UF UNIVERSITY of FLORIDA
IFAS Extension

EXTENSION

Institute of Food and Agricultural Sciences

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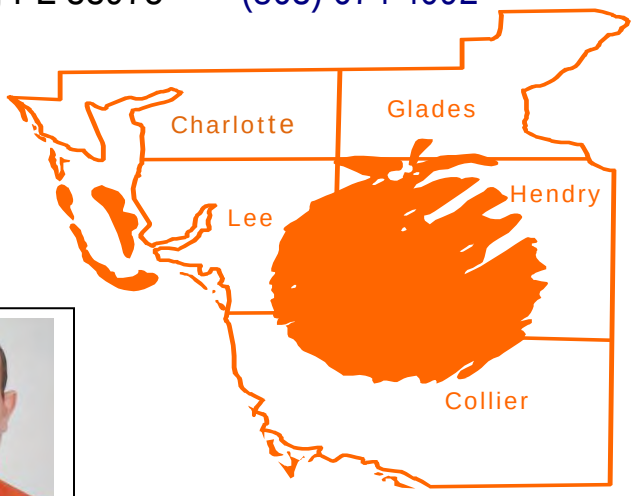
Flatwoods Citrus



Vol. 26, No. 11 **November 2023**

Dr. Mongi Zekri
Multi-County Citrus Agent, SW Florida

Mongi Zekri

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November 28, 2023 Zoom Citrus Workshop - Winter weather

Date and time: Tuesday, November 28, 2023, 10:00 AM – 11:10 AM

Speaker: **Chris Oswalt**, Multi-County Citrus Extension Agent in Central Florida

1. Winter weather watch
2. Ag weather forecasts
3. Freeze protection

We will be discussing the importance of consistently reliable weather information. How this information can be used to make informed decisions on when and what citrus cold protection practices should be considered. There will also be a review of weather-related information services available to growers.

Speaker: **Rick Lusher**, Director of the Florida Automated Weather Network (FAWN)

4. Florida Automated Weather Network (FAWN)
5. Cold protection and irrigation tools

"FAWN provides real-time data from its network of 47 automated weather stations every 15 minutes and uses the data to provide decision-making tools for cold protection, irrigation scheduling, and chemical application. This presentation will provide an overview of using the FAWN website as well as recent system enhancements. In particular, details will be provided on recently installed weather stations, new sensors, and enhancements to the FAWN Cold Protection Toolkit. "

The Zoom link will be provided next week

Coordinator: Dr. Mongi Zekri, UF-IFAS, maz@ufl.edu

1 CEU for pesticide license renewal

1 CEU for certified crop advisors

CEUs for pesticide license renewal

Earn CORE CEUs online through articles written by UF-IFAS Citrus Extension Agents in the Citrus Industry magazine

http://citrusindustry.net/ceu/

The following series of articles and quizzes are available with their expiration dates noted:

- 2023 #4: **How to Properly Transport and Store Pesticides (10/31/24)**
- 2023 #3: **A Guide to Safe, Effective Pesticide Use (7/31/24)**
- 2023 #2 **What To Do When You've Been Exposed to a Pesticide (4/30/24)**
- 2023 #1: **Key Terms to Know When Using Pesticides (1/31/24)**

Each article grants one General Standards (Core) CEU when submitted and approved toward the renewal of a Florida Department of Agriculture and Consumer Services restricted-use pesticide license.

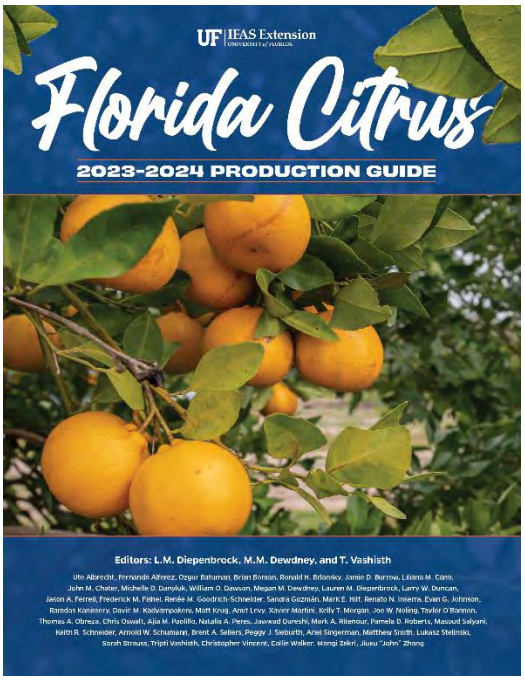
Florida Citrus Production Guide
https://crec.ifas.ufl.edu/resources/production-guide/

The objective of the Florida Citrus Production Guide is to assist citrus growers in the identification of pest management options and the selection of appropriate control measures. This publication should serve as a reference once it has been determined that control measures might be warranted. It is not intended to replace pesticidal product labels which contain important usage information and should be immediately accessible for reference. Violations of directions for use printed on the label are against State and Federal laws. Care should be taken to select only those treatments best suited for control of the specific pest(s) identified as requiring suppression. Products listed in all tables have been shown to be efficacious, non-phytotoxic to citrus, and relatively safe on non-target arthropods and microorganisms when used as directed. However, it is important to realize that results may not be consistent under different environmental, application, and tank mix conditions.

