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Institute of Food and Agricultural Sciences

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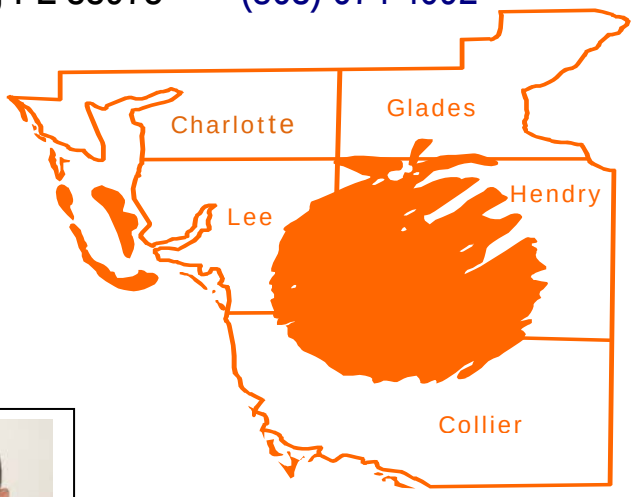
Flatwoods Citrus



Vol. 20, No. 7 **July 2017**

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

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Seminar

Use of soil microbial amendments and other plant health products in agriculture

The Unseen Soil: the importance of soil microbes in agriculture

Date & time: **Wednesday, July 26, 2017, 10:00 AM – 12:00 Noon**
Location: UF-IFAS Southwest Florida Research and Education Center, Immokalee
Speakers: Dr. Ute Albrecht, UF-IFAS and Dr. Sarah Strauss, UF-IFAS
Program Coordinator: Dr. Mongi Zekri, UF-IFAS
Program Sponsor: Charles McCartney with Timac Agro

2 CEUs for pesticide license renewal
2 CEUs for certified crop advisors (CCAs)

Pre-registration is required. No registration fee and lunch is free Thanks to **Charles McCartney with Timac Agro**. To reserve a seat, call 863 674 4092, or send an e-mail to Dr. Mongi Zekri at maz@ufl.edu

Agenda

----10:00 AM – 10:55 AM
"Use of soil microbial amendments and other plant health products in agriculture"
an overview of different biostimulant products (beneficial microbes, humic substances, seaweed, etc.), their effects on plant health, and information on ongoing citrus trials.
Dr. Ute Albrecht, UF-IFAS, Immokalee

10:55 AM – 11:05 AM Break

----11:05 AM - 12:00 Noon
"The Unseen Soil: the importance of soil microbes in agriculture"
an overview of how microbes influence soil nutrient cycling and plant growth, along with preliminary data from ongoing citrus trials.
Dr. Sarah Strauss, UF-IFAS, Immokalee

http://citrusexpo.net/registration/

8/16/17 GCGA's Annual Citrus Industry Celebration 5:30 PM FGCU Alico Arena

University of Florida Will be Celebrating a Century of Citrus Research on November 29, 2017, Lake Alfred CREC

Seminar

Breeding citrus for Tolerance/resistance to HLB

Date & time: **Wednesday, September 20, 2017, 10:00 AM – 12:00 Noon**
Location: UF-IFAS Southwest Florida Research and Education Center, Immokalee
Speakers: Dr. Jude Grosser and Dr. Fred Gmitter, UF-IFAS
Program Coordinator: Dr. Mongi Zekri, UF-IFAS

Special Thanks to sponsors of the "Flatwoods Citrus" newsletter for their generous contribution and support. If you would like to be among them, please contact me at 863 674 4092 or maz@ufl.edu

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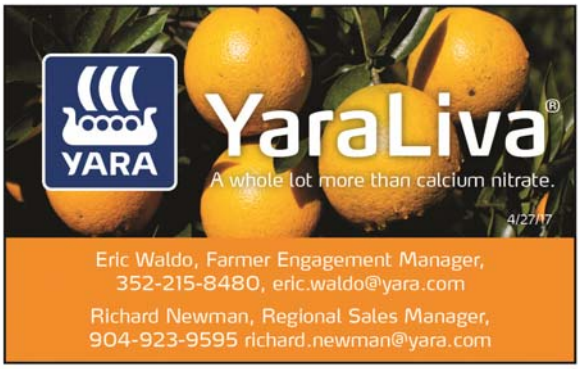

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Hurricane season started June 1 -- are you ready?

