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Flatwoods Citrus



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Multi-County Citrus Agent, SW Florida



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All Citrus Value Down 29 Percent, Production Down 22 Percent

The \$438 million preliminary on-tree value of the 2021-2022 citrus crop is 29 percent less than the \$613 million revised value for 2020-2021. Florida's all citrus production in 2021-2022 is 45.1 million boxes, down 22 percent from the previous season's 57.9 million boxes. All orange production decreased by 22 percent to 41.1 million boxes. Non-Valencia production at 18.3 million boxes is down 20 percent from the 2020-2021 season. Valencia orange production at 22.8 million boxes is down 25 percent. All grapefruit production decreased 19 percent to 3.33 million boxes. Tangerine and tangelo production in 2021-2022 is down 16 percent from the previous season.

All Citrus Acreage Down 8 Percent

Results of the annual Commercial Citrus Inventory show total citrus acreage is 375,302 acres, down 8 percent from the last survey. The net loss of 32,046 acres is 19,942 acres more than what was lost the previous season. New plantings at 7,980 acres are down from the previous season. All citrus trees, at 55.8 million, are down 7 percent from the previous season. Of the 24 published counties included in the survey, 23 recorded decreases in acreage while 1 county (Brevard) showed an increase. Hendry County lost the most acreage, down 6,640 acres from the previous season. DeSoto County records the most citrus acres at 64,641 acres.



Zoom Citrus Seminars

Date & time: Tuesday, 18 October 2022, 10:00 AM – 11:00 AM

Title: **HLB tolerant citrus varieties developed by the UF-CREC Plant Improvement Team**

Speaker: Dr. John Chater, Assistant Professor in Horticultural Sciences, UF-IFAS Citrus Research and Education Center, Lake Alfred

Huanglongbing (HLB) has devastated citrus in Florida. Breeders have been working towards selecting citrus with tolerance to HLB. There exist UF/IFAS selections that appear to be HLB tolerant. This presentation will cover some of these accessions.

To register and attend via Zoom, here is the Zoom link:

<https://ufl.zoom.us/j/96544211588?pwd=bWwzbkE0b1QvYTZCcDR0bitnWVpXUT09>

After registering, you will receive a confirmation email containing information about joining the Zoom meeting.

1 CEU for pesticide license renewal, 1 CEU for certified crop advisors

Date & time: Thursday, 3 November 2022, 10:00 AM – 11:00 AM

Title: **Candidatus Liberibacter asiaticus-Asian citrus psyllid interferences: from basic science to potential innovative control strategy**

Speaker: Dr. Nabil Killiny, Associate Professor in Plant Pathology, UF-IFAS Citrus Research and Education Center, Lake Alfred

Dr. Killiny will talk about the interaction of CLAs and its insect vector and how that could be a targeted link to mitigate Huanglongbing

1 CEU for pesticide license renewal, 1 CEU for certified crop advisors

CEUs for pesticide license renewal

Earn CORE CEUs online through Southeast AgNet & Citrus Industry magazine

<http://citrusindustry.net/ceu/>

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

- 2022 #3: **Agricultural Pesticide Licensing: Frequently Asked Questions (7/31/23)**
- 2022 #2: **How Weather Affects Pesticide Applications (4/30/23)**
- 2022 #1: **Increasing Pesticide Effectiveness With Adjuvants (1/31/23)**
- 2021 #4: **Protecting People From Pesticide Exposure (10/31/22)**

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.

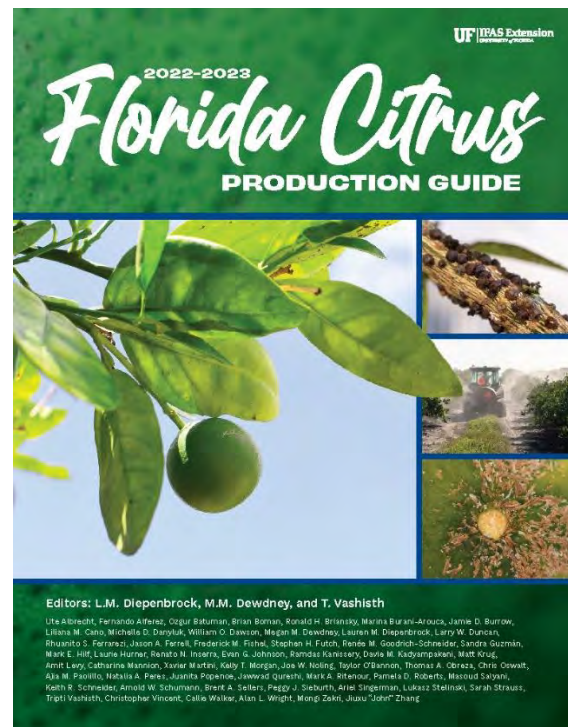
The objective of the Florida Citrus Production Guide is to assist citrus growers in the identification of pest management options and the selection of appropriate control measures. This publication should serve as a reference once it has been determined that control measures might be warranted. It is 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

- [General](#)
- [Horticultural Practices](#)
- [Mites, Insects & Nematodes](#)
- [Diseases](#)
- [Weeds](#)
- [Pesticides](#)

If you did not pick up your hard copy of the newly updated Florida Citrus Production Guide at the Citrus 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.