PRODUCTION GUIDE MENU

If you did not pick up your hard copy of the newly updated Florida Citrus Production Guide at the **Citrus & Specialty Crop Expo**, you can find the electronic version online https://crec.ifas.ufl.edu/resources/production-guide/

If you need hard copies, you can get them free from your Citrus Extension Agent or from the Citrus Research & Education Center in Lake Alfred and the Southwest Florida Research and Education Center in Immokalee.



2023-2024 Citrus Production Guide Available at Florida Citrus Expo

An updated perennial resource for Florida commercial citrus growers is available to support their efforts to produce a successful citrus harvest

PUBLISHED ON **JULY 24, 2023**

The 2023-2024 publication includes the latest technical advice on citrus greening disease management, tree nutrition, grove management and other aspects of Florida citrus cultivation. (Courtesy Photo)

LAKE ALFRED, Fla. — An updated perennial resource for Florida commercial citrus growers is available to support their efforts to produce a successful citrus harvest. The 2023-2024 UF Institute of Food and Agricultural Sciences Citrus Production Guide will be available to growers at the August Florida Citrus Expo in Tampa and through their local UF/IFAS Extension citrus agents afterwards.

The document is a comprehensive reference meant to assist growers in development and management of citrus groves in Florida, said Tripti Vashisth, a UF/IFAS horticulture associate professor and a member of the guide's editorial team.

Additions this year include new fertilizer recommendations for some nutrients that have been recently changed and information on the plant growth regulator gibberellic acid (GA). Information on pesticides registered for use in Florida citrus is also updated in every new edition.

Topics covered in the guide include planting, irrigation, fertilization, weed control, insect management and disease management, she said. For a grove management practice to be recommend in the guide, a minimum of two years of field validated data is required. About 50 UF/IFAS personnel contributed to the latest edition.

"Each year, we update the guide with new information as it becomes available. This is a fundamental component of the UF/IFAS faculty mission to continue to meet the needs of our growers as we learn about and/or develop new tools and strategies for citrus production," Vashisth said.

Hard copies of the updated guide will be available at the UF/IFAS booth at the Florida Citrus Expo held at the Florida State Fairgrounds in Tampa, August 16 – 17. After that, they will be at local UF/IFAS Extension county offices (please see chart) in citrus growing counties.

For a directory of citrus agents, visit http://citrusagents.ifas.ufl.edu/locate/index.shtml. Another way to access the guide is on-line through the UF/IFAS Extension Electronic Data Information Source library at the EDIS website. It will also be available at the UF/IFAS Citrus Research and Education Center and the cirtrusresearch.ifas.ufl.edu websites.

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EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

issued by

CLIMATE PREDICTION CENTER/NCEP/NWS

9 November 2023

ENSO Alert System Status: El Niño Advisory

Synopsis: El Niño is anticipated to continue through the Northern Hemisphere spring (with a 62% chance during April-June 2024).

Above-average sea surface temperatures (SST) across the equatorial Pacific Ocean [Fig. 1] were indicative of a strong El Niño, with anomalies increasing in the central and east-central Pacific in the past month. The latest weekly Niño index values were +1.4°C in Niño-4, +1.8°C in Niño-3.4, +2.1°C in Niño-3, and +2.2°C in Niño-1+2 [Fig. 2]. Area-averaged subsurface temperatures anomalies increased slightly [Fig. 3] associated with the initiation of a downwelling oceanic Kelvin wave, which strengthened above-average subsurface temperatures in the central equatorial Pacific [Fig. 4]. Low-level wind anomalies were westerly in the east-central Pacific, while upper-level wind anomalies were easterly in the western and central Pacific. Convection/rainfall was enhanced around the International Date Line, extending into the eastern Pacific. Suppressed convection/rainfall strengthened around Indonesia [Fig. 5]. The equatorial Southern Oscillation Index (SOI) and the station-based SOI remained negative. Collectively, the coupled ocean-atmosphere system reflected a growing El Niño.

