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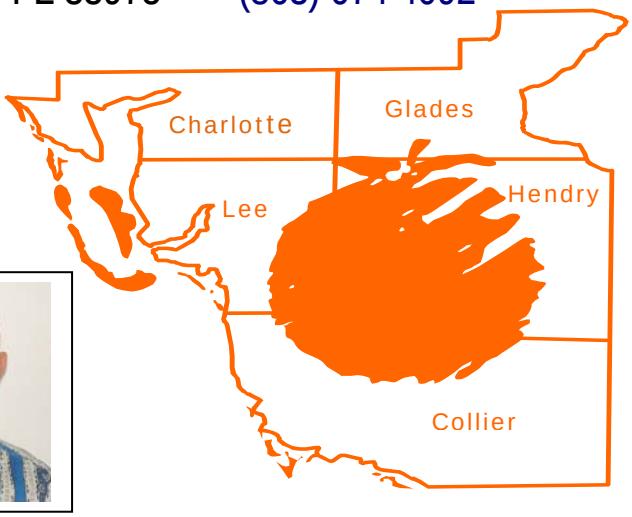
EXTENSION

Institute of Food and Agricultural Sciences

Hendry County Extension, P.O. Box 68, LaBelle, FL 33975 (863) 674 4092

Flatwoods Citrus



Vol. 18, No. 8 **August 2015**

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

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Previous issues of the Flatwoods Citrus newsletter can be found at:
http://citrusagents.ifas.ufl.edu/agents/zekri/index.htm
http://irrec.ifas.ufl.edu/flcitrus/

I M P O R T A N T E V E N T S

SEMINAR-

PHYTOPHTHORA, NEMATODES, AND DIAPREPES

Date & time: Thursday, **August 27th, 2015, 10:00 AM – 12:00 Noon**
Location: Immokalee IFAS Center
Program Coordinator: Dr. Mongi Zekri, UF-IFAS
Program Sponsors: W Garry Gibson

----10:00 AM - 10:50 AM

1. HLB interactions with Phytophthora diseases. **Dr. Jim Graham**, UF-IFAS

--Statewide Phytophthora soil populations have surged, declined, and resurged as HLB spread statewide.

--HLB interaction with soil and water stress increases susceptibility to Phytophthora.

--Control of Phytophthora populations and how well HLB roots infected with Phytophthora respond to fungicides has been affected.

--Priorities for management of HLB groves affected by soil and water stresses and Phytophthora will be discussed.

10:50 AM – 11:05 AM Break

----11:05 AM - 12:00 Noon

2. Nematodes and Diaprepes. **Dr. Larry Duncan**, UF-IFAS

--Importance of managing weevil and nematode problems in conjunction with HLB infection

--Current management methods

--Expected outcomes of management

2 CEUs for Certified Crop Advisors (CCAs)
2 CEUs for Pesticide License Renewal

Pre-registration is required. No registration fee and lunch is free Thanks to **W Garry Gibson with BASF.** To reserve a seat, call 863 674 4092, or send an e-mail to Dr. Mongi Zekri at: maz@ufl.edu
No pre-registration = No lunch

CITRUS EXPO IN NORTH FORT MYERS

http://www.citrusexpo.net/

UF IFAS Extension UNIVERSITY of FLORIDA

Farm Labor Supervisor Training Program

2015 Fall Training Sites & Dates

Belle Glade

UF/IFAS Everglades Research & Education Center

3200 E. Palm Beach Rd. Belle Glade, FL 33430

Ph: 561-993-1500

Date	Classes/Time	Classes/Time
Tues, 10/13	First Aid/ 8am-12pm	CPR/ 1pm-4pm
Tues, 10/20	HR Compliance/ 9am-11:30am	Management Communications/ 12:30pm-3pm
Tues, 10/27	Wage & Hour/ 9am-11:30am	Contractor Basics/ 12:30pm-3pm
Tues, 11/3	Rules for Bus & Van Drivers/ 9am-11:30am	Safe Driving/ 12:30pm-3pm
Thurs, 11/5	Agriculture Equipment Safety/ 9am-11:30am	Pesticide Safety/ 12:30pm-3pm

Immokalee

UF/IFAS Southwest Florida Research & Education Center

2685 SR 29 N. Immokalee, FL 34142

Ph: 239-658-3400

Date	Classes/Time	Classes/Time
Tues, 11/3	First Aid/ 8am-12pm	CPR/ 1pm-4pm
Tues, 11/10	Rules for Bus & Van Drivers/ 9am-11:30am	Safe Driving/ 12:30pm-3pm
Tues, 11/17	HR Compliance/ 9am-11:30am	Management Communications/ 12:30pm-3pm
Thurs, 11/19	Agriculture Equipment Safety/ 9am-11:30am	Pesticide Safety/ 12:30pm-3pm
Tues, 11/24	Wage & Hour/ 9am-11:30am	Contractor Basics/ 12:30pm-3pm

Lake Alfred

UF/IFAS Citrus Research & Education Center

700 Experiment Station Rd. Lake Alfred, FL 33850

Ph: 863-956-1151

Date	Classes/Time	Classes/Time
Wed, 10/7	HR Compliance/ 9am-11:30am	Management Communications/ 12:30pm-3pm
Wed, 10/14	Rules for Bus & Van Drivers/ 9am-11:30am	Safe Driving/ 12:30pm-3pm
Wed, 10/21	First Aid/ 8am-12pm	CPR/ 1pm-4pm
Wed, 10/28	Wage & Hour/ 9am-11:30am	Contractor Basics/ 12:30pm-3pm
Tues, 11/24	Agriculture Equipment Safety/ 9am-11:30am	Pesticide Safety/ 12:30pm-3pm