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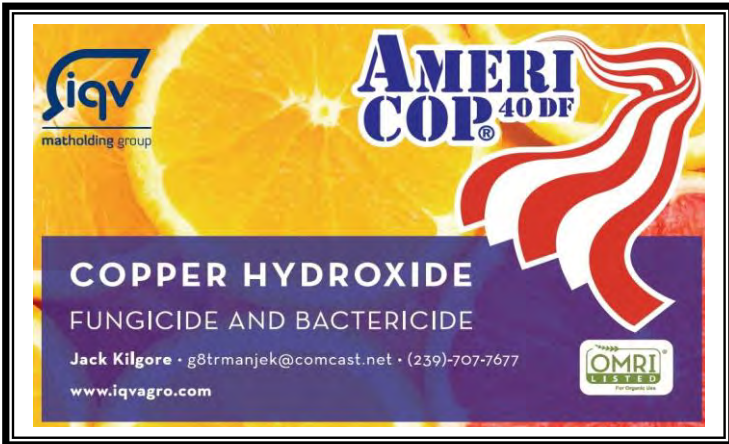


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EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

issued by

**CLIMATE PREDICTION CENTER/NCEP/NWS
and the International Research Institute for Climate and Society**

8 September 2022

ENSO Alert System Status: [La Niña Advisory](#)

Synopsis: La Niña is favored to continue through Northern Hemisphere winter 2022-23, with a 91% chance in September-November, decreasing to a 54% chance in January-March 2023.

During August, below-average sea surface temperatures (SSTs) persisted across the central and east-central equatorial Pacific Ocean [Fig. 1]. The largest SST anomalies were evident in the Niño-3.4 and Niño-4 regions, with the latest weekly values reaching -0.8°C and -1.1°C , respectively [Fig. 2]. Negative subsurface temperature anomalies were mostly unchanged during the month [Fig. 3], reflecting the dominance of below-average temperatures across the eastern Pacific Ocean [Fig. 4]. Low-level easterly wind anomalies and upper-level westerly wind anomalies continued across most of the equatorial Pacific. Convection and rainfall remained suppressed over the western and central tropical Pacific and enhanced over Indonesia [Fig. 5]. Overall, the coupled ocean-atmosphere system continued to reflect La Niña.

The most recent IRI plume forecast of the Niño-3.4 SST index indicates La Niña will persist into the Northern Hemisphere winter 2022-23 [Fig. 6]. There is an interesting split in the dynamical versus statistical model forecasts, with the latter set suggesting La Niña will persist longer, through January-March 2023. At this time, the forecaster consensus sides with the statistical models, although there is still large uncertainty over how long La Niña will last and when it will transition to ENSO-neutral (56% chance of a transition to ENSO-neutral during February-April 2023). In summary, La Niña is favored to continue through Northern Hemisphere winter 2022-23, with a 91% chance in September-November, decreasing to a 54% chance in January-March 2023 [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 13 October 2022.

To receive an e-mail notification when the monthly ENSO Diagnostic Discussions are released, please send an e-mail message to: ncep.list.enso-update@noaa.gov.

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

Granular Controlled-Release Fertilizers

Most commonly used commercial fertilizers are water soluble, meaning they are readily available to plants when properly applied. Soluble fertilizers are applied to the soil dry in granular form, liquid through fertigation, or foliarly.

When applied in granular form to the soil, soluble fertilizers release nutrients relatively quickly, assuming the soil water content is at the appropriate level. Applying too much readily soluble fertilizer to crops at once can result in plant toxicity. In addition, heavy rainfall or irrigation can result in leaching of the nutrients. Therefore, it is suggested to split the soluble fertilizer into smaller doses.

Over many decades, the fertilizer industry has developed controlled-release fertilizers (CRFs). The Association of American Plant Food Control Officials defines CRFs as fertilizers that contain a plant nutrient in a form in which the plant uptake is delayed after application, or that provide a longer duration of nutrient availability compared with quick-release fertilizers. CRFs have become more popular in recent years.

CRFs are often called slow-release fertilizers (SRFs) or timed-release fertilizers. However, the terms CRF and SRF should not be used interchangeably. The main difference between CRFs and SRFs is that in CRFs, the factors affecting the rate, pattern, and duration of release are well known and controllable, whereas in SRFs, they are not well controlled. CRFs were initially developed for their horticultural benefits, but they have also attracted attention in the best management practices (BMPs) and citrus greening era.

