Sediment Traps**						
	Under normal hydrologic conditions, have you observed a sand bar or significant gully erosion where your drainage ditches/canals meet or at a joint where runoff exits your property?						
	Contact the USDA-NRCS County Office for assistance in correcting existing ditch or field erosion, and to prevent future erosion.						

BMP #	BMP Group (See body of manual for full description)	In Use/CP# Check/ or AMU	Planned Month/ Year	Will not implement *(check reason below)* NA	TNF	ENF	Other
3.3.	**Level I – Middles Management**						
1.	As practicable, maintain vegetative cover in row middles.						
	4.0 Stormwater Management						
4.1.	**Level I – Stormwater Management**						
1.	Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure they perform their intended function.						
2.	**Level II – Stormwater Management Plan**						
	Does your operation have flooding issues that have not been addressed by an ERP or other WMD sutface water management permit?						
	Develop and implement a written stormwater management plan that specifically addresses various levels of rainfall, with the goal of reducing the volume of off-site discharge. Include guidelines for regular inspection of BMPs, and steps to implement operation and maintenance provisions.						
3.	Evaluate the plan's effectiveness, and make adjustments as needed.						
	5.0 Water Resources Protection						
5.1.	**Level I – Wetlands Protection**						
1.	Install and/or maintain a minimum 25-foot non-fertilized vegetated buffer upland of the landward boundary of all wetlands, unless you have an existing water management district permit (ERP, MSSW) that specifies a different buffer.						
2.	For existing operations without an ERP that are unable to meet the 25-foot vegetated buffer, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (see Comments Section at the end of this BMP checklist).						
3.	**Level II – Channelized Discharge to Wetlands**						
	Do you have ditches that discharge directly into wetlands?						
	Use spreader swales (or other means as needed) to intercept water discharging from the ditch(es), in order to reduce flow velocities and provide sheetflow through vegetative buffers prior to reaching the wetlands. Provide to FDACS a written description of the means you will use (see Comments Section at the end of this BMP checklist).						
5.2.	**Level I – 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 a Technical Service Provider for assistance in properly designing the riparian buffer in accordance with USDA-NRCS Codes 390 and/or 391 in Reference (1) below.						

BMP #	BMP Group (See body of manual for full description)	In Use/CP# Check/ or AMU	Planned Month/ Year	Will not implement *(check reason below)* NA	TNF	ENF	Other
	2. Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function. Refer to USDA-NRCS Stream Crossing, Code 578 for design criteria.						
	5.3. Level I – Protection for First- and Second-Magnitude Springs Recharge Basins						
	1. Install and/or maintain a 100-foot vegetated, non-fertilized buffer upland of the landward boundary of springs and spring runs.						
	2. Install and/or maintain a 50-foot vegetated, non-fertilized buffer around sinkholes and other karst features.						
	3. If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other refuse.						
	5.4. Level I – Well Operation and Protection						
	1. Use backflow-prevention devices at the wellhead to prevent contamination of the water source.						
	2. Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.						
	3. Cap or valve wells in accordance with water management district requirements.						
	4. Exclude crop production activities within a 75-foot radius of drinking water wellheads. This radius can be reduced to 25 feet if well-construction records show well-casing depths that extend through confining layers.						
	5. Maintain records of new well construction and modifications to existing wells.						
	6.0 Integrated Pest Management						
	6.1. Level I – Pesticide Use						
	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 mixlload facility with an impermeable surface, and locate it at least 100 feet from wells and/or surface waters. Where permanent facilities are not practicable, use portable mixlload stations.						
	3. When field mixing is necessary, conduct loading activities at random locations in the field, with the aid of nurse tanks if applicable. Use a check valve or air gap separation to prevent backflow into the tank when filling a sprayer.						

Specialty Fruit and Nut BMP Checklist Comments Section

BMP #	Describe Alternative Measures Used
1.2.1	
5.1.2	
5.1.3	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	**Justification for additional time to implement specified Level I BMP**
5.2.1	
BMP #	**Enter "Other" reasons for not implementing BMPs**