Sebring

UF/IFAS Highlands County Extension Office

4509 George Blvd. Sebring, FL 33875

Ph: 863-402-6540

Date	Classes/Time	Classes/Time
Thurs, 10/8	HR Compliance/ 9am-11:30am	Management Communications/ 12:30pm-3pm
Thurs, 10/15	Wage & Hour/ 9am-11:30am	Contractor Basics/ 12:30pm-3pm
Thurs, 10/22	Rules for Bus & Van Drivers/ 9am-11:30am	Safe Driving/ 12:30pm-3pm
Thurs, 10/29	First Aid/ 8am-12pm	CPR/ 1pm-4pm
Thurs, 11/12	Agriculture Equipment Safety/ 9am-11:30am	Pesticide Safety/ 12:30pm-3pm

Who should take these classes?

Labor Contractors, Crew Leaders, Bus & Van Drivers and Farm Office Staff

Language: English or Spanish

Minimum Class Size: 10 participants

Fee: $50 per person per class

To register visit: http://swfrec.ifas.ufl.edu/programs/economics/fls.php

Questions about FLS Classes:

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USDA

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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
9 July 2015

ENSO Alert System Status: El Niño Advisory

Synopsis: **There is a greater than 90% chance that El Niño will continue through Northern Hemisphere winter 2015-16, and around an 80% chance it will last into early spring 2016.**

During June, sea surface temperatures (SST) anomalies exceeded +1.0°C across the central and eastern equatorial Pacific Ocean (Fig. 1). The largest SST anomaly increases occurred in the Niño-3 and Niño-3.4 regions, while the Niño-4 and Niño-1+2 indices remained more constant through the month (Fig. 2). Positive subsurface temperature anomalies weakened (Fig. 3) due to the eastward shift of an upwelling oceanic Kelvin wave, which reduced above-average temperatures at depth in the central and east-central equatorial Pacific (Fig. 4). In many respects, the atmospheric anomalies remained firmly coupled to the oceanic warming. Significant westerly winds were apparent in the western equatorial Pacific and anomalous upper-level easterly winds continued. The traditional and equatorial Southern Oscillation Index (SOI) were both negative, which are consistent with enhanced convection over the central and eastern equatorial Pacific and suppressed convection over Indonesia (Fig. 5). Collectively, these atmospheric and oceanic features reflect an ongoing and strengthening El Niño.

Nearly all models predict El Niño to continue into the Northern Hemisphere winter 2015-16, with many multi-model averages predicting a strong event at its peak strength (3-month values of the Niño-3.4 index of +1.5°C or greater; Fig. 6). At this time, the forecaster consensus is in favor of a significant El Niño in excess of +1.5°C in the Niño-3.4 region. Overall, there is a greater than 90% chance that El Niño will continue through Northern Hemisphere winter 2015-16, and around an 80% chance it will last into early spring 2016 (click CPC/IRI consensus forecast for the chance of each outcome for each 3-month period).

Across the contiguous United States, temperature and precipitation impacts associated with El Niño are expected to remain minimal during the Northern Hemisphere summer and increase into the late fall and winter (the 3-month seasonal outlook will be updated on Thursday July 16th). El Niño will likely contribute to a below normal Atlantic hurricane season, and to above-normal hurricane seasons in both the central and eastern Pacific hurricane basins (click Hurricane season outlook for more).

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). Forecasts are also updated monthly in the Forecast Forum of CPC's Climate Diagnostics Bulletin. Additional perspectives and analysis are also available in an ENSO blog. The next ENSO Diagnostics Discussion is scheduled for 13 August 2015. 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.

PHYTOPHTHORA

Foot rot results from infection of the scion near the ground level, producing bark lesions, which extend down to the budunion on resistant rootstocks.

Crown rot results from infection of the bark below the soil line when susceptible rootstocks are used. Root rot occurs when the cortex of fibrous roots is infected, turns soft and appears water-soaked.

Fibrous roots slough their cortex leaving only white thread-like stele.

When managing Phytophthora-induced diseases, consider integration of cultural practices (e.g., disease exclusion through use of Phytophthora-free planting stock, resistant rootstocks, proper irrigation practices) and chemical control methods.

Cultural practices. Field locations not previously planted with citrus are free of citrus-specific *P. nicotianae*. Planting stock should be tested free of Phytophthora in the nursery and inspected for fibrous root rot in the nursery or grove before planting. In groves with a previous history of foot rot, consider use of Swingle citrumelo for replanting. Swingle citrumelo is resistant to foot rot and roots do not support damaging populations once trees are established.

Cleopatra mandarin should be avoided because it is prone to develop foot rot when roots are infected in the nursery or when trees are planted in flatwoods situations with high or fluctuating water tables and fine-textured soils. Trees should be planted with the budunion well-above the soil line and provided with adequate soil drainage. Overwatering, especially of young trees, promotes buildup of populations in the soil and increases risk of foot rot infection. Prolonged wetting of the trunk, especially if tree wraps are used on young trees, should be avoided by using early to midday irrigation schedules. Control of fire ants prevents their nesting under wraps and causing damage to tender bark.

Sampling for *P. nicotianae*. Population densities of the fungus in grove soils should be determined to assist in decisions to treat with fungicides. Soil samples containing fibrous roots should be collected during the spring through fall (March to November) from under-canopy within the tree dripline. Individual small amounts of soil from 20 to 40 locations within a 10-acre area are composited into one resealable plastic bag to retain soil

moisture. Samples must be kept cool but not refrigerated for transport to the analytical laboratory. Currently, populations in excess of 10 to 15 propagules per cm^3 soil are considered damaging. The same soil sample could be tested for populations of nematodes, to assess whether they occur at damaging levels.