CRFs have advantages in:

- inducing more growth and yield due to a continuous supply of nutrients.
- reducing rates and frequency of fertilizer applications.
- saving substantial labor and time.

CRFs are typically coated or encapsulated with inorganic or organic materials that control the rate, pattern, and duration of plant nutrient release. Soil moisture, temperature, and microbes have the greatest influence on nutrient release. CRFs have different N-P-K blends and may or may not include micronutrients. They can have different durations of release, expressed as months, which determine how long the CRF will persist.

Citrus fertilization research conducted in Florida within the past 30 years showed that tree growth and fruit yield where part or all of the fertilization program included CRF are similar or greater than growth and yield resulting from an all conventional water-soluble N fertilization program. CRFs are more efficient, have low plant toxicity hazard, and less leaching and volatilization potential than conventional soluble fertilizers. The improved efficiency of fertilizer use saves energy and reduces environmental pollution.

Applying Dry Fertilizers

Dry solid fertilizer spreaders should apply materials directly over the root zone. When applying fertilizers to young trees, managers should take advantage of manual or electronic spreader adaptations that deliver fertilizer rates accurately to small tree root zones while leaving out the area between trees where roots are not present. For economical and efficient fruit production, it is essential that spreaders be calibrated to apply accurate and appropriate amounts of fertilizers.

FINGER LIME: AN ALTERNATIVE CROP WITH GREAT POTENTIAL

Aditya Singh, Edward Evans, Jeff Wasielewski, Manjul Dutt, and Jude Grosser

INTRODUCTION

The aim of this article is to draw attention to a potential alternative niche crop, namely finger limes. Currently, commercial production of this crop in the United States is extremely limited, and data on the agronomic and economic aspect of domestically producing and marketing the crop are sparse and, in most cases, unavailable.

FINGER LIME ORIGIN

The Australian finger lime (*Microcitrus australasica*) is native to the rainforests located in the coastal border regions of Queensland and New South Wales (NSW) in Australia. Finger lime is classified as a citrus fruit. Its taste has been described as a combination of lemon, lime, and grapefruit. The cylindrical fruit, which comes in varied colors such as pink and green, grows to about three inches in length (comparable to a gherkin in size and shape and resembles the index finger, hence its name). The fruit consists of hundreds of tiny, tangy juice vesicles, which some refer to as citrus caviar due to their shape, desirability, and high price (Figure 1). Like other types of citrus fruit, finger limes have nutritional value, few calories, and a high vitamin content. Demand for finger lime in Australia has grown steadily since 2010, mainly because of its unique caviar-like pulp, attractive color range, and bushfood status (i.e., a food native to Australia and used as sustenance by Aboriginal Australians).



Figure 1. Finger lime fruit (Credit: USDA)

AGROCLIMATE REQUIREMENTS, INTERCULTURAL OPERATIONS, AND ESTIMATED ECONOMICS OF PRODUCTION

Ideally, finger lime planting sites should be frost-free and protected from prevailing winds. Commercial orchards do well if planted in full sun. Like all citrus varieties, finger lime requires well-drained soils. The trees are highly susceptible to wind and sunburn, so windbreaks should be established before planting. Finger lime is reported to require less fertilizer than other commercial citrus varieties partly due to less nutrient demand: the trees have smaller leaves and smaller canopy area. It is reported that growers use 25%–30% of the total annual amount of N-P-K fertilizer applied to other commercial citrus varieties. Yields vary with cultivar, but a well-managed 5-year-old tree can produce up to 44 pounds annually.

Finger lime is very delicate and susceptible to skin damage, with close to 50% of the harvest ending up as second grade or processed fruit due to injury caused by its own thorns during harvesting. Apart from prospects of high returns, other attractive features of the crop include the fact that it is reported to be highly resistant to *Phytophthora citrophthora* root disease. Preliminary studies have also indicated that finger lime is tolerant to Huanglongbing (HLB), or citrus greening, a devastating citrus disease that is now endemic in Florida. Field trials to evaluate the appropriate rootstock and nutritional requirements for optimum plant growth are currently underway at the University of Florida's Citrus Research and Education Center (CREC) in Lake Alfred, FL. Varieties currently available to growers include DPI-50-36, DPI-205-1, and DPI-205-4. However, these varieties are the typical non-pigmented type. CREC is in the process of importing the commercial red-pigmented type grown in California (VI 697 accession) to evaluate a population of seedlings from this and other red-pigmented finger limes.

