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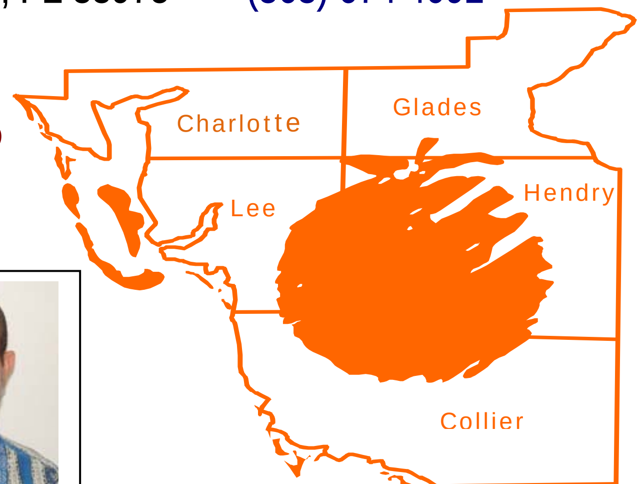
EXTENSION
Institute of Food and Agricultural Sciences

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

Flatwoods Citrus



Vol. 18, No. 5 **May 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

Workshop-Citrus Nutrition & Irrigation Management in the HLB Era

Date & time: Tuesday, **May 19th, 2015, 10:00 AM – 12:10 PM**
Location: Immokalee IFAS Center
Program Coordinator: Dr. Mongi Zekri, UF-IFAS
Program Sponsor: Todd Wilson and Jack Zorn with H.J. Baker & Bro. (Tiger-Sul Products).

----10:00 AM - 10:05 AM

1. **Introduction. Dr. Mongi Zekri**, UF-IFAS

----10:05 AM - 10:20 AM

2. Basic interaction of soil moisture, soil moisture sensors and evapotranspiration in irrigation scheduling. **Dr. Kelly Morgan**, UF-IFAS

----10:20 AM - 10:40 AM

3. Review of water uptake results for HLB affected citrus trees in field and greenhouse experiments. **Dr. Kelly Morgan**, UF-IFAS

----10:40 AM - 11:00 AM

4. Installation and use of smart phone citrus irrigation app. **Dr. Kelly Morgan**, UF-IFAS

11:00 AM – 11:10 AM Break

----11:10 AM – 11:30 AM

5. Citrus nutrient requirements. **Dr. Arnold Schumann**, UF-IFAS

----11:30 AM – 11:50 AM

6. Review of Citrus Advanced Production Systems projects in the HLB era. **Dr. Arnold Schumann**, UF-IFAS

----11:50 AM – 12:10 PM

7. Distribution and use of citrus nutrient model in the HLB era. **Dr. Arnold Schumann**, UF-IFAS

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 **Todd Wilson and Jack Zorn with H.J. Baker & Bro. (Tiger-Sul Products)**. 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**

Postponed to October 2015

Field Day at Lake Alfred CREC

Coping with Citrus HLB

--Advanced Citrus Production Systems (ACPS)
--Citrus Undercover Production Systems (CUPS)
--Whole Tree Thermotherapy (WTT)
--Experiments that target primarily fresh fruit production for maximum pack-out
--Mature tree canopy pruning, controlled release fertilization (CRF) and high density young tree drip fertigation experiments

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HLB ESCAPE TREES

To accelerate citrus gene discovery for HLB tolerance/resistance, UF-IFAS Citrus Researchers and Extension Agents are working closely with the citrus industry. They would like to know about trees that appear to be doing better than their cohorts in groves declining from HLB. We need your help in reporting to us about escape trees or potential survivor trees in your groves. Please contact Mongi Zekri (maz@ufl.edu or 863 674 4092) or any other citrus extension agent to determine if your trees meet this research criterion.

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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Sincere appreciation from the SW Florida Farm Safety Day Committee

to the sponsors of the 2015 Farm Safety Day


Florida Cooperative Extension Service

Certificate of Appreciation

Awarded to

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Kevin Rayburn, Rayburn Company, Inc.
David Wheeler, Wheeler Farms, Inc.

Please accept our sincere appreciation for your generous donation to the twenty fifth Farm Safety Day

Very Important - For SW Florida Citrus Growers

This is what you are asking for

We are conducting a survey of citrus growers and production managers to collect data on current costs of grove production practices.

Please feel out the survey form and bring it with you on Tuesday May 19 at 8:30 AM to the Immokalee IFAS Center auditorium.

We hope to see you on May 19 to collect the information from you at 8:30 AM.
We also invite you to attend the workshop on citrus nutrition and irrigation starting at 10:00 AM with Lunch around noon.

The data collection process is completely anonymous and confidential. There will be no linking back to your operations and also no individual data will be shared or disclosed

During the meeting, each grower/production manager will have a “clicker” or remote control. As Dr. Singerman goes through the different categories included in the survey, you will click in their estimates (again, confidentially and anonymously even to him because you do not need to submit the form)

Once you clicked in the answers for each category, the average (and the average only) across all of their responses will appear on the screen for you to see

Once in his office, Dr. Singerman will put together all the data across categories to come up with the 2014/15 average cost of production for SW FL and present the final results to the growers/production managers at their convenience

Please let us know if you have any question or need any clarification.

Thank you for your cooperation!

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2014/15 **SW Florida (Flatwoods)** Processed Oranges Cost of Production Survey

Please enter all annual estimates below on a **per acre** basis for a "*typical*" irrigated mature grove (10+ years old), including resets.