Chemical control.

Use of fungicides in young groves should be based on rootstock susceptibility, likelihood of Phytophthora infestation in the nursery, and history of Phytophthora disease problems in the grove. For susceptible rootstocks, such as Cleopatra mandarin and sweet orange, fungicides may be applied to young trees on a preventive basis for foot rot. For other rootstocks, fungicide treatments should commence when foot rot lesions develop. The fungicide program for foot rot should be continued for at least one year for tolerant rootstocks, but may continue beyond for susceptible stocks.

In mature groves, the decision to apply fungicides for root rot control is based on yearly soil sampling to indicate whether damaging populations of *P. nicotianae* occur in successive growing seasons. Time applications to coincide with periods of susceptible root flushes in late spring and late summer or early fall.

Soil application methods with fungicides should be targeted to under canopy areas of highest fibrous root density. To avoid leaching from the root zone, soil-applied fungicides should not be followed by excessive irrigation.

Recommended Chemical Controls for Phytophthora Foot Rot and Root Rot include Aliette, Phostrol, ProPhyt, Ridomil, UltraFlourish, and Copper.

For more details, go to:
http://www.crec.ifas.ufl.edu/extension/pest/PDF/2015/Phytophthora.pdf

BROWN ROT MANAGEMENT

Management of brown rot, caused by *Phytophthora nicotianae* or *P. palmivora*, is needed on both processing and fresh market fruit. While the disease can affect all citrus types, it is usually most severe on Hamlin and other early maturing sweet orange cultivars.
Phytophthora brown rot is a localized problem usually associated with restricted air and/or water drainage. It commonly appears from mid-August through October following periods of extended high rainfall. It can be confused with fruit drop due to other causes at that time of the year. If caused by *P. nicotianae*, brown rot is limited to the lower third of the canopy because the fungus is splashed onto fruit from the soil. *P. palmivora* produces airborne sporangia and can affect fruit throughout the canopy.
Early season inoculum production and spread of *Phytophthora* spp. are minimized with key modifications in cultural practices. Skirting of the trees reduces the opportunity for soil-borne inoculum to contact fruit in the canopy. The edge of the herbicide strip should be maintained just inside of the dripline of the tree to minimize the exposure of bare soil to direct impact by rain. This will limit rain splash of soil onto the lower canopy. Boom application of herbicides and other operations dislodge low-hanging fruit. Fruit on the ground becomes infected and produces inoculum of *P. palmivora* that can result in brown rot infection in the canopy as early as July while fruit are still green. The beginning stages of the epidemic are very difficult to detect before the fruit are colored and showing typical symptoms. Application of residual herbicides earlier in the summer may reduce the need for post-emergence materials later and minimize fruit drop throughout this early stage of inoculum production from fallen fruit.
Usually a single application of Aliette, Phostrol or ProPhyt before the first signs of brown rot appear in late July is sufficient to protect fruit through most of the normal infection period. No more than 20 lb/acre/year of Aliette should be applied for the control of all Phytophthora diseases. Aliette, Phostrol and ProPhyt are systemic fungicides that protect against postharvest infection and provide 60-90 days control. Copper fungicides are primarily protective but are capable of killing sporangia on the fruit surface and thus reducing inoculum. They may be applied in August before or after brown rot appearance and provide protection for 45-60 days. If the rainy season is prolonged into the fall, a follow-up application of either systemic fungicides at one-half of the label rate, or copper in October may be warranted. With average quality copper products, usually 2-4 lb of metallic copper per acre are needed for control.
Precautions should be taken during harvesting not to include brown rot-affected fruit in the field containers as this could result in rejection at the processing or packing facility.

Recommended Chemical Controls for Brown Rot of Fruit

Pesticide	FRAC MOA[2]	Mature Trees Rate/Acre[1]
Aliette WDG	33	5 lb
Phostrol	33	4.5 pints
ProPhyt	33	4 pints
copper fungicide	M1	Use label rate.

[1]Lower rates may be used on smaller trees. Do not use less than minimum label rate.
[2]Mode of action class for citrus pesticides from the Fungicide Resistance Action Committee (FRAC) 2013. Refer to ENY624, Pesticide Resistance and Resistance Management, in the 2014 Florida Citrus Pest Management Guide for more details.

Rates for pesticides are given as the maximum amount required to treat mature citrus trees unless otherwise noted. To treat smaller trees with commercial application equipment including handguns, mix the per acre rate for mature trees in 250 gallons of water. Calibrate and arrange nozzles to deliver thorough distribution and treat as many acres as this volume of spray allows.

For more information, go to Florida Citrus Pest Management Guide: Brown Rot of Fruit at: *http://www.crec.ifas.ufl.edu/extension/pest/PDF/2015/Brown%20Rot.pdf*

From: Citrus Industry magazine, June 2015.

Leaf Tissue and Soil Sampling and Testing

Mongi Zekri, Kelly Morgan, Tom Obreza, and Arnold Schumann

UF | IFAS Extension
UNIVERSITY of FLORIDA

Introduction

Nutrient deficiency or excess will cause citrus trees to grow poorly and produce sub-optimal yield and/or fruit quality. For this reason, diagnosis of potential nutritional problems should be a routine citrus-growing practice. Quantifying nutrients in soils and trees eliminates guesswork when adjusting a fertilizer program.

Benefits of leaf analysis

The goal in tissue analysis is to adjust fertilization programs so that nutritional problems and their costly consequences are prevented. Considerable research involving citrus leaf testing has established its reliability as a management tool, but sampling guidelines should be followed precisely to ensure that analytical results are meaningful.