The most recent IRI plume favors El Niño to continue through the Northern Hemisphere spring 2024 [Fig. 6]. Based on latest forecasts, there is a greater than 55% chance of at least a "strong" El Niño (≥ 1.5°C in Niño-3.4 for a seasonal average) persisting through January-March 2024. There is a 35% chance of this event becoming "historically strong" (≥ 2.0°C) for the November-January season. Stronger El Niño events increase the likelihood of El Niño-related climate anomalies, but do not necessarily equate to strong impacts (see CPC seasonal outlooks for probabilities of temperature and precipitation). In summary, El Niño is anticipated to continue through the Northern Hemisphere spring (with a 62% chance during April-June 2024; [Fig. 7]).

This discussion is a consolidated effort of the National Oceanic and Atmospheric Administration (NOAA), NOAA's National Weather Service, and their funded institutions. Oceanic and atmospheric conditions are updated weekly on the Climate Prediction Center web site (El Niño/La Niña Current Conditions and Expert Discussions). Additional perspectives and analysis are also available in an ENSO blog. A probabilistic strength forecast is available here. The next ENSO Diagnostics Discussion is scheduled for 14 December 2023.

Climate Prediction Center
National Centers for Environmental Prediction
NOAA/National Weather Service

Increasing Efficiency and Reducing Cost of Nutritional Programs

Importance of N & K

- N & K are the most important nutrients for Florida soils and citrus.
- An adequate level of N is required for vegetative growth, flowering, and fruit yield.
- K also plays an important role in determining yield, fruit size, and quality.
- Fertilizer ratios of N to K_2O are usually 1:1. However, a ratio of 1:1.25 is recommended for high pH or calcareous soils.

Management practices to improve fertilizer efficiency

They include:

♦ Evaluation of leaf analysis data

♦ Adjustment of N rates to the level based on expected production and IFAS recommendations

♦ Selection of fertilizer formulation to match existing conditions

♦ Careful placement of fertilizer within the root zone

♦ Timing to avoid the rainy season

♦ Split application

♦ Irrigation management to maximize production and minimize leaching

Tissue and soil analysis

- Leaf sampling and analysis is a useful management tool for fertilizer decisions.
- Soil analysis is useful for determining the pH and concentrations of P, Ca, and Mg.

N requirements for mature trees

- In a mature grove where there is little net increase in tree size, N used for leaf growth is largely recycled as leaves drop, decompose, and mineralize.
- Replacement of the N removed by fruit harvest becomes the main requirement, and nutrient requirements should vary as the crop load changes.

Fertilizer Sources

- Inorganic and synthetic organic nitrogen fertilizers are high-analysis materials and are generally most economical to use in citrus groves. They are rapidly available, unless they have been formulated in a controlled-release form.
- The use of high analysis fertilizers eliminates much of the filler. A great deal of the mixing, transportation, and application cost is reduced.
- The use of controlled-release fertilizers is a feasible option.

Timing and frequency of application

- 2/3 of the tree's nutritional requirements should be made available between January and early June, with most of it in place during flowering and fruit-setting period. The remaining 1/3 can be applied in September or October.
- Split fertilizer application or fertigation combined with sound irrigation management increase fertilizer efficiency by maintaining a more constant supply of nutrients and by reducing leaching if unexpected rain occurs. Less fertilizer will be required.
- Less fertilizer may also be required if fertilizer is confined to the root zone and if timing is adjusted to avoid rainy periods.

Foliar feeding

- Foliar feeding is useful under calcareous soil or any other condition that decreases the tree's ability to take up nutrients when there is a demand.
- Foliar applications of low-biuret urea (25-28 lbs N/acre) or phosphorous acid (2.6 quarts/acre of 26-28% P_2O_5) in late Dec.-early Jan. are known to increase flowering, fruit set, and fruit yield.
- Postbloom foliar applications of potassium nitrate or mono-potassium phosphate (8 lbs/acre K_2O) in late April have been found to increase fruit size and yield.

Phosphorus

- P applied to established groves had not leached but had accumulated in the soil at high levels and is available slowly so that P application may be reduced in established groves.

Micronutrients

- Copper should not be included in fertilizers if Cu sprays are used and if the grove soil test show adequate Cu (5-10 lbs/acre).
- Molybdenum (Mo) deficiency occurs on soils that have been allowed to become very acid. Liming those soils should fix the problem.
- Foliar spray applications of micronutrients (Mn, Zn, Cu, B, and Mo) are more effective and economically practical than soil applications when included with post-bloom and summer foliar sprays after full expansion of the new flush.

Soil pH & liming

- Soils should have a pH ranging from 5.5 to 6.5 with the higher values used for soils containing high Cu levels.
- Soil pH can be increased by application of either calcite or dolomite. Dolomite supplies both Ca and Mg. Therefore, the choice of dolomite would be more appropriate to supply Mg and have a good balance between Ca and Mg.