2017 Atlantic Hurricane Season: Expect It to Be Busier Than Usual

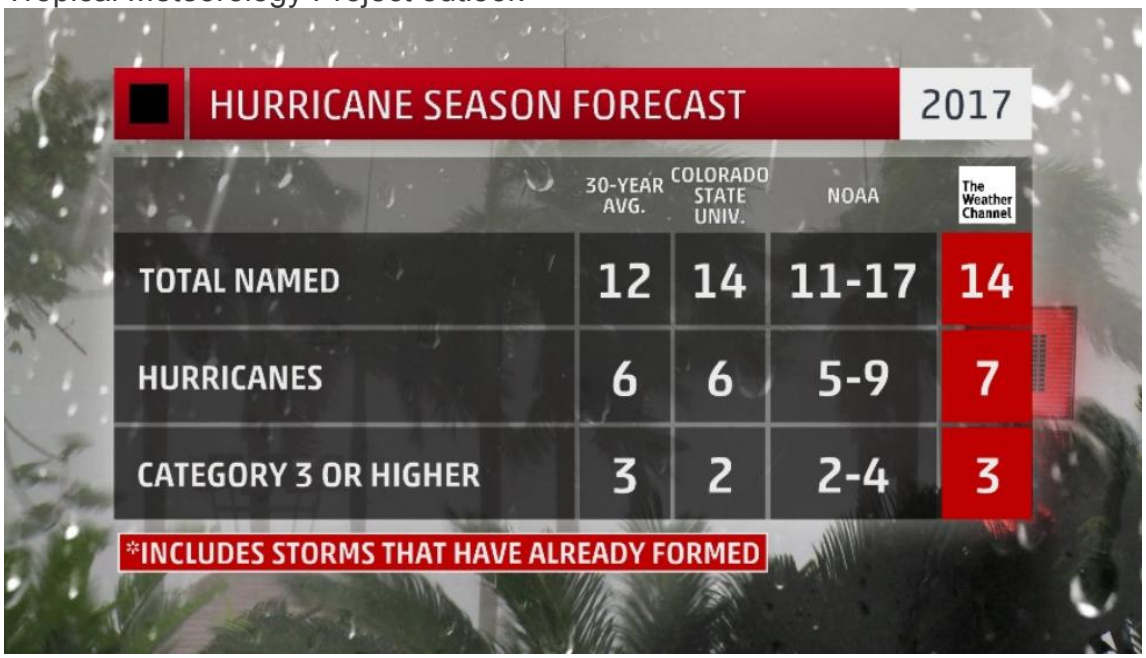
https://weather.com/storms/hurricane/news/2017-hurricane-season-forecast-atlantic-colorado-state-the-weather-company-may

By Jon Erdman and Linda Lam
Jun 1 2017 12:00 PM EDT
weather.com

The 2017 Atlantic hurricane season is forecast to be more active than historical averages with regard to the number of named storms, according to the latest forecasts released by Colorado State University, the National Oceanic Atmospheric Administration and The Weather Company, an IBM Business.
The Colorado State University (CSU) Tropical Meteorology Project outlook headed by Dr. Phil Klotzbach updated its forecast Thursday, calling for an above-average number of named storms with 14 expected. CSU forecasts an average number of hurricanes this year, with six expected in the Atlantic Basin. A below-average number of major hurricanes – two – is also anticipated.
The 30-year historical average (1981-2010) for the Atlantic Basin is 12 named storms, six hurricanes and three major hurricanes. A major hurricane is of Category 3 strength or higher on the Saffir-Simpson Hurricane Wind Scale.
NOAA issued its forecast at the end of May and called for:

- Eleven to 17 named storms – including April's Tropical Storm Arlene.
- Five to nine of which would become hurricanes.
- Two to four of which would become major hurricanes.

An important note is that Tropical Storm Arlene, which formed in April, is included in the seasonal forecast numbers in the outlooks.



Numbers of Atlantic Basin named storms, those that attain at least tropical storm strength, hurricanes, and hurricanes of Cat. 3 intensity forecast by The Weather Company, an IBM business, NOAA, and Colorado State University compared to 30-year average.