Leaf tissue analysis:

- Determines if the tree has had a sufficient supply of essential nutrients.
- Confirms nutritional deficiencies, toxicities, or imbalances.
- Identifies hidden toxicities and deficiencies when visible symptoms are not present.
- Evaluates the effectiveness of fertilizer programs.
- Provides a way to compare several fertilizer treatments.
- Determines the availability of elements not tested for by other methods.

Leaf tissue analysis tests all the factors that might influence nutrient availability and uptake.

Considerations in leaf sampling

Procedures for proper sampling, preparation, and analysis of leaves have been standardized to achieve meaningful comparisons and interpretations. If the procedures are done correctly, chemical analysis reliability, data interpretation, fertilization recommendations, and fertilizer program adjustments will be sound. Considerable care should be taken from the time leaves are selected for sampling to the time they are received at the laboratory for analysis.

Leaf Sample Timing

• Leaf samples must be taken at the correct time of year because nutrient concentrations within leaves continuously change. As leaves age from spring through fall, N, P, and K concentrations decrease; Ca increases; and Mg first increases and then decreases. However, leaf mineral concentrations are relatively stable from four to six months after leaf emergence in the spring.

• The best time to collect 4-6-month-old spring flush leaves is July and August. If leaves are sampled later in the season, summer leaf growth can be confused with spring growth.

Leaf sampling technique

- One leaf sample should represent an area not to exceed 20 acres. The sampler should make sure the selected trees are representative of the average within the block being sampled.
- Each leaf sample should consist of approximately 100 leaves taken from nonfruiting twigs of 15 to 20 uniform trees of the same variety and rootstock that have received the same fertilizer program.
- Use clean paper bags to store the sample. Label the bags with an identification number that can be referenced when the analytical results are received.
- Avoid immature leaves due to their rapidly changing composition.

● Do not sample abnormal-appearing trees. Also, trees at the block's edge or at the end of rows should not be sampled as leaves from these trees may be coated with soil particles and dust.
● Do not include diseased, insect-damaged, or dead leaves in a sample.
● Select only one leaf from a shoot, and remove it with its petiole (leaf stem).

Special Case: Diagnosing growth disorders

● Collect samples from both affected trees as well as normal trees and label each bag separately.
● Trees selected for comparison sampling should be of the same age, scion type, and rootstock.
● If possible, confine the sampling area to trees that are in close proximity to each other.

Handling of leaf samples

● Protect leaves from heat and keep them dry. Place them in a refrigerator for overnight storage if the leaves cannot be washed and oven dried during the day of collection.
● For macronutrient analysis, leaves do not need to be washed. Macronutrients include N, P, K, Ca, and Mg.
● For micronutrient determinations, leaf samples should be washed by hand soon after collection and before the leaves dehydrate. Leaves should be rubbed between the thumb and forefinger while soaking them in a mild detergent solution and then thoroughly rinsed with distilled or deionized water. It is difficult to remove all surface residues, but this procedure removes most of this contamination.
● Dry the leaves in a ventilated oven at about 140°F.

Analysis and interpretation

● The laboratory determines the total concentration of each nutrient in the leaf sample. Since total concentration is determined, there should be no difference in leaf analysis results between different laboratories.
● To interpret laboratory results, compare the values with the leaf analysis standards in Table 1. These standards are based on long-term field observations and experiments conducted in different countries with different citrus varieties, rootstocks, and management practices. The tabulated standards are used to gauge citrus tree nutrition throughout the world.
● The goal in nutrition management is to maintain leaf nutrient concentrations within the optimum range every year (Table 1). If the level of a particular nutrient is not optimum, various strategies can be used to address the situation. These might include supplemental foliar or soil applications of the appropriate nutrients.

Benefits of soil analysis

Soil analysis is helpful in formulating and improving a fertilization program because soil testing measures organic matter content, pH, and extractable nutrients. Soil analysis is particularly useful when conducted for several consecutive years because trends can be observed. However, a citrus grower cannot rely on soil analysis alone to formulate a fertilizer program or to diagnose a nutritional problem in a grove. Leaf sample analysis and observations of leaf deficiencies and toxicities should also be used.
Similar to leaf analysis, organic matter and soil pH determination methods are universal, so results should not differ between laboratories. However, soil nutrient extraction procedures can vary from lab to lab, including the University of Florida Extension Soil Testing Laboratory (ESTL). The University of Florida now recommends the Mehlich 3 extraction procedure. The single most useful soil test in a citrus grove is for pH. Soil pH greatly influences nutrient availability. Some nutrient deficiencies can be avoided by maintaining soil pH between 5.5 and 6.5.

Considerations in soil sampling

Standard procedures for sampling, preparing, and analyzing soil should be followed for meaningful interpretations of the test results and accurate recommendations.

Soil sample timing

● In Florida, soil samples should be collected once per year at the end of the summer rainy season and before fall fertilization (August to October).

● It is convenient to take annual soil samples when collecting leaf samples to save time and reduce cost.
● The accuracy of soil test interpretations depends on how well the soil sample represents the grove block or management unit in question.

Soil sampling technique

● Each soil sample should consist of one soil core taken about eight inches deep at the dripline of 15 to 20 trees within the area wetted by the irrigation system in the zone of maximum root activity.
● Sampled areas should correspond with grove blocks where leaf samples were collected. The area should contain similar soil types with trees of roughly uniform size and vigor.
● Thoroughly mix the cores in a nonmetal bucket to form a composite sample. Take a subsample from this mixture, and place it into a labeled paper bag.