Overliming

- Liming soils having a pH at or above 6 will be costly and not useful. In groves, where soils have adequate pH but low Ca levels, gypsum ($CaSO_4$) can be used as a source of Ca without affecting the soil pH.
- Applying dolomite as a source of Mg is not recommended if the soil pH is in the desired range. Under these conditions, soil application of either magnesium sulfate ($MgSO_4$) or magnesium oxide (MgO) and foliar application of magnesium nitrate ($Mg(NO_3)_2$) are effective for correcting Mg deficiency.

DROUGHT

Water stress is the physiological condition to which a plant is subjected whenever the rate of water loss from the leaves by transpiration exceeds the rate at which water is absorbed by the root system. Water stress can be the result of excessive transpiration due to hot weather or slow absorption from a dry soil, flooded soil or saline conditions. Any degree of water imbalance can produce a deleterious change in physiological activity of growth and reproduction. Short-term drought often reduces production and prolonged drought can cause total crop failure. Severe drought can reduce fruit set, fruit development and fruit growth. The number of fruit, fruit size, and tree canopy are reduced with water stress. Extension growth in shoots and roots, and leaf expansion are all negatively correlated with water stress. Trees subjected to water stress are generally reduced in size. Vegetative growth is particularly sensitive to water deficit. Growth is closely related to turgor and the loss of turgidity reduces photosynthesis, leaf and fruit enlargement, juice content and yield, and increases wilting and leaf and premature fruit drop. Growers cannot afford water stress or water restrictions during critical periods. Irrigation is not only essential during the springtime, but it is also important during dry falls to minimize premature fruit drop.

Mobile Irrigation Lab

https://www.swfwmd.state.fl.us/business/agriculture/mobile-irrigation-lab

Assisting the agricultural community by improving irrigation efficiency and conserving water.

The Mobile Irrigation Lab program is an ongoing joint effort between the District, the U.S. Department of Agriculture–Natural Resources Conservation Service (USDA–NRCS) and the agricultural community. The program began in 1987 to assist the District in meeting its statutory responsibilities and to assist growers with water conservation.

The Mobile Irrigation Lab is a free volunteer service to the agricultural community. Any grower can contact the District to arrange a free evaluation. It was expanded to help growers meet water use permit conditions. District staff has used high pumpage reports to identify users who might wish to voluntarily reduce water use before a resource problem or permit violation occurs.

A trained technician is invited to a grower's field and collects irrigation system and specific field data. System pressure and irrigation uniformity data are then reviewed and computer-analyzed. A report provides recommendations for improvements and irrigation schedules. If needed, the technician assists the local NRCS office in the redesign of the system.

An irrigation schedule offers a general guide to determine when and how much to irrigate based on system efficiency, crop requirements and soil characteristics. The technician returns several times for further data collection and review with the grower, installation of free soil moisture-sensing devices to help adapt the schedule to the site and calibration and maintenance of the devices.

In addition to the benefits of free irrigation evaluations, water conservation and water quality improvements, the program shares valuable technology and information with growers.

Mobile Irrigation Lab data suggests that most evaluated systems are already at or above permitted efficiency standards. With only minor improvements, about half the sites below these standards could easily meet them. Typically, if all recommendations are implemented, overall system irrigation efficiency can improve by an estimated 17 percent — helpful to any grower's bottom line, as well as the region's water resources.

Contact:

Jeff Whealton
Agricultural Regulation Program Coordinator
1-800-492-7862 (FL only), ext. 6119

PRUNING CITRUS TREES

The interception and utilization of sunlight should be an important consideration in citrus grove design. The effect of insufficient light is frequently observed in mature citrus groves that are not pruned (hedged, topped) regularly. Shading reduces yield and foliage on the lower parts of the trees. Sunlight not only influences flowering and fruit set but also enhances fruit quality and color development. Increased sunlight penetration within the tree canopy might also allow foliage to dry quicker after a rain shower and could help reduce establishment of fungal pathogens. Therefore, adjustments must be made in tree height and hedging angle to maximize sunlight interception.

Hedging and topping are important cultural grove practices. Severe hedging or topping of citrus trees during the winter can reduce cold hardiness. Trees with exposed internal scaffold wood and new tender growth are susceptible to cold injury.

In general, tree response to hedging and topping depends on several factors including variety, rootstock, tree age, growing conditions, time of pruning, and production practices. No one system or set of rules is adequate for the numerous situations encountered in the field. Growers are encouraged to gain a clear understanding of the principles involved in hedging and topping, and to take advantage of research results as well as consulting knowledgeable colleagues and custom operators for their observations.

Hedging should be started before canopy crowding becomes a problem. Developing a pro-active pruning program should assist managers in removing the right-sized branches. Removal of a significant portion of the tree will result in excessive vegetative growth and a drastic reduction in subsequent yield. Hedging is usually done at an angle, with the boom tilted inward toward the treetops so that the hedged row middles are wider at the top than at the bottom. This angled hedging allows more light to reach the lower skirts of the tree. Hedging angles being commonly used vary from 10 to 15 degrees from vertical.