Tree density per acre:_______________ Total acres your operation manages:_____________

Program	Materials Cost per acre	Application cost per acre		Annual number of applications per acre*	
Mechanical Mowing					
Chemical Mowing					
Herbicide					
Insecticide		Ground	Aerial	Ground	Aerial
Fungicide					
Foliar Nutritionals					
Ground/dry Fertilizer					
Fertigation/liquid fertilizer					
CHMAs sprays					
Hedging and Topping					
Chop/Mow Brush					

*If applicable, this refers to spraying every middle (as opposed to every other middle)

Irrigation. Include all of the following:	Cost per acre
Fuel for pump	
Travel set-up cost (Start/Stop pump)	
Maintenance and repairs (pump and emitters)	
Ditch and canal maintenance	
Water control (pump water in/out of ditches)	

Item	Cost per acre
Management Costs	
Water Management Tax	

Tree replacement	Per acre
Annual number of trees removed	
Annual number of trees reset	
For resetting:	Cost per Tree
Tree removal (Clip-shear; use front-end loader)	
Site preparation (disk; rotovate)	
Planting (cost of tree + plant and watering)	
Young tree care years 1 thru 3	

LIVING WITH LOVEBUGS

http://edis.ifas.ufl.edu/in694
Dr. Norman C. Leppla, professor, Entomology and Nematology Department, Institute of Food and Agricultural Sciences, University of Florida

The "lovebug," is a seasonally abundant member of a generally unnoticed family of small flies related to gnats and mosquitoes. The males are about 1/4 inch and the females 1/3 inch in length, both entirely black except for red on top of their thoraxes (middle insect body segment). Other common names for this insect include March flies, double-headed bugs, honeymoon flies, united bugs, and some expletives that are not repeatable. Lovebugs characteristically appear in excessive abundance throughout Florida as male-female pairs for only a few weeks every **April-May** and **August-September** (IPM Florida 2006). Although they exist over the entire state during these months, they can reach outbreak levels in some areas and be absent in others. They are a nuisance pest, as opposed to destructive or dangerous, in areas where they accumulate in large numbers.

Lovebug Description and Biology

Although the lovebug has two distinct generations per year in Florida, adults can be found during most months (Buschman 1976). Higher temperatures cause adult populations to peak slightly earlier in the southern areas of the state. As in all other flies, lovebugs exhibit complete metamorphosis, having egg, larva, pupa and adult stages (Figure 3). An individual female deposits an average of 350 eggs under decaying vegetation in a grassy or weedy area with adequate moisture. Conditions must not be too wet or dry, although the larvae soon emerge and can move short distances to locate the best habitats. Larvae develop more rapidly at higher temperatures, so the summer generation is shorter than the one in the winter. The larvae feed on decomposing leaves and grass until they pupate. The pupal stage lasts 7-9 days (Hetrick 1970). In nature, the adults live just long enough to mate, feed, disperse and deposit a batch of eggs, about 3-4 days (Thornhill 1976b).

Lovebugs do not fly during the night. After a pair disperses, the male dies and the female deposits as many as 600 eggs under decaying leaves or grass before also dying. Groups of about 300 larvae have been found on or near the surface of the soil among the roots of grasses (Thornhill 1976a).

Lovebug Myths

Lovebugs escaped after University of Florida researchers brought them into Florida. Lovebugs are not native to most of the southern United States (Hardy 1945). According to Buschman (1976), since 1940 *P. nearctica* has extended its range from Louisiana and Mississippi across the Gulf States, reaching Florida in 1949. In the late 1960s, it became established entirely across north Florida. During the 1970s explosive populations occurred progressively southward nearly to the end of peninsular Florida and northward into South Carolina (Figure 4). Its movement may have been accelerated by prevailing winds, vehicle traffic, sod transport, increased habitat along highways, and expansion of pastures, but not by UF researchers.

University of Florida researchers genetically engineered lovebugs to kill mosquitoes. Lovebugs are small, slow herbivorous insects that feed on the pollen and nectar found in flowers. Thus, they lack the mandibles (jaws), grasping legs, speed, and other characteristics of predaceous insects, such as dragonflies. Lovebugs are active during the day, whereas most mosquitoes are crepuscular (active at twilight) or nocturnal, and they are only adults for a few weeks each year. For these and many other reasons, the lovebug would be a poor candidate to genetically engineer as a mosquito predator, even if it were possible.

Lovebugs are attracted to automobiles. After mating, lovebugs disperse as coupled pairs, presumably flying in search of nectar on which to feed and suitable oviposition sites. Mated females are attracted to sandy sites with adequate moisture, dead leaves, grass clippings, cow manure, and other decomposing organic debris. Cherry (1998) found that lovebugs are attracted to anethole, an essential oil found in plants that also attracts bees. Additionally, female lovebugs are attracted to UV irradiated aldehydes, a major component of automobile exhaust fumes (Callahan and Denmark 1973, Callahan et al. 1985). They may confuse these chemicals with the odors emitted from decaying organic matter at typical oviposition sites. Heat has also been shown to attract lovebugs (Whitesell 1974) and contribute to their abundance on highways. Additionally, lovebugs seem to collect on light-colored buildings, especially when freshly painted (Callahan 1985). Many kinds of flies are attracted to light-colored and shiny surfaces, although the physiological or behavioral mechanisms are unknown. Thus, lovebugs apparently accumulate in relatively warm, humid, sunny areas with food and chemicals in the atmosphere that mimic oviposition sites.

Dispersing lovebugs move great distances and are attracted to homes. Lovebug pairs are not strong fliers, so tend to remain within a few hundred yards of emergence sites when there is little or no wind (Thornhill 1976b). They are able to move across the wind when it is 5-7 mph and search for sources of nectar and suitable oviposition sites. Stronger winds blow them as high as 1500 ft in the air and concentrate them against down-wind objects. Coupled females initiate and control flight but males assist if they are able to obtain food (Sharp et al. 1974). Locations within 20-30 miles can have quite different levels of lovebug emergence and dispersal (Cherry and Raid 2000), and this variable distribution can lead to naturally occurring "hotspots" in different places from year to year. Lovebugs are most abundant in moist grassy habitats. People who live near these habitats, or are exposed to winds that deposit the insects at their homes, can perceive erroneously that they are attracting these pests.