Special case: Diagnosing growth disorders

● Collect soil samples from beneath affected trees as well as normal trees, and analyze them separately.
● If possible, confine the sampling area to trees that are close to each other.

Preparation for analysis

● Soil samples should be air-dried before shipping to the laboratory for analysis.

Analysis and interpretation

● The basic soil analysis package run by most agricultural laboratories includes soil pH and extractable P, K, Ca, and Mg. Organic matter is sometimes part of the basic package, or it may be a separate analysis. Extractable Cu is normally determined upon request.
● Since **extractable** nutrients are measured, the magnitude of soil test values may differ between different laboratories. This difference is not a concern as long as the extraction method is calibrated for citrus.
● The laboratory interprets each soil test result as very low, low, medium, high, or very high or low, medium and high in the case of Mehlich 3 and may also provide fertilizer recommendations accordingly. Citrus growers can independently interpret the numerical results according to UF-IFAS guidelines based on the extractant used.
● The interpretations should be used to make management decisions regarding soil pH adjustment or fertilizer application.

Summary

Tissue and soil analysis are powerful tools to confirm nutrient deficiencies and toxicities, identify “hidden hunger,” evaluate fertilizer programs, study nutrient interactions, and determine fertilizer rates. However, if any steps in site selection, sampling, or analysis are faulty, the results may be misleading.

Experience interpreting sample results is essential due to the many interacting factors that influence the concentrations of elements in soil and leaf tissue. Tree age, cropping history, sampling techniques, soil test interpretations, and leaf analysis standards all must be considered before making a final diagnosis. If done properly, tissue and soil analysis will lead to more economical and efficient use of fertilizers because excessive or insufficient application rates will be avoided. A summary of the most important attributes of citrus nutrient of soil and leaves is provided in the following list.

Soil and leaf tissue analysis summary

Use this checklist as a guide for starting a soil and leaf tissue testing program:

* A sampling program is most effective if it is done annually at the same time of year.
* Leaf tissue testing is valuable for all elements.
* Soil testing is most useful for pH, P, K, Ca, Mg, and Cu.
* Use the standard sampling procedures for soil and leaves described in this document.
* Be aware that spray residues or dust on leaf surfaces affect sample results; wash leaves for accurate micronutrient analysis. Avoid sampling recently sprayed trees.
* Be aware that a number of different soil extracting solutions exist, and they can differ in their ability to extract plant nutrients, especially P.

* Interpretation of leaf and soil tests should be used to make fertilizer or liming decisions. Wise use of the results allows optimal citrus production and minimizes fertilizer loss.

Table 1. Guidelines for interpreting orange tree leaf analysis based on four- to six-month-old spring flush leaves from nonfruiting twigs. The information contained in this article pertains to healthy citrus trees. The values for some nutrients in HLB-affected trees may not conform to Table 1 values.

Element	Unit of measure	Optimum
N	%	2.5 – 2.7
P	%	0.12 – 0.16
K	%	1.2 – 1.7
Ca	%	3.0 – 4.9
Mg	%	0.30 – 0.49
S	%	0.20 – 0.40
Cl	%	< 0.20
Na	%	< 0.15
Mn	mg/kg or ppm[1]	25 – 100
Zn	mg/kg or ppm	25 – 100
Cu	mg/kg or ppm	5 – 16
Fe	mg/kg or ppm	60 – 120
B	mg/kg or ppm	36 – 100
Mo	mg/kg or ppm	0.10 – 2.0

[1]ppm = parts per million.

Foliar fertilization in citriculture

UF | IFAS Extension
UNIVERSITY of FLORIDA

From: Mongi Zekri. 2014. Foliar fertilization in citriculture. Citrus Industry 95(4): 6-10

Foliar fertilizer application is certainly not a new concept to the citrus industry. For over five decades, foliar fertilization of citrus has been recommended to correct zinc, manganese, boron, copper, and magnesium deficiencies. It is now common knowledge in agriculture that properly nourished crops may tolerate insect pests and diseases. Traditionally citrus growers try to achieve optimum nutrition through direct soil management. Currently with the introduction of citrus greening in Florida, many growers and production managers consider foliar fertilization a key factor to stimulate the natural defense mechanisms of their trees, to induce pest and disease tolerance, and to improve fruit yield and fruit quality.

In Florida, foliar nutrition programs are becoming very common and extensively used to deliver all of the essential nutrient elements to citrus trees. Furthermore, economic and environmental considerations require the utilization of more efficient methods for nutrient applications. Foliar application of fertilizers is more efficient than traditional soil application because of better, faster nutrient uptake and reduced losses. Although field research has shown that supplemental foliar feeding can increase yield by 10-25% compared with conventional soil fertilization, foliar fertilization should not be considered a substitute for a sound soil-fertility program.

Foliar fertilizer application is highly efficient because the materials are targeted to areas where they can be directly absorbed into the plant. However, nutrients foliarly applied prior to a rainfall are subject to being washed off the leaves and onto the soil. Foliar fertilizer application also provides a more timely and immediate method for delivery of specific nutrients at critical stages of plant growth. Foliar nutrition programs are therefore valuable supplements to soil applications. As indicated previously, foliar feeding is not intended to replace soil-applied fertilization of the macronutrients (nitrogen, potassium, and phosphorus). Foliar applications of macronutrients can however be alternatively applied in sufficient quantities to influence both yield and fruit quality. Citrus trees can have a large part of the annual nitrogen requirements met through foliar applications. Foliar applications of other macronutrients (calcium, magnesium, and sulfur) and micronutrients (zinc, manganese, copper, boron, and molybdenum) have proven to be an excellent means for satisfying citrus tree requirements.