The growth habit of finger limes can range from a large shrub to a medium size tree (up to 20 ft) (Australian National Herbarium). It should be noted that some growers in California are using spacing of 12 feet by 12 feet, or about 300 trees per acre. Furthermore, assuming a conservative farm gate price of \$12 per pound (estimated at 40% of the retail price of \$30 per pound for small [0.37 ounces per fruit]), we arrive at a gross revenue of about \$57,420 per acre. In order to arrive at net return per acre, we further assumed the production cost to be around 50% of gross revenue (47% based on earlier studies carried out on 'Tahiti' lime), given the high labor requirement for harvesting. Even with this assumption, the estimated net return would still be close to \$28,700 per acre. Again, it is worth emphasizing that these are conservative preliminary estimates and much research remains yet to be done on the economics of finger lime productions under Florida conditions.

MARKETING AND MARKET OPPORTUNITY

Australian government data estimate the total national production of finger limes at around 10 tons, with about half of the fruit exported to Europe and Asia. The US domestic retail price ranges from \$30 per pound for the fruit (0.35 to 0.39 ounces) to about \$50 per pound for the premium fruit (weighing more than half of an ounce per fruit). Once harvested, finger lime has a four-week shelf-life if stored in a cool room. The fruit, which retains its shape and flavor when frozen, is available year-round and can be a substitute to lemon and lime varieties, which do not sustain such prolonged freezing periods during storage after harvesting. Commercially, finger lime can also be used in a wide-range of pharmaceutical and nutraceutical products; however, information on market prices is not readily available.

Within the United States, finger lime is beginning to gain popularity and could eventually become more mainstream as crop supply increases and crop prices decrease. California's Central Valley between Visalia and Bakersfield is the main growing area for finger lime, with about 15,000 trees owned by less than a dozen growers. Due to its small-scale production, the fruit is somewhat difficult to find in the marketplace. The main distribution is in large metropolitan areas, where it is sold primarily to high-end retail markets and upscale hotels/bars/restaurants. Mixologists use finger lime fruit in drinks; chefs primarily use them in seafood and Asian Fusion recipes and as a caviar-type garnish. At certain markets in California, a one-ounce container sells for as high as \$8. The reason for such an exorbitant price is because production volumes are still small and demand outweighs supply. As mentioned earlier, around 50% of the Australian finger lime production is exported to markets in Europe and Asia, where demand is growing; hence, the US market is not crowded.

CONCLUDING REMARKS

While commercial production of finger lime in Florida has not yet been undertaken, evidence suggests that it is likely to do well in this environment and possibly replace some of the existing crops. The varied ranges of the colors of fruit flesh and rind certainly make finger limes appealing to high-end hoteliers and those consumers wishing to try something new. Moreover, with increased production, prices on the local market will likely decline somewhat further, stimulating local demand as it becomes accessible to a wider cross-section of consumers. The crop has several attractive features, including its tolerance to some of the most devastating citrus diseases and its relatively low fertilizer requirements. Most importantly, as our preliminary desk analysis reveals, the crop has the potential for high returns. Drawbacks include the current high retail price for the crop limiting growth in demand, labor requirements for harvesting the crop, and the need to optimize production practices.

Challenges notwithstanding, the prospects for the finger lime industry look promising for Florida. Growers who would like more information on the agronomy of the crop, as well as where to obtain budwood planting material, may contact **Dr. Manjul Dutt** (manjul@ufl.edu), (863) 956 8679 at the Citrus Research and Education Center in Lake Alfred, FL.

SOIL HEALTH AND FERTILITY

Tina McIntyre, Rachel Gutner, Tiare Silvasy, and Esen Momol

INTRODUCTION

Integrating practical pest management strategies, addressing plant nutrition and proper irrigation scheduling are very important for successful cropping. This publication provides growers with key agricultural concepts and tips to enhance the health and fertility of soils while protecting the environment. Healthy soils result in improved production, fruit quality, and a more resilient environment.

This publication specifically addresses Best Management Practices (BMPs) for building soil and maintaining soil health. Florida soils are naturally sandy and low in organic material, resulting in leaching and low nutrient levels. Soil amendments are important in the success of plant production.