Lovebugs mate the entire time they are coupled. The general pattern of mating in lovebugs begins with males forming swarms above emergence areas each day in the morning and afternoon (Leppla et al 1974, Thornhill 1976c). Individual males also may fly just above these areas. Females emerge from the soil later than males, crawl onto vegetation, and fly into the swarms. A male may grasp a female before or after she flies into a swarm. In either case, the pair lands on vegetation where the male transfers sperm to the female. Sperm transfer requires an average of 12.5, hours but the pair can remain coupled for several days during which they feed and disperse (Thornhill 1976c). The male ejects a depleted spermatophore after separating from the female (Leppla et al. 1975), and both sexes may mate again. Pairs formed during the morning hours begin dispersal flights, whereas those that couple in the evening remain on vegetation until taking flight the following day.

The body fluids of lovebugs are acidic and immediately dissolve automobile paint. When numerous lovebugs are smashed on the front of a vehicle, the contents of their bodies, especially eggs, coat the painted surface. No permanent damage is caused, however, if the surface is cleaned before the coating is baked by the sun for a day or two. Marisa and Jeffrey Gedney (personnel communication) determined that macerated lovebugs are about neutral with a pH of 6.5 but become acidic at 4.25 within 24 hours. Yet, automobile paint was not damaged after being coated with macerated lovebugs and held in a humid indoor environment for 21 days. A lovebug-coated surface exposed to the sun for an extended period of time, however, may be damaged by the insects and their removal (Denmark and Mead 2001). The front of a vehicle can be protected by coating it with “car wax” and removing the lovebugs within 24 hours.

Lovebugs have no significant natural enemies. No parasites have emerged from lovebug larvae or adults held in the laboratory, and few cases of predation have been observed in nature over the years (Hetrick 1970, Mousseau 2004). Apparently lovebugs adults are avoided by red imported fire ants, *Solenopsis invicta* Buren (=*S. wagneri* Santschi), and other predators but one periodically eaten by spiders, dragonflies, and birds. They have aposematic coloration that implies defensive mimicry but have not been chemically analyzed or tested as food for predators (Dunford et al. 2008).

Bee keepers report anecdotally that honeybees do not visit flowers infested with lovebugs. Fungal pathogens have been identified by screening, six from larvae and one from adults, that could be limiting lovebug populations (Kish et al. 1974). These fungi include the well-known insect pathogenic genera, *Metarhizium*, *Beauveria* and *Conidiobolus*. Although not yet studied, lovebug eggs may be subjected to predation or parasitism.

Insecticides are effective in controlling lovebugs. Insecticides available to the public for controlling houseflies, mosquitoes, and other flies will also kill lovebug adults. However, there are risks associated with using these products around humans and pets, and the lovebugs will return almost immediately. Other insects are often misidentified as being lovebugs, some of which are innocuous or beneficial, and therefore, should not be killed. It is important to preserve lady beetles, lacewings, honeybees, and other insects that help to protect or pollinate plants. Thus, insecticides are expensive, potentially harmful, and of no value in controlling lovebugs. It is best just to avoid lovebugs if they become a nuisance during their brief appearances each year.

University of Florida scientists are working to control lovebugs. The University of Florida research programs in urban and public health entomology are among the strongest in the U.S. Priority is placed on destructive or dangerous pests that threaten human health and resources. These pests include mosquitoes that transmit West Nile virus, equine encephalitis, and other diseases; those that infest people, livestock and pets; and urban insects, such as cockroaches, ants, and termites. Nuisance pests like lovebugs and blind mosquitoes are important but much less damaging and costly. The Florida Legislature funded research on lovebugs at the University of Florida during the outbreak that swept through the state in the early 1970s. Additional resources were contributed by the USDA and Florida Department of Agriculture and Consumer Services, Division of Plant Industry. Even though this support is no longer available, the University of Florida continues to provide information to help educate Florida residents and tourists about lovebugs.

Lovebugs and People

It is possible but usually not necessary to avoid lovebugs and the problems they cause. Unlike some of their close relatives, lovebugs do not bite, sting, or transmit diseases and are not poisonous. Lovebugs are only active in the daylight and are much less mobile during the early and late daytime hours. Typically, the pairs fly across the wind during their dispersal flights and are blown against obstacles, especially vehicles traveling at high speeds. Their remains can be removed from surfaces easily if not left to bake in the sun. Lovebugs are poor fliers that can be kept out of a building by creating positive pressure with an air-conditioning fan. If a few lovebugs enter, a vacuum cleaner can be used to remove them. Screens can be added to windows and doors, particularly on the prevailing windward side of a building, and placed over decks and swimming pools. A fan can be used outside near work or recreational areas to keep lovebugs away. Due to their abundance and mobility, lovebugs cannot be controlled effectively with poisons or repellents.

Some people consider the lovebug to be among the peskiest alien invasive species to become established in the Gulf States. On the contrary, these potentially annoying flies are actually beneficial as larvae because they help to decompose dead plant material. People would also appreciate esthetic aspects of the adults, if these insects were not such a nuisance. Like cute little migratory birds, lovebugs signal changes in the seasons from spring to summer and again from summer to fall. Moreover, if they were larger, people could easily see and admire their delicate features, particularly the big round eyes of the males. Wilhelm Rudolph Wiedemann named the lovebug genus *Plecia* in 1828, so his concept for the term may never be known. A reasonable guess, however, is that he applied the Greek verb "pleo" intending to mean "to sail" (Jaeger, E. C. 1955). Lovebugs sail from flower to flower much like butterflies and in smaller numbers could be perceived as beautiful. They have become less abundant over the past 30 years, and people living in the Gulf States are beginning to accept them as a normal part of nature. However, newcomers are much less tolerant of lovebugs until they learn that these insects are not dangerous. Since lovebug populations tend to rebound unpredictably, we are fortunate that these creatures create inconveniences and tickle, rather than threaten human health and the environment.