Because fertilizer applications to the soil can be subjected to undesirable processes such as leaching, runoff, and being tied up in the soil in unavailable forms, foliar

applications of nutrients have been designed to be an integral component of overall tree nutrition programs. It is used in other situations to help trees through short, but critical periods of nutrient demand, such as vegetative growth, bud differentiation, fruit set and fruit growth. Foliar application of nutrients is of great importance when the root system is unable to keep up with crop demand or when the soil has a history of problems that inhibit normal nutrient uptake. Foliar nutrition is proven to be useful under prolonged periods of wet conditions, droughty conditions, calcareous soil, cold weather or any other condition that decreases the tree's ability to take up nutrients when there is a demand. Foliar feeding may be effectively utilized when a nutritional deficiency is diagnosed. Foliar application is absolutely the quickest method of getting the most nutrients into plants. However, if the deficiency can be observed on the tree, the crop has already lost some potential yield.

While foliar feeding has many advantages, it can burn leaves at certain rates under certain environmental conditions. It is important, therefore, to foliar feed within some established guidelines. There are a number of plant, soil, and environmental conditions that can increase the chances of causing foliar burn to foliar fertilizer application. For example, a tree under stress is generally more susceptible to damage. Stressful conditions include drying winds, disease infection, and unfavorable soil conditions. The environmental conditions at the time of application are also important factors. Applications when the weather is hot (above 80^0F) should be avoided. This means that during warm seasons, applications should be made in the morning or evening when the temperature is right, wind is minimal, and the stomates on citrus leaves are open, allowing leaves to efficiently exchange water and air.

Nutrient absorption is increased when spray coverage reaches the undersides of the leaves where the stomates are located. Favorable results from foliar feeding are most likely to occur when the total leaf area is large. Foliar applications of micronutrients with the exception of iron are more effective and efficient when the spring, summer, and fall new flush leaves are about fully expanded. Additionally, applications should be at least two-week apart to give the tree sufficient time to metabolize the nutrients and deal with the added osmotic stress. To be efficient and to avoid crop damage, dilute solutions of nutrient formulations are recommended. Highly concentrated sprays, especially those including salt-based fertilizers, have the potential to cause leaf burn and/or drop.

Another important factor when applying nutrients foliarly is to ensure that the pH of the spray solution is in the proper range (between 5.5 and 6.5). This is particularly important in areas where water quality is poor. In order to enhance uptake and thus the effectiveness of any foliar application, nitrogen should be added to the solution. Urea may be the most suitable nitrogen source for foliar applications due to its low salt index and high solubility in comparison with other nitrogen sources. Urea has been shown to stimulate absorption of other nutrients by increasing the permeability of leaf tissue. However, the urea utilized in foliar sprays should be low in biuret

content (0.2% or less) to avoid leaf burn. Other sources of nitrogen can be obtained from ammonium polyphosphates, ammoniated ortho-phosphates, potassium nitrate, calcium nitrate, and ammonium thiosulfate. These sources, when utilized at low rates of foliar application, are excellent supplemental nitrogen carriers with minimal foliage burn side-effects. Triazone nitrogen has been shown to significantly reduce leaf burn and enhance foliar absorbed nitrogen compared with urea, nitrate, and ammonium nitrogen sources.

The use of a combination of poly and ortho-phosphates has been shown to lessen leaf burn and aid in leaf phosphate absorption. Phosphites have also been found useful, safe, and not phytotoxic as foliar sprays on citrus trees. Potassium polyphosphates, potassium hydroxide, potassium nitrate and potassium thiosulfate sources combine both low salt index and high solubility characteristics. Foliar application of calcium, magnesium, sulfur, zinc, manganese, copper, boron and molybdenum can be highly effective to satisfy nutrient requirements. However, there can be difficulties associated with leaf tissue absorption and translocation of calcium, magnesium, boron and molybdenum. Choosing the correct fertilizer sources for these nutrients can be critical. Good sources for supplying many of the micronutrient elements are the sulfate sources.

Be careful about possible chemical interactions among foliar fertilizers. Some materials are incompatible and should not be mixed together. They may create precipitates that tie up and make some nutrients unavailable and/or clog spray nozzles. Many product labels warn of such incompatibilities. If there is no specific packaging information, small quantities of the materials should be mixed with water in a jar and shaken. If there is no precipitate, there should be no problem. Foliar fertilization can sometimes be combined with pesticide application. However, timing conflicts and material incompatibilities can sometimes make combining such sprays unwise. Be sure to read all product labels and do the jar's test if uncertain.

Foliar applications of low biuret urea at 12-14 gallons or at 53-60 lbs (24-28 lbs N) per acre or phosphite (PO_3) at 3 pints (60% P) to 2 quarts (26% P) per acre in late December-early January (6 to 8 weeks before bloom) have been demonstrated to increase flowering, fruit set, and fruit production. Postbloom foliar applications of potassium nitrate or mono-potassium phosphate at 8 lbs K_2O per acre have also been found to increase yield and fruit size. Foliar spray applications of 3-5 lbs/acre of magnesium, manganese, zinc, and copper, and 0.25-0.50 lb/acre of boron and molybdenum are also recommended for citrus trees to prevent nutrient deficiencies and improve production.

Today, foliar feeding is playing an important role in Florida citrus production. It is rapidly gaining ground as a nutritional supplement to soil-applied fertilizers to improve yield and fruit quality, particularly in the face of HLB (citrus greening). Foliar nutrition is also a very important and effective way of addressing diagnosed problems with specific deficiencies observed within the grove and a best management strategy for supplying micronutrients with the exception of iron. The

concept that foliar sprays should be applied only after the appearance of a deficiency is unsound since reductions in yield and quality usually precede the appearance of visual symptoms. In addition to soil-applied fertilizers, foliar sprays of nutrients should be used with the objective of maintaining citrus trees health at an optimal level.