Topping should be done before trees have become excessively tall and should be an integral part of a tree size maintenance program. Long intervals between toppings increase the cost of the operation due to heavy cutting and more brush disposal. Furthermore, excessively tall trees are more difficult and expensive to harvest and spray. Topping trees will improve fruit quality and increase size. Some common topping heights are 10 to 12 ft at the shoulder and 13 to 14 ft at the peak. As a general rule, topping heights should be two times the row middle width.

After severe hedging or topping, heavy nitrogen applications will produce vigorous vegetative regrowth at the expense of fruit production. Therefore, nitrogen applications should be adjusted to the severity of hedging and/or topping. Reducing or omitting a nitrogen application before and possibly after heavy hedging will reduce both costs and excessive vegetative regrowth. Light maintenance hedging should not affect fertilizer requirements.

Large crops tend to deplete carbohydrates and results in a reduced

fruit yield and increased vegetative growth the following year. Pruning after a heavy crop additionally stimulates vegetative growth and reduces fruit yield the following year. Pruning after a light crop and before an expected heavy crop is recommended because it can help reduce alternate bearing which can be a significant problem in Valencia and Murcott production.

Severe hedging may create problems of brush disposal and stimulates vigorous new vegetative growth, especially when done before a major growth flush. This happens because an undisturbed root system is providing water and nutrients to a reduced canopy area. The larger the wood that is cut, the larger is the subsequent shoot growth. Severe pruning reduces fruiting and increases fruit size.

The best time of year to hedge and/or top depends on variety, location, severity of pruning, and availability of equipment. Since pruning is usually done after removal of the crop, early maturing varieties are generally hedged before late maturing varieties. Most growers prefer to hedge before bloom, but trees will get more vegetative regrowth, which may not be desirable. Pruning could begin as early as November prior to harvesting in warmer areas. During this period, conducted pruning operations should only cut minimal foliage and fruit from the trees.

Valencia trees may be hedged in late fall with only minimal crop reduction when the hedging process removes only a small amount of vegetative growth. In cases where excessive growth is to be removed, the trees are usually harvested before hedging is conducted. Light maintenance pruning can be done throughout the summer and until early fall with little or no loss in fruit production. Moderate to severe pruning should not continue into the winter in freeze-prone areas, as trees with tender regrowth are susceptible to cold injury.

With citrus canker and greening diseases, selecting the best time for hedging and topping is becoming more complicated. New growth flushes promoted by hedging and topping in late spring, during the summer, and early fall can increase the population of leafminers and psyllids and aggravate the spread of citrus canker and greening. Declining trees with defoliated tops, dieback, reduced cropping, and severe root loss due to citrus greening are being hedged and topped to help balance the shoot to root ratio to improve tree performance and extend tree longevity.

Skirting is the pruning to raise tree skirts. Without skirting, the movement of herbicide booms is impeded. Fruit and limbs near the ground are often damaged by the passage of such equipment and by herbicide spray and fertilizer contact. Skirting allows uniform distribution of granular fertilizers and good water coverage of microsprinkler irrigation systems under tree canopies. Skirting facilitates the inspection of microirrigation systems and reduces the incidence of Phytophthora foot rot and brown rot because it allows good air circulation.

ALGAE

UF UNIVERSITY of FLORIDA
IFAS Extension

Algae are in the plant kingdom, but maybe they're not really plants!

In Florida's freshwaters, algae are what make the water green, or even "slimy". However, green water is not necessarily undesirable, and neither are algae. In fact, algae are essential to the ecosystem and to life as we know it, and must be treated with respect.

Algae are a diverse group of organisms, which survive in all different types of habitats. They range in size from microscopic to meters in length and in complexity from single-celled to complex organisms that would rival even large plants. Though these organisms may look like the true, "higher", plants, they are anything but, since they do not have roots or true stems and leaves.

Algae are one of the first steps of the food web. There are microscopic algae, like phytoplankton, and there are macroalgae, algae that can be seen by the naked eye. Algae occur naturally in all types of systems and may be considered indicators of ecosystem condition. Even the mere presence of a species can give an indication of the amount and type of nutrients that run through the system. Algae provide food for all types of animals, including fish, insects, mollusks, zooplankton (microscopic animals), and humans.

What causes an algae bloom?

At times algae can grow so quickly and densely that they form a "bloom". Many people don't like the "look" of a bloom, though blooms can be a natural occurrence. Blooms are not necessarily green, though that is the most common color. They can be blue-green, brown, red, and even violet.