Tree Assistance Program for Florida Citrus Greening

Ariel Singerman and Fritz Roka

On September 17, 2014, the United States Department of Agriculture (USDA), Farm Service Agency (FSA) announced additional support for commercial Florida citrus growers to manage greening (USDA/FSA 2014). To qualify as a commercial operation, the grower must market the fruit. Farm Service Agency support is in the form of an expanded Tree Assistance Program (TAP). The original program assisted growers in the event the loss occurred within a single year due to a natural disaster such as a hurricane. The expanded TAP recognizes citrus greening (Huanglongbing, or HLB). The program provides growers cost-sharing financial assistance to replace trees that meet a mortality criterion within a time period of up to six years.

The starting date of the expanded TAP is retroactive to October 1, 2011. The deadline for submitting an application for cost-sharing assistance on expenses of trees pulled between October 1, 2011 and December 31, 2014 depends on the year in which the grower applies. For example, if the grower applies for assistance for 2015—say, for cumulative losses from 2013 and 2014—the deadline is 90 calendar days after December 31, 2014. For 2015 and subsequent years, growers need to apply within 90 calendar days of the disaster event, or the date the loss became apparent.

TAP Eligibility

The Tree Assistance Program is available for individuals or legal entities with an average annual adjusted gross income (AGI), during the last three years, of $900,000 or less. Adjusted gross income refers to taxable income; that is, gross income minus adjustments such as farm expenses and personal deductions and exemptions. Below we provide a rough approximation of the maximum acreage that a grower who produces oranges for the juice market would need to earn, at most, an annual AGI of $900,000. However, our calculations are for illustration purposes only and do not apply to any single operation. Therefore, we advise growers to consult their accountants or tax specialists to check whether their operation actually meets the established AGI limit.

We estimate the size of an operation potentially eligible for the expanded TAP by making several assumptions. We begin by using USDA's latest figures for acreage and production of oranges for 2013/14. These figures are 418,900 bearing acres (USDA/NASS, 2014a) and 104.6 million boxes (USDA/NASS, 2014b), respectively. The resulting average production per acre is 250 boxes. We use this figure as the mean of a yield bracket with a low and high of 200 and 300 boxes per acre, respectively. Assuming an average of six pounds solid per box, we combine yields with sensible price assumptions to obtain an estimate of gross income per acre for each yield-price combination. Finally, assuming no other income, we adjust gross income per acre by deducting farm expenses per acre ($1,500), pick and haul charges per box ($2.50), FDOC tax per box ($0.20), a standard deduction for a married couple ($12,200), and the self-employment tax deduction (computed as half of the applicable self-employment tax).

How TAP Works

The grower can choose the length of the time period for which to claim a loss due to greening. That is, growers can choose to apply for TAP during any single year in which a stand sustained a mortality loss greater than 15 percent, after adjustment for normal mortality. Or, alternatively, growers can apply for TAP after the stand has accumulated tree mortality in excess of 15 percent (again, after adjustment for normal mortality) over a period of up to six years.

To receive financial assistance in 2015 and subsequent years, growers will first need to obtain approval from FSA for the trees they intend to replace. An authorized FSA representative will visit the grove and assess the trees' condition before the trees are removed. Citrus trees will meet the TAP mortality criterion when they are either biologically dead or no longer commercially viable due to greening.

TAP Payments

Payments will be triggered when the stand sustains damage or mortality in excess of 15 percent after adjustment for normal mortality, which is established at 3 percent. Therefore, TAP will reimburse the grower for a proportion of the expenses incurred when replacing any number of trees greater than 18 percent for the time period for which claims are made.

The calculation for TAP payments is the lesser of the following:

Payment is 65 percent of the actual cost of replanting and 50 percent of the actual cost of site preparation

The maximum eligible amount established for each individual practice by FSA

In addition, payments are subject to a mandated sequestration (i.e., reduction) of 7.3 percent. Table 2 shows an example of TAP payment calculations for replacing one tree, assuming the requirement for 15 percent mortality plus 3 percent adjustment has been fulfilled. Note FSA will examine each practice individually for computing payments.

Other payment considerations include the following:

An annual cap of 500 acres has been established on the cumulative total quantity of acres for which a grower can receive TAP payments.

The total payments under TAP will be capped to a maximum of $125,000 per individual or legal entity per application.

There will be no partial payments (e.g., growers will not receive a partial payment after site preparation is complete; they will only receive a single payment after resets are planted).

Resets planted under TAP that are infected by greening are not re-eligible for cost-sharing assistance due to greening for another six years.

The new types of trees planted may differ from those replaced if the new types have the same general end use, as determined and approved by the FSA County Committee.

All approved practices must be completed by the grower within 12 months of the approval of the TAP application by the FSA.

The cost-sharing program is “one-for-one,” which means that it calls for replacing a tree with a single tree. If the grower replaces a tree with two or more trees to increase density, the program will only cost share one tree.

There will be no financial assistance for abandoned groves.

Below is an example for the calculation of the payment's trigger based on a single grove acre.

Trigger

To qualify for assistance, the program requires the stand to sustain cumulative tree mortality over 15 percent due to greening, adjusted by a normal mortality rate of 3 percent, that is, a total of 18 percent. Assuming there are 100 trees in our single acre, cost-sharing payments will be triggered when the number of trees to be replaced is greater than 18 (=100 x 18 percent).

Cost-Sharing Payments

Assuming a total of 28 trees needs to be replaced in our hypothetical grove, the expanded TAP will provide cost sharing for the expenses related to the replacement of 23 trees (=28 x [100 percent–18 percent]). If we further assume the grower in this example has the same costs as those described in Table 2, the TAP cost-sharing payments included in that table for each practice after sequestration are as follows (totals do not add up exactly due to rounding error):

Resets: $110.87 (=$5.20 x 23 x [100% - 7.3%])

Planting: $36.59 (=$1.72 x 23 x [100% - 7.3%])

Site preparation: $126.65 (=$5.94 x 23 x [100% - 7.3%])

In this example, the total TAP payment is $274.10 per acre.