ASSESSING SOIL HEALTH

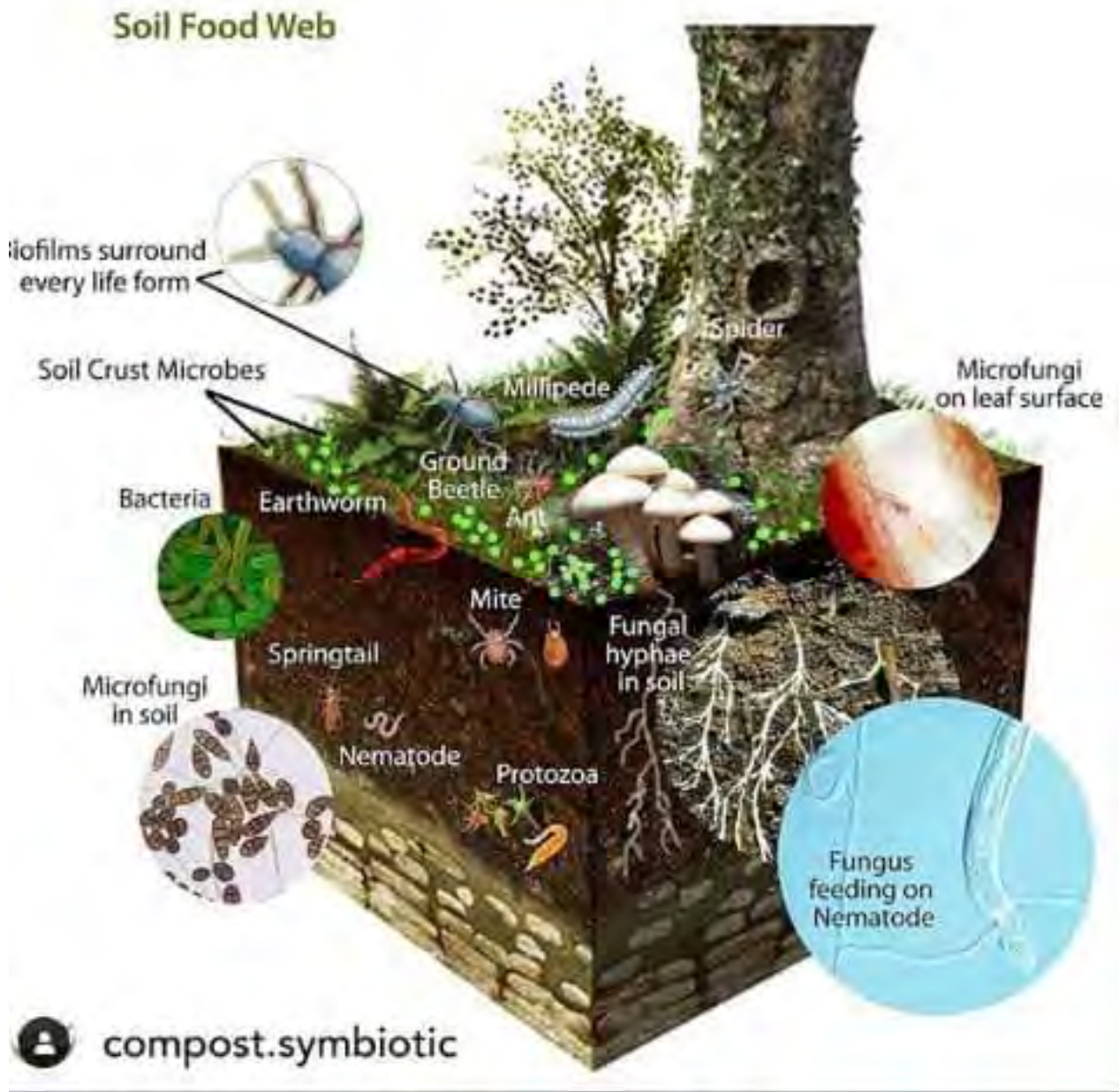
The foundation for growing healthy plants begins with healthy soil. If soil quality is compromised, plants will produce poor yields. Soil structure and type affect a plant's ability to grow roots and uptake water and nutrients. Organic matter is vital to healthy soil because it provides nutrients and habitat for microorganisms and binds soil particles, which improves the water-holding capacity of soil. Following fertilizer recommendations can help prevent nutrient deficiencies, improve tree health and increase crop yield.

INCREASING SOIL HEALTH AND FERTILITY BENEFITS OF ADDING COMPOST AND MANURE

Manure can be used similarly to compost and greatly improves organic matter content in soil. Animal manure should always be composted before use because raw manure can be a risk to food safety. Adding compost to your soil will increase the amount of organic matter and improve the health and production of plants.