Some blooms turn the water a certain color; this is usually a bloom associated with phytoplankton (microscopic algae). Other blooms form clumps or mats that float on top of the water, or that grow attached to the bottom or to plants. Still others can form dense mats that cover the water surface. Algae need nutrients, such as nitrogen and phosphorous, and light to grow. The level of growth or productivity is often dependent on the amount of nutrients in a system. There is a classification for productivity of a system; it ranges from oligotrophic (low productivity and nutrients) to hypereutrophic (very high nutrients). Also, since algae need light to photosynthesize, how far light penetrates the water is also another limiting factor.

Blooms can have far reaching effects on the environment. Some can become so dense they can ultimately cause a problem with low oxygen levels. A decrease in oxygen causes hypoxia (low oxygen) or anoxia (no oxygen) and the other organisms in the water that need oxygen to survive, such as fish, become stressed and may die. Other blooms may release toxins that can be harmful to animals.

There is a general consensus that rapidly growing human development, and increased human use and disposal of nutrients over the past few centuries, has increased the frequency and intensity of algal blooms in many regions of the world. This has created a global effort to control harmful blooms.

Controlling blooms

The most direct way to control blooms is to reduce the availability of nutrients. Most water management organizations throughout the world are actively pursuing a variety of nutrient control strategies. However, for some aquatic ecosystems nutrient control is impractical, ineffective or simply too costly. For some cases chemical or biological treatments can be helpful alternatives.

Chemical Treatments

Copper sulfate (bluestone) and **chelated copper compounds** such as Cutrine-Plus, Algae Pro, and K-TEA, as well as Endothall are common chemical treatments used to kill algae. Chemical compounds that shade out the light for algae growth, e.g. Aquashade, are also used to control blooms. Each chemical has its own restrictions and toxicity to animals. Read the directions carefully before application.

Biological Treatments

The main biological treatment that is employed today is the use of various carp fish species to control submersed and floating algae. **Grass carp** (*Ctenopharyngodon idella*) is mainly used for aquatic weeds and attached submersed algae, such as *Nitella* sp., and *Chara* sp. Where they do not prefer filamentous algae to eat, grass carp will eat *Lyngbya*. The **silver carp** (*Hypophthalmichthys molitrix*) has been shown to be an effective treatment for controlling filamentous algae, including blue-green algae.

Both species are non-native species and there are many restrictions to employing them as a means of weed control; some states prohibit their use altogether. When they are allowed, the use is restricted to **triploid carp**. Triploid carp have an extra set of chromosomes that render the fish sterile, therefore prohibiting a population explosion if the fish escapes into an uncontrolled area.

Physical Treatments

Physical treatments for algae in ponds include aeration and airlifts. While aeration does not kill or remove algae from the water, it oxygenates and stirs the water column, and can create conditions to shift from toxic and smelly blue-green algae to preferred green algae species. The resultant algal population is usually not as dense or as toxic to other organisms in the ponds.

Mechanical Treatments

Harvesters are sometimes used to skim dense mats of blue-green lyngbya alga from the surface of lakes and rivers. Lyngbya normally grows in dense mats at the bottoms of nutrient enriched lakes. These mats produce gasses during photosynthesis that often causes the mats to rise to the surface. At the surface, winds pile the algal mats against shorelines or in navigation channels; these mats can be several acres in size. Managers have developed a process called "grubbing" whereby harvesting machines lift the mats off of submersed plants such as native eelgrass, without cutting the eelgrass. By removing the blanket of lyngbya from the eelgrass, the plants grow and expand. Eelgrass is an important food source for manatees in the Crystal and Homossassa Rivers.

WHERE **FLORIDA'S WATER COMES FROM?**

Please be active in conserving and protecting our waters

Average annual rainfall in Florida is 53 inches, making it one of the wettest states in the nation. The state's differing climate types yield much rainfall variability from region-to-region and from year-to-year. In central and South Florida, most of the rain falls during four summer months and much of the annual amount is "lost" to the natural hydrologic system through evaporation. The region is prone to wide weather extremes of flood and drought.

Nearly two-thirds of Florida's freshwater use is pumped from vast underground reservoirs called aquifers. Of Florida's groundwater sources, the deep Floridan Aquifer, which spans the majority of the state, supplies 62%; the shallower Biscayne Aquifer (underlying most of Miami-Dade and Broward and portions of Palm Beach and Monroe counties), provides 17%; the remaining 21% is supplied by surficial and intermediate unnamed aquifers. The state's remaining freshwater is supplied from surface waters, including lakes and rivers.

In South Florida, approximately 90% of the water used in homes and businesses comes from groundwater sources. The remaining 10% comes from surface waters. Both surface and groundwater supplies are highly dependent on rainfall for replenishment.