For more information go to: http://edis.ifas.ufl.edu/fe966

CITRUS RUST MITES

The citrus rust mite (CRM) is an important pest of fruit grown for the fresh market. On some specialty varieties (such as Sunburst tangerine), damage may be particularly severe on stems and foliage, causing leaf injury and possible abscission. Fruit damage is the main concern with other varieties. CRM feeds on green stems, leaves, and fruit. Egg deposition begins within 2 days after the female reaches sexual maturity and continues throughout her life of 14 to 20 days. The female lays one to two spherical transparent eggs per day and as many as 30 during her lifetime. Eggs hatch in about 3 days at 81°F. The newly hatched larva resembles the adult, changing in color from clear to lemon yellow (CRM). After about 2 days at 81°F, molting occurs. The first nymphal stage resembles the larval and requires about 2 days to molt to an adult at the above temperature. The CRM adult has an elongated, wedge-shaped body about three times longer (0.15 mm) than wide. CRM usually is straw to yellow in color. CRM population densities increase in May-July and then decline in late August, but can increase again in late October or early November. Mite densities in the fall rarely approach those early in the summer. During the summer, CRM are more abundant on fruit and foliage on the outer margins of the tree canopy. Generally, the north bottom of the tree canopy is preferred and supports the highest mite populations. The least favorable conditions for CRM increase are found in the south top of the tree canopy.

Visible characteristics of injury differ according to variety and fruit maturity. When rust mite injury occurs on fruit during exponential growth, before fruit maturity (April to September), epidermal cells are destroyed resulting in smaller fruit. Early season rust mite injury is called "russeting." Rust mite injury to mature fruit (after September) differs significantly from early "russeting." Unlike "russeting" on fruit, fall damaged fruit will polish since the natural cuticle and wax layer remain intact. This condition is known as "bronzing." While the primary effect of fruit damage caused by rust mites appears to be a reduction in grade, other conditions have been associated with severe fruit injury that include reduced size, increased water loss, and increased drop.

Leaf injury caused by feeding of CRM exhibits many symptoms on the upper or lower leaf epidermis. When injury is severe, the upper cuticle can lose its glossy character, taking on a dull, bronze-like color, and/or exhibit patchy yellowish cells in areas of "russeting" that have been degreened by ethylene release during the wounding process. Lower leaf surfaces often show "mesophyll collapse" appearing first as yellow degreened patches (collapsed spongy mesophyll cells) and later as necrotic spots. With the exception of upper leaf epidermal injury to some specialty varieties, such as Ambersweet, Fallglo, and Sunburst, defoliation caused by CRM is rarely severe.

The need for chemical treatments to control rust mites is dictated by numerous biological attributes of the mites, marketing objectives for the fruit, and horticultural practices. These key biological factors include: 1) inherent ability of mites to quickly increase to injurious densities on fruit and sustain the potential for reproductive increase over time; and 2) small size, which makes it difficult to monitor population densities in the field and detect injurious levels until visible injury has occurred on the fruit. The marketing objective for fruit is particularly important. Cosmetic appearance is a priority for fruit grown for the fresh market. Fruit growth and abscission are not affected until 50% to 75% of the surface has been injured. Thus, there is reduced justification for chemical control of rust mites on fruit grown for processing. Citrus groves producing fruit designated for the fresh market may receive three or four miticides per year, typically during April, June, August, and October. In contrast, groves producing fruit designated for processing receive zero to two treatments per year. Miticides applied for the control of rust mites on fresh fruit varieties are often combined with compatible fungicides in the spring and summer. An alternative approach is using FC 435-66, FC 455-88, or 470 petroleum oil as a fungicide for greasy spot control and to suppress pest mites.

From a horticultural perspective, canopy density has an effect on rust mite populations and their ability to increase over a short period of time. The denser the canopy, the less favorable conditions are for a rapid rust mite increase. Since most registered miticides have no ovicidal activity and short residual activity on fruit and foliage, residual control is generally better if the miticide is applied when rust mite adult and egg population densities are low for fresh market varieties.

Since external blemishes caused by rust mites, fungal diseases, and wind are less important when fruit are grown for processing, the chemical control strategy for rust mites can be modified significantly. A summer spray is often required for greasy spot control. Use of petroleum oil in place of copper will reduce the likelihood of requiring a subsequent miticide treatment. Further miticide treatment may be unnecessary. However, a second petroleum oil application may be required for greasy spot control on summer flush.

Many scientific methods for sampling or scouting rust mite populations have been described. Of these, three general approaches are in widespread use: 1) determining the percentage of fruit and/or leaves infested with rust mites, 2) qualitative rating scales and 3) individual adult mite counts taken from fruit on randomly selected trees. These sampling approaches are similar in that they are designed to avoid bias by randomly selecting different representative areas within a grove for sampling, avoiding border rows, and selecting fruit and/or leaves within a tree randomly.

One sampling method based on rust mite density (rust mites/square centimeter [cm^2]) is described.

Processed Fruit: Initiate rust mite monitoring in April on leaves and fruit through casual observations and continue every 2 to 3 weeks throughout the fruit season. Select trees at random and within uniformly distributed areas throughout a 10- to 40-acre block representing a single variety with uniform horticultural practices. Avoid sampling adjacent trees. Fruit should be sampled at random representing the four quadrants of the tree and taken midway in the canopy (between interior and exterior). One fruit surface area should be examined midway between the sun and shade areas. The number of rust mites per cm^2 should be recorded and averaged for the 10 acres, represented by 20 trees with four fruit per tree or 80 readings per 10 acres. Six rust mites/cm^2 would be a planning threshold where pesticide intervention may be required within 10 to 14 days. Ten rust mites/cm^2 would be an action threshold where treatment would be required as soon as possible.