WATER MANAGEMENT

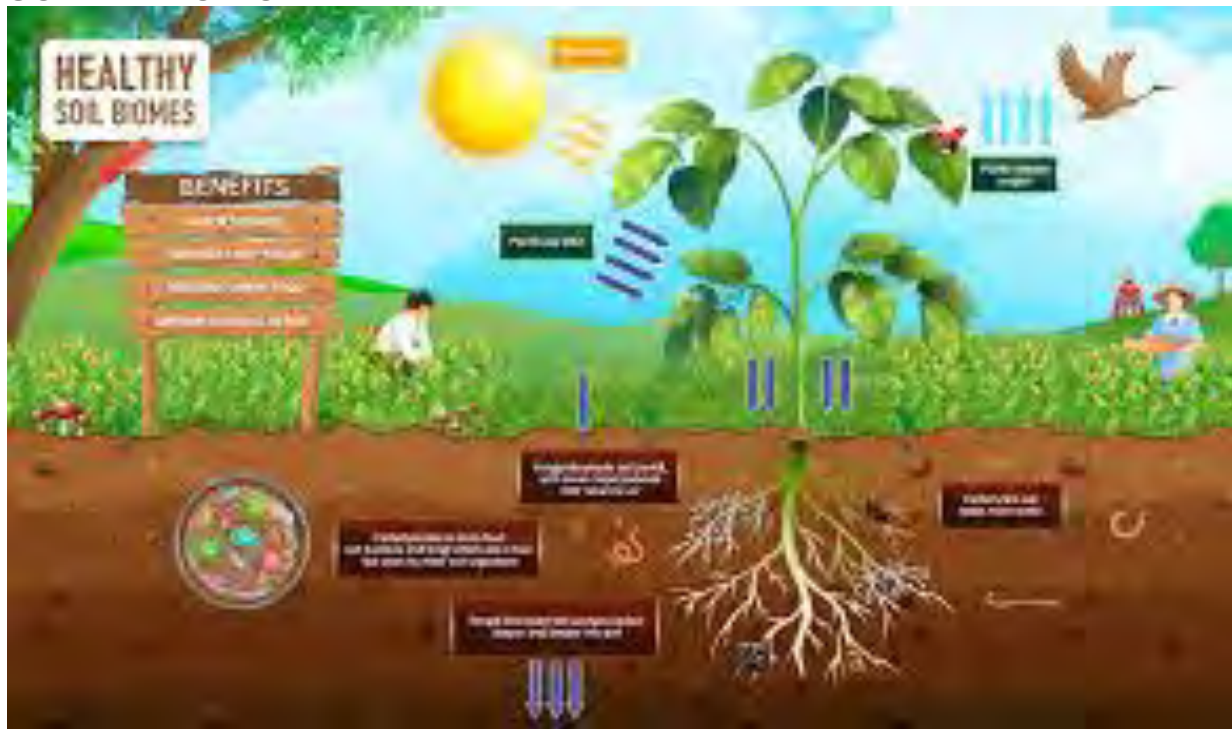
Proper water management is an essential practice. Overwatering can lead to nutrient leaching, which can seep into the underground aquifer or runoff into nearby water bodies. Saturated soil may encourage harmful pathogen growth due to root rot. It leads to shallow root systems, making soil more vulnerable to erosion. A great way to ensure proper watering is to invest in a reliable irrigation scheduling system. Controlling the time and rate at which your trees are watered prevents water waste and pollution. Appropriate and efficient irrigation reduces water use and improves nutrient uptake by plants.



CROPS TO FORTIFY SOIL

There is a good opportunity to increase soil organic matter by utilizing cover crops. For legumes, when tilled into the soil and allowed to decompose after harvest, approximately two-thirds of their nitrogen is available for the main crop. When composted, nutrients are recycled into the soil system for crop use. Legumes also improve the soil's microbial activity and physical and chemical properties. Cover crops, such as cowpea, clover, winter rye, buckwheat, and sunn hemp also help in soil recovery, reduce erosion, and aid in pest and weed management. Some are referred to as "green manure," a crop primarily used for soil amendment and as a nutrient source.

SOIL MICROBIOME



The plant soil microbiome is the dynamic, living community of microorganisms that live in soil and interact with plants. Plant soil microbiomes are underground communities made up of bacteria, archaea, and fungi that have potentially harmful or beneficial aboveground implications. The microbiome can help plants adapt to drought, heat, and other stressful conditions. Because the soil microbiome affects plants and vice versa, treating the soil with care is tied to the health of the microbiome. The soil microbiome is affected by a variety of factors including the soil composition and physical properties, nutrient availability, and plant species. Regularly applying compost and manure contributes to soil building and is essential to microorganisms and the environment.

Soil is considered by many to be inert, but it is one of the most diverse ecosystems, consisting of a vibrant community of microorganisms and a thriving food web. This food web connects fungi, bacteria, microarthropods, nematodes, and protozoa that live in healthy, productive soil. Each plays a vital role. Fungi decompose dead wood and replenish organic matter into the soil, then bacteria break down wood and other plant material, and microarthropods shred organic matter, stimulating microbial activity. Nematodes cycle nutrients and can suppress disease; however, some may be harmful. Protozoa can cycle nutrients.

The soil microbiome is invariably tied to soil health. Microorganisms that live in the soil have been shown to prevent and fight against plant pathogens and improve nutrient availability for plants. Mycorrhizae (fungi) systems have been shown to form beneficial relationships with the roots of plants and form a protective cover around the roots, as well as provide the plant with nutrients, primarily phosphorous, and water.