Figure 1. Foliar feeding of citrus trees.

Figure 2. Citrus tree performance under soil-applied fertilizer program supplemented with foliar nutrition.

Danger of Heat Stress

Be alert to early warnings of heat stress, both in yourself and in your co-workers.

Heat stress needs to be taken seriously.

Working in a hot environment puts stress on the body's cooling system. When heat is combined with other stresses like hard physical work, loss of fluids, or fatigue it may lead to heat-related illness. Individuals over 40 years of age need to take extra care when the weather is hot because their ability to sweat declines as they age. However, heat stress can also affect individuals who are young and fit.

POINTS TO EMPHASIZE:

●Drink plenty of water to keep body fluid levels up

●Get out of the heat occasionally

Water is crucial to help the body adjust to high temperatures. The rate of water intake must be equal to the rate of water loss by perspiration to keep body temperature normal. **When it's hot, drink plenty of water!**

Your body must work even harder to get rid of excess heat when conditions are both hot and humid. Unfortunately, water can't evaporate as readily under muggy conditions. The process is easier if the surrounding air is moving. That's why we welcome a cool breeze, or turn on a fan when the air is "sticky".

Sickness and accident rates increase when heavy work is done at temperatures above 86 F.

Don't push yourself beyond your limits. It could be harmful to your health, and could put you at increased risk of having an accident.

Heat stress hazards

1. **Heat cramps:** Heavy sweating drains the body of salt, which cannot be replaced by simply drinking water. Painful cramps occur in the arms, legs, or stomach while on the job, or later at home. Move to a cool area at once if cramping is experienced. Loosen clothing and drink cool, commercial fluid replacement beverage. Seek medical aid if the cramps are severe, or don't go away.

2. Heat exhaustion: Inadequate water and salt intake causes the body's cooling system to break down. Symptoms include heavy sweating, cool, moist skin, body temperature over 100 F, weak pulse, and normal or low blood pressure. The victim is likely to be tired, weak, clumsy, upset, or confused. He will be very thirsty, and will breathe rapidly. His vision may be blurred. **Get medical help immediately!** Heat exhaustion can lead to heat stroke, which can kill. Move the person to a cool, shaded area. Loosen or remove excess clothing. Provide cool, lightly-salted water. Fan and spray the victim with cool water.

3. **Heat stroke can kill a person quickly!** Once the body uses up all its water and salt, sweating ceases. Temperature can rise quickly. You can assume a person is suffering from heat stroke if their body temperature is over 105 F, and any of the following symptoms are present:

- ●weakness, confusion, distress, strange behavior
- ●hot, dry, red skin
- ●rapid pulse
- ●headache or dizziness
- ●In later stages of a heat stroke, a victim may pass out and have convulsions

Call an ambulance immediately if heat stroke is suspected. The victim's life may be on the line! Until help arrives, move the victim to a cool area and remove excess clothing. Fan and spray them with cool water. Offer sips of water if the victim is conscious.

Heatwave guidelines

The following measures should help prevent the development of heat-related illnesses.

- ●Slow down in hot weather. Your body's temperature regulating system faces a much greater workload when temperature and humidity are high.
- ●Heed early warnings of heat stress, such as headache, heavy perspiration, high pulse rate, and shallow breathing. Take a break immediately and get to a cooler location. **Watch for heat stress signs among your co-workers.**
- ●Dress for hot weather. Lightweight, light-colored clothing reflects heat.
- ●**Drink plenty of water.** Don't let yourself "dry out".
- ●Try to get used to warm weather gradually. Take it easy for those first three hot days. Your body will have a better chance to adjust if you take it slow.
- ●Get out of the heat occasionally. Physical stress increases with time in hot weather. Take breaks in a cool, shady location.
- ●Wear a hat and long-sleeved shirt to prevent burning (which can increase the risk of skin cancer.)

"Do's" and "Don'ts" of preventing heat-related illnesses

DO:	**DON'T:**
Drink plenty of water Take breaks in a cool, shady area Watch for symptoms of a heat stress, both in yourself and co-workers	Ignore symptoms of heat stress Try to "keep up" with the rest of the crew, even though you feel ill

MANAGING HEAT STRESS

By Dr. Norman Nesheim, UF-IFAS

Heat stress is caused by working in hot conditions and when the body builds up more heat than it can cope with. Several factors work together to cause heat stress. Before beginning a task, think about whether any of these factors are likely to be a problem. Consider making adjustments in the task itself or in the workplace conditions, including: heat factors--temperature, humidity, air movement, and sunlight; workload--the amount of effort a task takes; drinking water intake; and scheduling.

High temperatures, high humidity, and sunlight increase the likelihood of heat stress. Air movement, from wind or from fans, may provide cooling. Because hard work causes the body to produce heat, a person is more likely to develop heat stress when working on foot than when driving a vehicle. Lifting or carrying heavy containers or equipment also increases the likelihood of overheating. Use fans, ventilation systems (indoors), and shade whenever possible. A work area or vehicle sometime can be shaded by a tarp or canopy or provided with fans or air conditioners. Consider wearing cooling clothes that help keep the body cool.

People who have become used to working in the heat are less likely to be affected by heat stress. To become adjusted to hot work environments, do about two hours of light work per day in the heat for several days in a row; then gradually increase the work period and the workload for the next several days. An adjustment period of at least seven days is recommended. If the warm weather occurs gradually, workers may adjust naturally to working in hot conditions.