According to NOAA, "The outlook reflects our expectation of a weak or non-existent El Niño, near- or above-average sea-surface temperatures across the tropical Atlantic Ocean and Caribbean Sea and average or weaker-than-average vertical wind shear in that same region."
Strong El Niños typically lead to increased wind shear in parts of the Atlantic Basin, suppressing the development or intensification of tropical cyclones in the Atlantic, so the prediction for weak conditions increased the chance for more activity this season.
"The climate models are showing considerable uncertainty, which is reflected in the comparable probabilities for an above-normal and near-normal season," NOAA added.
The Weather Company updated its seasonal forecast earlier in May and expects a total of 14 named storms – seven hurricanes and three major hurricanes – this season. This is an increase from its forecast compared to April due to a couple of factors.
One of the reasons is that warmer sea-surface temperatures have been observed in the North Atlantic, which have correlated with more active seasons in the past. In addition, there are indications that further warming is likely.
Another factor the outlook cited is that there is a reduced potential for the development and strength of El Niño later this summer.
Given the current trends, there is the potential for another increase with the next update in June. "The historically strong North Atlantic blocking event in early May also suggests the possibility of continued increases in North Atlantic sea-surface temperature anomalies, so it would be no surprise if we increased our forecast numbers again," said Dr. Todd Crawford, chief meteorologist with The Weather Company.

2017 Atlantic hurricane season names.

However, Dr. Phil Klotzbach noted, "While the tropical Atlantic is warmer than normal, the far North Atlantic remains colder than normal, potentially indicative of a negative phase of the Atlantic Multi-Decadal Oscillation (AMO). Negative phases of the AMO tend to be associated with overall less conducive conditions for Atlantic hurricane activity due to higher tropical Atlantic surface pressures, drier middle levels of the atmosphere and increased levels of sinking motion."

The official Atlantic hurricane season begins June 1 and runs through Nov. 30. Occasionally, storms can form outside those months as happened this year with Tropical Storm Arlene. This also occurred last season with January's Hurricane Alex and late May's Tropical Storm Bonnie.

What Does This Mean For the U.S.?

There is no strong correlation between the number of storms or hurricanes and U.S. landfalls in any given season. One or more of the 11 to 14 named storms forecast to develop this season could hit the U.S., or none at all. Therefore, residents of the coastal United States should prepare each year no matter the forecast.

A couple of classic examples of why you need to be prepared each year occurred in 1992 and 1983.

The 1992 season produced only six named storms and one subtropical storm. However, one of those named storms was Hurricane Andrew, which devastated South Florida as a Category 5 hurricane.

In 1983 there were only four named storms, but one of them was Alicia. The Category 3 hurricane hit the Houston-Galveston area and caused almost as many direct fatalities there as Andrew did in South Florida.

In contrast, the 2010 season was active. There were 19 named storms and 12 hurricanes that formed in the Atlantic Basin.

Despite the large number of storms that year, not a single hurricane and only one tropical storm made landfall in the United States.

In other words, a season can deliver many storms, but have little impact, or deliver few storms and have one or more hitting the U.S. coast with major impact.

Leaf Tissue and Soil Sampling and Testing

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.		

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/**

Flooding Injury and Importance of Drainage

Almost all citrus trees grown in the Indian River and Southwest Florida production areas are located on high water tables and poorly drained soils. Water management on these soils is difficult and expensive. During heavy rains in the summer, excess water must be removed from the root zone while periods of limited rainfall require irrigation. On these soils, drainage is as important as or sometimes even more important than irrigation. The concept of total water management must be practiced. If either system—irrigation or drainage—is not designed, operated, and maintained properly, then the maximum profit potential of a grove cannot be achieved.

Roots, like the rest of the tree, require oxygen for respiration and growth. Well-aerated soils in Florida typically contain around 20-21% oxygen. When flooding occurs, the soil oxygen is replaced by water. This condition causes tremendous changes in the types of organisms present in the soil and in the soil chemistry.

Flooding injury is highly probable if the root zone is saturated for 3 or more days during the summer when soil temperatures (86-95°F) are relatively high (Figure 1). Flooding during the cooler December-March period can be tolerated for several weeks at low soil temperatures (< 60° F). The rate of oxygen loss from the soil is much greater at higher than at lower temperatures. The potential for damage to roots is less obvious, but equally serious, when the water table is just below the surface. Flooding stress is much less when water is moving than when water is stagnant. The use of observation wells is an easy and a quick method for evaluating water-saturated zones in sites subject to chronic flooding injury (See “Water Table Measurement and Monitoring in Citrus Groves”, Citrus Industry magazine, May 2015 issue).