Individual Protective Covers (IPCs)

An increasing number of citrus growers and researchers in Florida are using individual protective covers (IPCs) for their young citrus trees. They are called Tree Defenders, Tree Sleeves, TreeTubes, TreeGuardians, and mini-cups. These covers are installed immediately after the new trees are planted and are usually kept for two years. With no psyllids getting through the cover, trees avoid infection for the time the covers are on the trees. Without infection, trees enter the fruit-producing stage disease free. The delay in HLB infection maximizes yield for many years to come. The covers not only help prevent psyllids from infecting citrus trees with greening, but they also help trees grow faster and larger. Research demonstrated that IPCs stimulate growth due to increased leaf chlorophyll, reduced vapor pressure deficit, and increased stomatal conductance and photosynthesis. IPCs are a cost-effective and an efficient tool in growing healthy citrus trees. The covers cut the costs of chemical treatments to control psyllids, leafminers, weevils, aphids and other pests. Citrus canker infection and spread are also reduced. Although the primary target is the citrus psyllid, IPCs also protect trees from deer, wind, frost, and hail damage. Typically, the optimum profitability for use of small, cheap IPCs is 2 years, but IPCs can be reusable for several more years on future resets. In conclusion, IPCs provide an effective solution to citrus greening by preventing psyllids from infecting trees during their first two years. They are a highly profitable investment for citrus growers who plant young trees. They create a micro-environment that keeps insect pests out and promote healthy vegetative growth.



IPCs are useful for newly planted solid blocks as well as for resets. IPCs come in different sizes and shapes. Larger size IPCs can protect trees for up to 4 years.



However, like any other tool or strategy, these covers are not perfect. They allow some scale insects, mites, and mealy bugs inside some covers. These tiny pests or creatures can multiply to heavy populations because of the lack in biological control with parasitoids and predators not being able to get inside the covers.

BIOSOLIDS

Biosolids are nutrient-rich organic materials. Although classified as a waste material, biosolids can be beneficial to agriculture because they contain many essential plant nutrients and organic matter. Following proper treatment and processing, biosolids can be recycled as fertilizers or soil amendments to improve soil chemical and physical properties with negligible negative impacts.

Application of organic wastes like biosolids to agricultural land provides several benefits, including:

1. Reduction of the chemical fertilizer requirement, since biosolids are sources of many plant nutrients;
2. Improvement of soil chemical properties by increasing the nutrient pool, promoting an increase in pH of acid soils, and increasing soil buffering capacity;
3. Improvement of soil physical properties, such as structure and particle aggregation, aeration and drainage, and water retention;
4. Enhancement of biological properties by increasing microbial communities and soil fauna and contributing to disease suppression.

Biosolids are generated when solids, accumulated during domestic sewage processing, undergo pathogen control

treatment that meets federal and state sewage sludge regulatory requirements before being applied to the soil.

Wastewater treatment facilities monitor their incoming wastewater stream to ensure that the water and the accompanying organic material are safe to recycle and are compatible with the treatment plant process. This pre-treatment has resulted in dramatic decreases in metal concentrations of biosolids nationwide. The biosolids of today are cleaner and of better quality than those that were produced one to two decades ago.

Once wastewater reaches the treatment plant, domestic sewage is subjected to physical, chemical, and biological processes that kill pathogens and remove solids. The overall mass and volume of solids are reduced as the organic matter is degraded and digested by microorganisms. At some treatment plants, the solids are further treated with lime (calcium oxide or calcium hydroxide) to raise the pH, which reduces bad odors. Lime treatment also decreases the amount of pathogens and the attractiveness of the material to insects and other organisms capable of transporting diseases.

Agricultural uses of biosolids that meet strict quality criteria have been shown to produce improvements in crop growth and yield when applied at recommended rates. Nutrients found in biosolids, including nitrogen, phosphorus, sulfur, calcium, magnesium and micronutrients, are necessary for crop growth and production. Most biosolids contain micronutrients in a natural organically-chelated form. Crops

use nutrients from biosolids efficiently because they are released slowly as the biosolids break down. Biosolids application does not necessarily replace inorganic fertilization. Organic wastes lack the proper balance of nutrients necessary to fully meet crop requirements. They can, however, be used in conjunction with fertilizers to reduce chemical fertilizer inputs. At high rates, the organic matter in biosolids can improve water and nutrient holding capacities of the soil.

Because the fertilizer value of biosolids is so well established, most recent investigations in Florida have focused on various environmental or health risk evaluations. Research has addressed "heavy metal" (cadmium) availability to plants, toxic organic behavior, and possible molybdenosis risk to cattle grazing biosolids-amended pastureland. A major current interest in Florida is the biosolids-phosphorus relationship because many states, including Florida, are moving to restrict biosolids application rates based on phosphorus concerns associated with water quality impairment (leaching and runoff). Researchers are studying phosphorus forms, solubility, leachability, and availability to plants.