Whenever it is practical, choose coveralls that allow air to pass through. Woven fabrics (cotton, or cotton-polyester blends) allow air to pass through fairly easily. Rubberized or plastic fabrics and fabrics coated with chemical-resistant barrier layers allow almost no air to pass through.

Perspiration or evaporation of sweat cools the body. Under the conditions that lead to heat stress, the body produces a large amount of sweat. Unless the water lost in sweat is replaced, body temperature will rise. Drink plenty of water before, during, and after work during heat stress conditions. Do not rely on thirst alone to guide you. A person can lose a dangerous amount of water before feeling thirsty, and the feeling of thirst may stop long before fluids are replaced. Be sure to keep body weight fairly constant. All weight lost because of sweating should be regained every day.

When the combination of temperature, sunlight, humidity, and workload is likely to lead to overheating, use scheduling to avoid heat stress. Schedule tasks requiring the heaviest workload during the coolest part of the day. When heat stress risk is high, schedule frequent breaks to allow the body to cool. Anyone who gets dangerously hot should stop work immediately and cool down. If necessary, shorten the time between breaks.

The above steps will prevent most heat stress problems. But under extremely hot conditions when cooling devices cannot be used, it may be necessary to stop work until conditions improve.

Signs and Symptoms of Heat Stress

Heat stress, even mild heat stress, makes people feel ill and impairs their ability to do a good job. They may get tired quickly, feel weak, be less alert, and less able to use good judgment.

Severe heat stress (heat stroke) is a serious illness. Unless victims are cooled quickly, they can die. Severe heat stress is fatal to more than 10 percent of its victims--even young, healthy adults. Victims may remain sensitive to heat for months and be unable to return to the same work.

Learn the signs and symptoms of heat stress and take immediate action to cool down if you observe:

- fatigue (exhaustion, muscle weakness),
- headache, nausea, and chills,
- dizziness and fainting,
- loss of coordination,
- severe thirst and dry mouth,
- altered behavior (confusion, slurred speech, quarrelsome or irrational attitude).

Heat cramps can be painful. These are muscle spasms in the legs, arms, or stomach caused by loss of body salts through heavy sweating. To relieve cramps, drink cool water or "sports drinks." Stretching or kneading the muscles may temporarily relieve the cramps.

First Aid for Heat Stress

It is not always easy to tell the difference between heat stress illness and pesticide poisoning. The signs and symptoms are similar. **Don't waste time trying to decide what is causing the illness. Get medical help right away.**

- Get the victim into a shaded or cool area.
- Cool victim as rapidly as possible by sponging or splashing skin, especially face, neck, hands, and forearms, with cool water or, when possible, immersing in cool water.
- Carefully remove clothing that may be making the victim hot,
- Have the victim, if conscious, drink as much cool water as possible.
- Keep the victim quiet until help arrives.
- **Severe heat stress (heat stroke) is a medical emergency! Cool victim immediately. Brain damage and death may result if treatment is delayed**.

How to reduce spray drift of pesticides?

- Avoid high spray pressure, which create finer droplets. Use as coarse a spray as possible and still obtain good coverage and control. Droplet size is one of the most important factors affecting drift, however, addressing droplet size alone is not sufficient to reduce the probability of drift and potential damage.
- Don't apply pesticides under windy or gusty conditions; don't apply at wind speeds over 10 mph. Read the label for specific instructions.
- Maintain adequate buffer zones to insure that drift does not occur off the target area.
- Be careful with all pesticides. Insecticides and fungicides usually require smaller droplet sizes for good coverage and control than herbicides; however, herbicides have a greater potential for non-target crop damage.
- Choose an application method and a formulation that is less likely to cause drift. After considering the drift potential of a product/formulation/application method, it may become necessary to use a different product to reduce the chance of drift.
- Use drift reduction nozzles.
- Use wide-angle nozzles, lower spray boom heights, and keep spray boom stable.
- Use drift control/drift reduction agents. These materials are designed to minimize the formation of droplets smaller than 150 microns. They help produce a more consistent spray pattern and aid in deposition. Drift control additives do not eliminate drift. Therefore, common sense is still required.
- Apply pesticides early in the morning or late in the evening; the air is often more still than during the rest of the day.
- Don't spray during thermal inversions, when air closest to the ground is warmer than the air above it. When possible, avoid spraying at temperatures above 90°-95° F.
- Know your surroundings! You must determine the location of sensitive areas near the application site. Some crops are particularly sensitive to herbicides, which move off-site.
- Be sure you are getting the spray deposition pattern you think you are; service and calibrate your equipment regularly.
- Whenever possible, cut off the spray for missing trees in the row. Spray that does not enter the tree canopy is wasted and contributes significantly to drift problems.
- Keep good records and evaluate pesticide spray results.

Remember, ALWAYS read and follow label directions.

Certifying and Training Applicators

EPA works with the USDA and the Florida Department of Agriculture and Consumer services (FDACS) to carry out certification and training programs for pesticide applicators. States have primary responsibility for ensuring that pesticide applicators are licensed and certified, as required by Federal and state laws, to apply pesticides in an appropriate manner. Part of the program for certification includes training about how to protect people and the environment from off-target spray drift. In Florida, the certification exams for restricted use pesticide applicator licenses are administered by the **University of Florida/IFAS Cooperative Extension Service** in local county offices statewide. Individuals who need to take the exams should check with local extension office(s) for training and exam schedules **http://sfyl.ifas.ufl.edu/map/**

Flatwoods Citrus

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__Hispanic
__White, non-Hispanic
__Black, non-Hispanic

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