Figure 1. Flooded citrus grove after a heavy summer rain event.

Short-term estimates of flooding stress can be obtained by digging into the soil and smelling soil and root samples. Sour odors indicate an oxygen deficient environment. The presence of hydrogen sulfide (a disagreeable rotten egg odor) and sloughing roots indicate that feeder roots are dying. In flooded conditions, root death is not exclusively associated with oxygen deficiency. Anaerobic bacteria (the kind that can grow only in the absence of oxygen) develop rapidly in flooded soils and contribute to the destruction of citrus roots. Toxic sulfides and nitrites formed by anaerobic sulfate- and nitrate-reducing bacteria are found in poorly drained groves. Sulfate-reducing bacteria require both energy and sulfates to change sulfates to sulfides. The best sources of energy have been found to be certain organic acids contained in citrus roots, grass roots, and buried pieces of palmetto. Thus, citrus roots can contribute to their own destruction by being an energy source for these bacteria.

Symptoms of flooding injury may occur within a few days or weeks, but usually show up after the water table has dropped and the soil dries. Leaf wilting appears since the damaged roots cannot take up enough water to meet tree demand. This wilting is followed by leaf drop and twig dieback. Chlorosis patterns may develop and tree death may occur. Trees subjected to chronic flooding damage are stunted with sparse canopies and dull colored small leaves. Trees produce low yields of small fruit. New flushes of growth will have small, pale leaves due to poor nitrogen uptake by restricted root systems. Usually, the entire grove is not affected, but most likely smaller more defined areas will exhibit the symptoms. Striking differences in tree condition can appear within short distances associated with only slight changes in rooting depths. Water damage may also be recognized by a marked absence of feeder roots and root bark that is soft and sloughs easily.

With acute water damage, foliage wilts and sudden heavy leaf drop follows (Figure 2). Trees may totally defoliate and actually die. More frequently, partial defoliation is followed by some recovery. However, affected trees remain in a state of decline and are susceptible to drought when the dry season arrives because of the shallow, restricted, root systems. Moreover, waterlogged soil conditions, besides debilitating the tree, are conducive to the proliferation of soil-borne fungi such as Phytophthora root and foot rot. These organisms cause extensive tree death especially in poorly drained soils.

Figure 2. Flooding damage causing severe leaf wilt.

Water damage may usually be distinguished from other types of decline by a study of the history of soil water conditions in the affected areas. Areas showing water damage are usually localized and do not increase in size progressively as do areas of spreading decline. Foot or root rot symptoms include a pronounced chlorosis of the leaf veins caused by root damage and girdling of the trunk. Lesions also appear on the trunk usually near the soil level (foot rot) or roots die and slough-off (root rot). Flood damage does not produce lesions. Trees with blight or citrus tristeza virus are usually randomly distributed within the grove and diagnostic tests are available to distinguish them from water-damaged trees.

Citrus trees respond physiologically to flooding long before morphological symptoms or yield reductions appear. Photosynthesis and transpiration decrease within 24 hours of flooding and remain low as flooding persists. Water uptake is also reduced. These effects eventually translate to decreased shoot growth and yields.

It is both difficult and costly to improve drainage in existing groves, so drainage problems should be eliminated when the grove area is prepared for planting by including a system of ditches, beds, and/or tiling. Growers should not depend on the slight and often unpredictable differences in rootstock tolerance to waterlogging to enable trees to perform satisfactorily in soil-saturated conditions. Trees, irrespective of scion and rootstock cultivars, should be planted using the best drainage conditions possible.

Do not disk a grove when trees were injured by flooding. Irrigation amounts should be reduced, but frequencies should be increased to adequately provide water to the depleted, shallow root systems. Soil and root conditions should be evaluated after the flooding has subsided. Potential for fungal invasion should be determined through soil sampling and propagule counts. If there is a Phytophthora problem, the use of certain fungicides can improve the situation.

Both surface and subsoil drainage is necessary for citrus trees grown in flatwoods areas to obtain adequate root systems. Drainage systems consist of canals, retention/detention areas, open ditches, subsurface drains, beds, water furrows, swales, and the pumps required to move the drainage water. These systems require continued good maintenance to minimize the chances of root damage from prolonged exposure to waterlogged soils following high intensity rains. Rutting in the water furrows that prevents water from efficiently moving into ditches is often a precursor to waterlogging and root damage.