Fresh Fruit: Similar to above except monitor every 10 to 14 days with an average of 2 CRM/cm^2 as an action threshold.

For more information, go to:
http://www.crec.ifas.ufl.edu/extension/pest/PDF/2015/Rust%20Mites.pdf

TABLE 1. CONTROL THRESHOLDS AND APPROPRIATE SAMPLE SIZES FOR 10 ACRES

If the control threshold is:	Sample size (Sample trees should be uniformly scattered across a 10-acre block. Do not sample adjacent trees.)
5 mites/leaf	Examine 4 leaves/tree from 6 trees/area from 4 areas/10 acres = 96 leaves on 24 trees/10 acres
8 mites/leaf	Examine 4 leaves/tree from 6 trees/area from 3 areas/10 acres = 72 leaves on 18 trees/10 acres
10 mites/leaf	Examine 4 leaves/tree from 5 trees/area from 2 areas/10 acres = 40 leaves on 10 trees/10 acres
15 mites/leaf	Examine 4 leaves/tree from 4 trees/area from 2 areas/10 acres = 32 leaves on 8 trees/10 acres

TABLE 2. CITRUS MITICIDE SELECTION*

Supplemental (early Spring)	Post Bloom	Summer	Fall	Supplemental Fall
--	--	Agri-mek + oil	--	--
--	--	--	Comite	Comite
Envidor	Envidor	Envidor	Envidor	Envidor
--	Petroleum oil	Petroleum oil	Petroleum oil	--
--	--	--	Sulfur	Sulfur
--	--	Micromite	Micromite	--
--	--	--	Nexter	Nexter
Movento	Movento	Movento	--	--
Vendex	Vendex	--	Vendex	Vendex

*Except for petroleum oil, do not use the same miticide chemistry more than once a year.

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

May-June

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

July

- 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

May-June

- Petroleum oil (455, 470) 10 gal
- Cu fungicides < 2 lb metal, No oil
- Abound, Gem, Headline + 5 gal oil
- Pristine
- Quadris Top
- Enable

July

- 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/2015/Greasy%20Spot.pdf

Water Quality: Alkalinity and Hardness

The terms alkalinity and hardness are often used interchangeably when discussing water quality. They share some similarities but are distinctly different.

Alkalinity is a measure of the acid-neutralizing capacity of water. It is an aggregate measure of the sum of all titratable bases in the sample. Alkalinity in most natural waters is due to the presence of carbonate ($CO_3^{=}$), bicarbonate (HCO_3^{-}), and hydroxyl (OH^{-}) anions. However, borates, phosphates, silicates, and other bases also contribute to alkalinity if present. This property is important when determining the suitability of water for irrigation and/or mixing some pesticides. Alkalinity is usually reported as equivalents of calcium carbonate ($CaCO_3$).

Hardness is most commonly associated with the ability of water to precipitate soap. As hardness increases, more soap is needed to achieve the same level of cleaning due to the interactions of the hardness ions with the soap. Chemically, hardness is often defined as the sum of polyvalent cation concentrations dissolved in the water. The most common polyvalent cations in fresh water are calcium (Ca^{++}) and magnesium (Mg^{++}).

Hardness is usually divided into two categories: *carbonate hardness* and *noncarbonate hardness*. Carbonate hardness is usually due to the presence of bicarbonate [$Ca(HCO_3)_2$ and $Mg(HCO_3)_2$] and carbonate ($CaCO_3$ and $MgCO_3$) salts. Noncarbonate hardness is contributed by salts such as calcium chloride ($CaCl_2$), magnesium sulfate ($MgSO_4$), and magnesium chloride ($MgCl_2$). Total hardness equals the sum of carbonate and noncarbonate hardness. In addition to Ca^{++} and Mg^{++}, iron (Fe^{++}), and manganese (Mn^{++}) may also contribute to hardness. However, the contribution of these ions is usually negligible.

Hardness is generally classified as soft, moderately hard, hard, and very hard. It is best to report results as the actual equivalents of $CaCO_3$ since the inclusive limits for each category may differ between users of the information. The classification scheme used by the U.S. Environmental Protection Agency (EPA) is shown in Table 1.

Table 1. Water hardness classifications (reported as $CaCO_3$ equivalents) used by the U.S. EPA.

Classification	$CaCO_3$ equivalent, mg/L (ppm)
Soft	<75
Moderately hard	75–150
Hard	150–300
Very hard	>300

Sources of Alkalinity and Hardness

Water alkalinity and hardness are primarily a function of 1) the geology of the area where the surface water is located and 2) the dissolution of carbon dioxide (CO_2) from the atmosphere. The ions responsible for alkalinity and hardness originate from the dissolution of geological minerals into rain and ground water. Rainwater is naturally acidic, which tends to solubilize some minerals more easily. Surface and ground water sources in areas with limestone formations are especially likely to have high hardness and alkalinity due to the dissolution of bicarbonates and carbonates. Bicarbonate (HCO_3^{-}) dominates between pH 6.3 and 10.3. The pH of most natural waters falls in the 7 to 8 range because of the bicarbonate buffering.

Alkalinity and Hardness Relationship

Alkalinity and hardness are related through common ions formed in aquatic systems. Specifically, the counter-ions associated with the bicarbonate and carbonate fraction of alkalinity are the principal ions responsible for hardness (usually Ca^{++} and Mg^{++}). As a result, the carbonate fraction of hardness (expressed as $CaCO_3$ equivalents) is chemically equivalent to the bicarbonates of alkalinity present in water in areas where the water interacts with limestone. Any hardness greater than the alkalinity represents noncarbonate hardness.