At the heart of the South Florida system sits Lake Okeechobee – the largest natural water body in the southeastern United States. It serves as a source of public water supply for the City of Okeechobee (16,000 utility customers) and provides a supplemental source of irrigation water to more than 700,000 acres in agricultural production. In addition, it serves as the backup water supply for more than five million residents. The massive lake also plays a critical environmental and economic role as a sport and commercial fishery, navigation/recreation waterway and natural habitat for fish, wading birds and other wildlife, including a variety of endangered and threatened species.

While heavy rainfall throughout South Florida benefits and recharges underground supplies, the ability to capture and store the rainwater for future use is extremely limited. When floods threaten – even during water shortage situations – the top priority is channeling the excess water away from homes and businesses as quickly as possible. To lower the levels in coastal canals and accommodate direct rainfall and stormwater runoff, freshwater must oftentimes be released to the ocean or gulf.

The demand for water by growing urban populations and agricultural operations in South Florida is expected to increase significantly in the coming decades. Meeting the growing need for water hinges on our efforts to develop region-specific sources that offer an alternative to traditional ground water and surface water. Alternative water sources are important to Florida's future. They also help to make communities less susceptible to the effects of drought.

Developing alternative water sources diversifies our supply while reducing our dependence on fresh water resources. Examples of Alternative Water Supply are:

- saltwater and brackish water
- water reuse
- surface water captured predominately during heavy rainfalls
- sources made available through the addition of new storage capacity
- stormwater (for use by a consumptive use permittee)
- any other source designated as nontraditional in a regional water supply plan

To address the challenge of ensuring the state's current and future water supply, the 2005 Florida Legislature enacted the Water Protection and Sustainability Program. This precedent-setting law encourages cooperation between municipalities, counties and the state's five water management districts to protect and develop water supplies in a sustainable manner. Water management districts are promoting and supporting local government alternative water supply projects that support smart growth and reduce the use of fresh ground and surface water supplies, such as aquifers and lakes for a sustainable future.

Water reuse plays an important role in water resource, wastewater and ecosystem management in Florida. When reclaimed water is used, it eases the demand on traditional, often limited, sources of water. By recycling or reusing water, communities can still grow while minimizing or even reducing their impact on the water resources around them.

Water reuse involves using highly treated domestic wastewater for a new purpose. Reclaimed water systems are continually monitored to ensure the health and welfare of the public and the environment are protected.

Using reclaimed water also reduces discharges to surface waters, recharges ground water and postpones costly capital investments in the development of new, more costly water sources and supplies. Reclaimed water is an excellent water source for:

--Irrigating golf courses, residences, highway and street medians and other landscaped areas
--Meeting urban demands for water to wash cars, flush toilets and maintain ponds and fountains
--Meeting industrial and commercial demands for water at power plants and for processing needs
--Irrigating food crops, such as citrus, and irrigating other crops and pastures for livestock
--Creating wetlands and enhancing restoration
--Recharging groundwater

Saline Irrigation Water: Impacts on Citrus Production

What conditions lead to irrigation water becoming salinized?

Irrigation of Florida citrus can be challenging due to the variety of ways that salts can be introduced into the agricultural water supply. For example, the use of Floridan aquifer water containing high salt levels, leaking artesian wells that have contaminated surficial aquifer wells, saltwater intrusion into groundwater aquifers, and the salt index of fertilizers are all factors that should be taken into consideration when developing a citrus irrigation management plan. In general, all irrigation water has at least some dissolved salt. The degree to which irrigation water is salinized can be measured through monitoring the Total Dissolved Solids (TDS). Typically, irrigation water intended for citrus production is usually considered "adequate" if the TDS (measured in parts per million, ppm) is less than 1,000 ppm – 1,200 ppm. In irrigation water with TDS values greater than 1,000 ppm, the potential for developing toxic conditions for plant growth arises from high levels of sodium and chloride ions. High concentrations of these ions, even when the total volume of irrigation water applied is adequate for tree growth and fruit production, can make it more difficult for a tree to take up water from the soil due to increased osmotic stress of the plant's root cells.

Why is monitoring irrigation water salinity important?

If irrigation water salinity is not managed (for example, if the TDS value chronically exceeds 1,200 ppm), there is an increased risk of toxicity to the citrus tree. Highly salinized water negatively affects all biological stages of citrus, including root, leaf, and fruit development (**Figure 1**). Citrus is considered to be a salt-sensitive crop because important plant physiological processes (including leaf photosynthesis and flower induction) are negatively impacted with even moderately salinized irrigation water.

How can irrigation water salinity be managed?

Throughout the growing season, water content within the soil fluctuates. During the rainy months of summer, water content is higher, and in the drier months of winter, it is lower. Salt ions become concentrated within the soil when water contents are relatively low. This is due to the inability of salts to be leached below the citrus tree's root zone. Thus, periodic leaching may be required to help flush salts from the root zone. This flushing is accomplished by frequent irrigation cycles during the dry months of the year.