Water furrows and drainage ditches should be kept free of obstruction through a good maintenance program including chemical weed control. Drainage systems should generally be designed to allow water table drawdown of 4 to 6 inches per day, which should be adequate to prevent root damage. Good drainage allows air to move into the soil and prevents oxygen-deprived conditions. Tree recovery from temporary flooding is more likely to occur with good drainage structure maintenance conditions.

Recent research work has shown that citrus greening (HLB-) infected trees are much more affected by extremes in soil moisture than trees without HLB. This stress intolerance was found to be due to a significant loss of fibrous roots. This finding makes attention to good drainage even more important because flooding could cause additional damage to root systems already weakened by HLB.

Additional information on drainage systems for citrus can be found at: http://edis.ifas.ufl.edu/ch165

GREASY SPOT FUNGAL DISEASE

Management of greasy spot must be considered in groves intended for processing and fresh market fruit. Greasy spot is usually more severe on leaves of grapefruit, pineapples, Hamlins, and tangelos than on Valencias, Temples, Murcotts, and most tangerines and their hybrids.

Greasy spot spores germinate on the underside of the leaves and the fungus penetrates through the stomates (natural openings on lower leaf surface). Warm humid nights and high rainfall, typical of Florida summers, favor infection and disease development.

On processing Valencias, a single spray of oil (5-10 gal/acre) or copper + oil (5 gal/acre) should provide acceptable control when applied from mid-May to June. With average quality copper products, 2 lb of metallic copper per acre usually provide adequate control. The strobilurin fungicides (Abound, Gem, Headline or Quadris), as well as Enable 2F, are also suitable with or without petroleum oil. On early and mid-season oranges and grapefruit for processing, two sprays may be needed especially in the southern part of the state where summer flushes constitute a large portion of the foliage. Two applications also may be needed where severe defoliation from greasy spot occurred in the previous year. In those cases, the first spray should be applied from mid-May to June and the second soon after the major summer flush has expanded. Copper fungicides provide a high degree of control more consistently than oil sprays. Control of greasy spot on late summer flushes is less important than on the spring and early summer growth flushes since the disease develops slowly and defoliation will not occur until after the next year's spring flush. Thorough coverage of the underside of leaves is necessary for maximum control of greasy spot, and higher spray volumes and slower tractor speeds may be needed than for control of other pests and diseases.

The program is essentially the same for fresh fruit. That is, a fungicide application in May-June and a second in July should provide control of rind blotch.

A third application in August may be needed if rind blotch has been severe in the grove. Petroleum oil alone is less effective than other fungicides for control of greasy spot rind blotch (GSRB). Heavier oils (455 or 470) are more effective for rind blotch control than are lighter oils (435).

Copper fungicides are effective for control of GSRB, but may result in fruit spotting especially if applied at high rates in hot, dry weather or if applied with petroleum oil. If copper fungicides are applied in summer, they should be applied when temperatures are moderate, at rates no more than 2 lb of metallic copper per acre, without petroleum oil or other additives, and using spray volumes of at least 125 gal/acre. Enable 2F can be applied for greasy spot control at any time but is especially indicated in mid to late summer for rind blotch control.

The strobilurin fungicides (Abound, Gem, Headline, Pristine or Quadris Top) or Enable 2F can be applied at any time to all citrus and provide effective control of the disease on leaves or fruit. Use of a strobilurin (Abound, Gem, Headline, Pristine or Quadris Top) is especially indicated in late May and early June since it will control both melanose and greasy spot and avoids potential fruit damage from the copper fungicides at that time of year. A strobilurin fungicide should not be applied more than once a year for greasy spot control. Addition of petroleum oil increases the efficacy of these products.

•Processed fruit

July-August

- Petroleum oil (455, 470) 5-10 gal
- Cu fungicides 2-4 lb metal
- Abound, Gem, Headline + 5 gal oil
- Pristine
- Quadris Top
- Enable

•Fresh fruit

July-August

- Petroleum oil (455, 470) 10 gal
- Cu fungicides < 2 lb metal
- Abound, Gem, Headline + 5 gal oil
- Pristine
- Quadris Top
- Enable 8 oz

For more information on greasy spot, go to:
http://www.crec.ifas.ufl.edu/extension/pest/PDF/2016/Greasy%20Spot.pdf

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