Decades of worldwide research have demonstrated that biosolids can be safely used in agriculture. As previously mentioned, some biosolids are treated with lime to reduce pathogen concentrations. These lime-stabilized biosolids have an alkaline pH and can increase soil pH the same way agricultural lime does following application to soil. A major land application issue in Florida is the use of lime-stabilized biosolids on pastures

where "acid-loving" grasses like bahiagrass grow. Addition of an alkaline material can result in elevated soil pH, which in turn leads to poor grass growth caused by micronutrient deficiencies. For a citrus grove that has been receiving alkaline irrigation water and/or has been limed to obtain a soil pH of 6.0 to 7.0, a lime stabilized material could possibly induce a micronutrient deficiency because it has a pH greater than 12. Florida's sandy soils have low capacity to resist changes in pH. Thus, soil pH can increase quickly and substantially in fields where lime-stabilized biosolids have been land applied. Production managers using soil amendments should be aware that biosolids may contain lime, and should apply biosolids stabilized by other means where acid-loving plants are growing.

Biosolids are land-applied across most of the state of Florida without restriction beyond the basic federal and state guidelines. However, since biosolids contain considerable amounts of phosphorus, application has recently been limited or banned outright in phosphorus-sensitive regions (e.g. the area adjacent to Lake Okeechobee) due to water quality concerns. FDEP and the USEPA continue to support land application of biosolids and insist that, when conducted correctly, the practice is safe. USEPA continues to support research to improve testing and verification procedures confirming that treatment practices accomplish intended pathogen reductions.

There are several types of municipal biosolids available for land application in Florida, and they can vary widely in moisture content: a) Fresh Materials--2-6% solids; b) De-watered materials--18-

35% solids; and c) Pelletized (granular), like Milorganite and Granulite organic fertilizers--more than 90% solids. The stabilization process used to treat wastewater significantly alters the nutrient composition and the rate of nutrient release or mineralization of the resulting biosolids. Mineralization values ranging from 40 to 50% of the organic N from aerobically (with oxygen)-digested sewage sludge and 25 to 40% of the organic N from anaerobically (without oxygen)-digested sludge have been reported during the initial crop season. Mineralization rates of approximately 40%, 15%, and 10% have also been estimated for waste-activated sludge, anaerobically-digested sludge, and composted sludge, respectively.

The two main types of biosolids produced in Florida are based on the stabilization process: 1) lime-stabilized, and 2) stabilized by other processes (chemical, physical, or biological). Most biologically stabilized materials undergo an aerobic or an anaerobic digestion process. The typical compositions of lime-stabilized and anaerobically-digested biosolids are shown in the Table next page.

Economic values of biosolids are determined by the marketplace of goods and services for which people are willing and able to pay. Grower should be willing to pay for biosolids only if the product increases overall net returns. An increase in net returns can be achieved

by reducing production costs and/or increasing crop yield or quality. Growers and farmers purchase fertilizers and liming materials, and the extent to which biosolids provide plant nutrients and/or liming capacity provides a basis for valuing biosolids.

Biosolids pose a management challenge in that they do not deliver plant nutrients in the same proportion required for crop production. The economic value of biosolids can be expanded to include micronutrients. Most biosolids contain micronutrients in a natural "chelated" form. Commercially available chelated products can be expensive.

Computing a value for biosolids is a worthwhile exercise for growers who are considering supplying a portion of plant nutrient requirements with biosolids rather than with commercial sources. While the actual material may be "free," other costs such as transportation and field application have to be considered. If the "value" of the biosolid is less than these costs, applying biosolids will not be a wise economic decision. The value of a biosolid will depend on the nutrient analysis of the material and amount of nutrients which will be utilized at a specified application rate. Improvements to soil tilth, microbial populations, and disease suppression are other benefits associated with applying biosolids, but they are difficult to be quantified in terms of yield gains.

Selected characteristics of two types of municipal biosolids.

Characteristic	Type of Biosolids	
	Anaerobically Digested	Lime Stabilized
Solids (%)	25	25
Nitrogen (%)	5.6	3.8
Phosphorus (%)	2.2	1.0
Potassium (%)	0.2	0.4
Copper (ppm)	566	236
Molybdenum (ppm)	23	5
Zinc (ppm)	1484	321
Arsenic (ppm)	4	1
Cadmium (ppm)	11	4
Chromium (ppm)	91	10
Lead (ppm)	195	17
Nickel (ppm)	59	33
Mercury (ppm)	2	2
Selenium (ppm)	3	1
pH	8	12



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Hispanic

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Male