If groves are located in a region where it is known that TDS values regularly exceed 1,200 ppm, or in areas where soil is poorly drained or where there is a perched water table, there is an increased risk of salinity-associated plant toxicity. In these situations, frequent irrigation cycles are also used to help flush excess salts beyond the citrus tree's root zone. However, salt concentrations also fluctuate throughout the year, and it is important to regularly monitor the TDS value of irrigation water. A County Extension Agent can assist in developing a salinity monitoring program, including providing instructions on how to take water samples and interpreting the results. Regular maintenance of any water furrows, ditches, and canals will also reduce the risk of developing salinity-associated toxicity by ensuring that the soil in the grove is drained properly.

The salt index (**Table 1**) and fertilizer source materials should be taken into consideration when developing a citrus irrigation management plan. As values of the salt index increase, the osmotic stress (the stress placed on citrus roots' ability to absorb water from the soil) also increases. Thus, selecting fertilizers with low salt indexes, particularly in situations where TDS values exceed 1,200 ppm, should be part of the management program. Specifically, replacing sodium nitrate and potassium chloride N and K sources with lower salt index N and K materials should result in lowered salinity-associated stress and reduce exposure to toxic Na and Cl in the soil solution. Frequent irrigation cycles aimed at leaching salts below the root zone (mentioned above) can also flush essential plant nutrients away from roots. Therefore, using split-applications of dry, water-soluble fertilizers several times during the year, or low-volume, low-concentration with high-frequency liquid fertigation cycles, may be preferred to fewer fertilizer applications at higher rates.

Citrus scion cultivar and rootstock also have known interactions with salinized irrigation water. Generally, grapefruit cultivars are more sensitive to high salt levels than orange cultivars; although both grapefruit and orange cannot tolerate salinized irrigation water for long periods of time. Through both anecdotal and formal research observations, it has been noted that some rootstocks are more forgiving of saline irrigation water than others. The following rootstock varieties are generally viewed as being relatively less-to-more sensitive to salinity: 'Cleopatra' mandarin, sour orange, sweet orange, 'Swingle' citrumelo, 'Carrizo' citrange, and rough lemon.

In summary

The salinity of irrigation water can have far-reaching effects on citrus production. Chronically high levels of salt (when TDS values exceed 1,200 ppm) can severely damage citrus tree growth and fruit production. Under these conditions, it is important to regularly provide a flushing irrigation that will be successful in leaching potentially toxic salt ions past the root zone. Even when water sources typically have TDS values below 1,200 ppm, periods of little rainfall can lead to high concentrations of salt ions in the soil. Thus, a leaching irrigation is often also required in times of little or no rainfall. The following are basic guidelines that might form the basis for successful citrus irrigation management.

- Regular flushing irrigations to achieve root zone leaching (duration of at least 6 hours every 7-10 days) when TDS values regularly exceed 1,200 ppm or during periods of little or no rainfall.
- Maintenance of any water furrows, ditches, or canals to ensure that the grove space is drained properly.
- Avoid using fertilizers whose components have high salt indexes. If using dry fertilizer, rely upon split-applications as frequently as possible. If fertigating, rely on low-volume, low-concentration applications with frequent cycles.
- Rootstock selection can have significant implications regarding salinity management: 'Swingle,' 'Carrizo,' and rough lemon are relatively more sensitive to salt; although all citrus is susceptible to salinity-associated toxicity.

Figure 1. Symptoms of salt damage (yellowing and desiccation) to citrus foliage.

Table 1. Salt index of some fertilizer sources

Material and Analysis	**Salt Index per unit (20 lb) of plant nutrient**
Nitrogen	
Ammonia, 82.2% N	0.572
Ammonium nitrate, 33.5% N	2.990
Ammonium sulfate, 21.2% N	3.253
Ammonium nitrate, 20.5% N	2.982
Calcium nitrate, 15.5%	4.194
Sodium nitrate, 16.5% N	6.060
Urea, 46.6% N	1.618
Phosphorus	
Normal superphosphate, 20% P_2O_5	0.390
Concentrated superphosphate, 45% P_2O_5	0.224
Concentrated superphosphate, 48% P_2O_5	0.210
Monoammonium phosphate, 12.2% N, 61.7% P_2O_5	0.405
Diammonium phosphate, 18% N, 46% P_2O_5	0.456
Potassium	
Potassium chloride, 60% K_2O	1.936
Potassium nitrate, 13.8% N, 46.6% K_2O	1.219
Potassium sulfate, 46% K_2O	0.853
Monopotassium phosphate, 52.2% P_2O_5, 34.6% K_2O	0.097
Sulfate of potash-magnesia, 21.9% K_2O, 10.8% Mg	1.971

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__Black, non-Hispanic

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__Female
__Male