Hardness by Calculation

Hardness can be measured by titration or by quantification of individual ion concentrations (Ca^{++} and Mg^{++}) contributing to hardness. Using the calculation technique, separate determinations of calcium and magnesium are made using an appropriate analytical technique. Hardness is calculated using this equation.

Hardness (as mg $CaCO_3$/L) = 2.497•[Ca, mg/L] + 4.118•[Mg, mg/L]

Neutralizing Excess Bicarbonates from Irrigation Water in Florida

By Gerald Kidder and Ed Hanlon, UF-IFAS

Many sources of irrigation water in Florida contain dissolved bicarbonates. Irrigation with such water can cause adverse plant growth by excessively raising the pH of the soil. The magnitude of the effect depends on the concentration of the bicarbonates in the water, the amount of the water applied, the buffering capacity of the soil, and the sensitivity of the citrus variety/rootstock being grown.

This publication addresses this important water quality problem and suggests management practices to minimize adverse effects on citrus tree growth and production.

1. Where in Florida is the problem most likely to occur?

The problem of high dissolved bicarbonates is likely to occur wherever water comes from a limestone aquifer, such as the Floridan or Biscayne, or from lakes or canals that cut into limestone. Thus, this is a potential problem in most of Florida.

2. How can I find out if I have high-bicarbonate water?

A water test is the surest means of determining if a problem exists. Interpretation of the test should include an evaluation of the liming potential of your water. This is best determined directly by titration of the water with an acid to the methyl orange end point. An indirect method which uses the calcium (Ca) and magnesium (Mg) analyses may also be used but may result in over-estimation of liming potential. Such an estimate assumes that all of the Ca and Mg are present as bicarbonates, which is not always the case. Many Soil Testing Laboratories offer a water test for bicarbonates.

3. Isn't it sufficient to just measure the water's pH?

If the pH of your irrigation water is below 7.0, then we may safely assume that it will not be a significant source of liming materials. However, if the pH is above 7.0, we know that the water contains bases but we don't know how much. For example, one water source may have a relatively high pH of 8 and yet contain a very low level of bicarbonates. Another water source, with the same pH, may have a very high bicarbonate level.

4. How are Ca and Mg analyses useful?

Multiplication of parts per million (ppm) Ca by 0.05 and ppm Mg by 0.083, and summing the two products, will give the milliequivalents of those cations per liter (me/L) of water. In many cases, Ca and Mg will be associated with bicarbonate and carbonate salts. Under those conditions, the me/L of Ca plus Mg will be a good estimate of the me/L of associated bases. However, if other non-basic ions such as sulfate are present, the calculation would overestimate the base content of the water. Thus, Ca and Mg analyses may be useful in estimating base content but should be used with caution.

5. In which crop situations am I likely to have a problem with high pH water?

Trifoliate and most trifoliate hybrid rootstocks are particularly sensitive to high pH soil are trees budded onto them usually exhibit ill effects of high bicarbonate water through micronutrient deficiency symptoms. Trees budded on Swingle rootstock are well-known for their sensitivity to pH-induced iron chlorosis. Trees budded on citrange rootstocks have shown manganese and zinc deficiencies when the soil pH has been raised by heavy or prolonged use of "hard" water (i.e., water with lots of Ca and Mg bicarbonates).

6. Which irrigation situations are most problematic?

Heavy irrigations applied to soils of low buffering capacity will present the most problems to citrus trees.

7. What can I do to minimize the adverse effects of high-bicarbonate water?

Be careful not to over-irrigate. Know the water holding capacity of your soil and apply only enough water without exceeding the root zone water-holding capacity. Over-irrigation is costly in many ways -- the cost of pumping, of leached nutrients, of wasted water resources and, in this case, of accelerating the increase in soil pH. Avoid these with good irrigation management.

Apply acids or acid-forming materials to the soil to counteract the bases applied in the water.

Neutralize the liming effect of the water by adding acid to the water before it is applied to the trees.

8. What can be done if the trees are already suffering from water-induced high pH?

Where high levels of bicarbonates in the water have caused soil to be too high for proper tree performance, it may be necessary to lower the soil pH. This may be accomplished by addition of extra acid in the irrigation water, use of acid-forming fertilizer in certain cases, or application of elemental sulfur to the soil.

It is important to note that the acid-producing effect of sulfur comes from the formation of sulfuric acid when soil bacteria act on the elemental sulfur. The sulfate form of sulfur applied in fertilizers such as potassium sulfate, magnesium sulfate, or gypsum (calcium sulfate) does not have the acid-producing effect of elemental sulfur.

Sulfur application rates of 300 to 500 pounds per acre should not be exceeded. This rate is equivalent to between 0.7 and 1.1 lbs/100 square feet of treated surface area. Over-application of sulfur or acid can cause damage to trees, an effect you certainly want to avoid. Monitor changes carefully.

Remember the pH will increase again as you continue to irrigate with high bicarbonate water. Water or soil acidification will be a continuing effort.

9. Can acid-forming fertilizers keep the soil pH from getting too high?

Under many circumstances the quantity of bases that is being supplied in the irrigation water far exceeds the quantity of acid formed by addition of fertilizer. Under those conditions acid-forming fertilizer will not control the problem of increasing soil pH.

10. How can I neutralize the bicarbonates in my irrigation water?

Injection of acid into the irrigation water is a direct way of neutralizing the bases present. Acid may be injected in much the same way as fertilizer. You must take precautions to avoid injuring yourself and your trees and to avoid contamination of the aquifer. These points are discussed below.

11. How much acid should I apply?

The amount of acid that you mix with the irrigation water will depend on the quantity of bases your water contains and on the strength of the acid you use. The base content of the water is determined in the water test and the strength of the acid is given on the container. One milliequivalent (me) of acid completely neutralizes one milliequivalent of base. For example, if an irrigation water contains 5.2 me of bases per liter, it would take 5.2 me of acid to completely neutralize the liter of water. Neutralization of 80 to 90% of the bases in water is a reasonable goal for most irrigation situations.

Multiply the factor by the milliequivalents of base per liter (me/L) which your water contains. This value is determined in the laboratory test of your water or is estimated from its Ca and Mg contents (this calculation is described under Question 4).

The result is the milliliters of your acid which you should apply to each 100 gallons of your water. The factor is calculated to neutralize 80% of the bases in the water. There are 29.6 ml in one U.S. fluid ounce. Divide the number of ml by 29.6 to convert to U.S. fluid ounces.

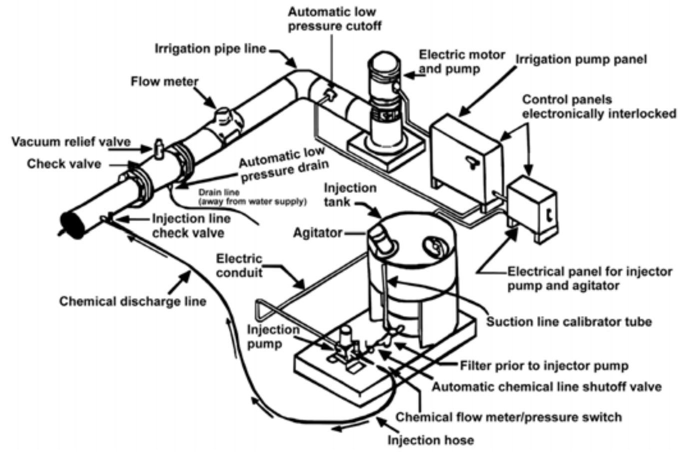
$$80\% \times \frac{me\ base}{L\ water} \times \frac{378\ L}{to\ be\ neutralized} \times \frac{1}{34.7\ N\ acid} = 8.7 \times \frac{me\ base}{L\ water}$$

NOTE:When calculating your rates for larger volumes, be careful not to round off too soon when making conversions.

12. Why not neutralize 100 percent of the bases?

Some of the reasons for not attempting to neutralize 100% of the bases are:

It is not necessary to neutralize all of the bases in order to reduce the problem to insignificant levels. Not trying for 100% neutralization allows some room for error in acid application rates, variability in water, etc. The risk of over-acidifying is not worth the benefit of neutralizing the last 10 or 20 % of the bases. It is poor management to spend money and effort creating new problems by over-reacting to the initial problem.



13. In what kind of irrigation system can I practically inject acid?

Neutralization is relatively easy to accomplish in microirrigation systems. The system must allow careful addition of known volumes of acid to known volumes of water. Since acids can be quite corrosive to metals, the system must be able to withstand this possible adverse effect.

NOTE: It is illegal to inject any chemicals into irrigation systems without appropriate safety devices which will automatically prevent the backflow of water and chemicals to the water supply. This is done to protect our water resources.

14. What kind of acid can I use?

The most commonly used acids are sulfuric, hydrochloric, and phosphoric acid. Other acids could be used but cost and availability usually limit the choices to these three. Phosphoric and sulfuric acids may have some nutritional value but this should be a minor consideration in choosing an acid for water neutralization.

15. What are the dangers of using acids for water neutralization?

Hydrochloric, sulfuric and phosphoric acids are highly toxic materials irritating to the skin, eyes, nose, throat, lungs, and digestive tract. Always wear goggles and chemical resistant (rubber, neoprene, vinyl, etc.) gloves, apron and boots whenever handling these acids. Acid must be poured into water, never vice versa, and should be done in a well-ventilated area.

Should a spill or splash occur, remove all clothing and shower immediately. Immediately irrigate eyes with large quantities of water. Seek immediate medical attention.

It is generally advisable to dilute concentrated acid in a nonmetal mixing tank prior to injection into the irrigation system, rather than injecting concentrated acid directly. Most metal fittings, tanks, and other parts of the irrigation system will be damaged by acid, so proper precautions must be taken. Flushing the system after application is frequently sufficient to avoid significant damage.

In addition to the dangers involved with handling strong acids there is also the danger of over-application of acid. Excess acid addition could result in injury to tree parts which come in direct contact with the water, such as leaves. Also, an excessive acidification of the soil could result in tree injury or death. These problems can be avoided by (1) determining the proper amount of acid to apply and (2) monitoring the irrigation system to ensure that the correct amount is applied.

16. How can I assure that I'm adding the correct amount of acid to my water?

Monitoring the pH of the acid-treated water is one way of checking on a daily operational basis. You can do this with a pH meter. Add acid to bring the water pH to between 4.5 and 5.0. Because the neutralization reaction continues slowly over a period of a day or two, the measured pH of the water immediately after acid addition will usually be lower than that measured once the reaction is complete. For monitoring purposes during acid additions, use the pH measured immediately after acid addition as a guide to avoid over-acidifying.

If the pH after treatment is very different from that calculated from the chemical analysis, you may want to have another water sample analyzed.

Summary

1. Have your irrigation water tested.
2. Select an acid of known strength.
3. Determine how much of your acid is needed to neutralize 80% of the bases in your water.
4. Add the calculated amount of acid to your water.
5. Measure the pH of the water as it comes out of the irrigation line.
6. If the pH is not between 4.5 and 5.0, increase or decrease the amount of acid.
7. If the amount of adjustment in Step 6 is more than 15 to 20% of the calculated value, consult a specialist before extended use of the system.
8. Retest the well water and irrigated soil about once a year and keep a record of the test results.

Flatwoods Citrus

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Multi-County Citrus Agent
Hendry County Extension Office
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LaBelle, FL 33975

Subscriber's Name:____

Company:____

Address:____

City:______________________State:___________Zip:__________

Phone:__________________________

Fax:____________________________

E-mail:____

Racial-Ethnic Background

__American Indian or native Alaskan
__Asian American
__Hispanic
__White, non-Hispanic
__Black, non-Hispanic

Gender

__Female

__Male