

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

Flatwoods Citrus



Vol. 18, No. 6

June 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

Please take note of the upcoming opportunities for obtaining a pesticide applicators license and/or earning CEUs for renewing a pesticide license.

1. **Monday Morning, June 8, 2015 at 7:45 am - Pesticide Applicators Core Examination Class.** This examination is required for any and all categories of Pesticide Applicators licenses.
2. Monday Afternoon, June 8, 2015 at 1:00 pm - Private Agricultural Pest Control
3. **Tuesday Morning, June 9, 2015 at 8:00 am, Ag Tree Crop**
4. Tuesday Morning, June 9, 2015 at 8:30 am - Natural Areas Weed Management
5. Tuesday Afternoon, June 9, 2015 at 1:00 pm – Right of Ways Weed Management
6. Wednesday Morning, June 10, 2015 at 8:30 am – Aquatic Weed Control

These programs will be held at the Dallas B. Townsend Agricultural Center (Hendry County Extension Office) in LaBelle, Florida. A Registration Fee of \$10.00 per session will be charged to all participants for the program.

Please note that the state pesticide office allows you to earn CEU's from attending these classes only once per calendar year.

For pre-registration and more information, please contact Debra at 863-674-4092 or email dcabrera@ufl.edu

Please mark your calendar and plan to attend a useful **Field day**

to showcase two cooperative IFAS-grower trials:

1. The mulch trial is completing its 3rd year and has taught us a lot about the separate and combined effects of insecticides and UV reflective mulch and possible improvements to the mulch-open hydroponic system employed.
2. The rootstock trial is in its 6th year and has also produced a great deal of interesting results.

Date: Friday, 19 June 2015, 10:00 AM – 12:00 Noon.

Location: Old Duda nursery site in LaBelle, Felda, FL, on Hwy 29 between LaBelle and Immokalee

Presenters: Dr. Phil Stansly, Scott Croxton, Joby Sherrod

Please pre-register by calling 863 674 4092 or by sending an e-mail to Dr. Mongi Zekri at: maz@ufl.edu

SEMINAR- **Breeding for Tolerance/Resistance to HLB, New Citrus Varieties, and Citrus Roots in Relation to HLB**

Date & time: Thursday, **June 11th, 2015, 10:00 AM – 12:00 Noon**

Location: Immokalee IFAS Center

Program Coordinator: Dr. Mongi Zekri, UF-IFAS

Program Sponsors: Larry Bridge and Paul Fabry with Plant Food Systems, Inc.

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

1. **Breeding for Tolerance/Resistance to HLB and the Genetics/Nutrition Interaction.** **Dr. Jude Grosser**, UF-IFAS

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

2. **New Citrus Varieties.** **Peter Chaires**, New Varieties Development & Mgt. Corp. (NVDMC)

11:10 AM – 11:20 AM Break

----11:20 AM - 12:00 Noon

3. **HLB in roots and implications for root health management.** **Dr. Evan Johnson**, 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 **Larry Bridge and Paul Fabry with Plant Food Systems, Inc.** 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

The Great CEU Round-Up

PRESENTED BY



July 22, 2015

8:30 am—4:00 pm EDT

AGENDA		CEU Information
8:30 – 9:00	Registration	Up to 6 Aerial Ag. Row Crop Pest Control Ag. Tree Crop Pest Control Aquatic Weed Control Comm. Lawn & Ornamental Demo & Research Forestry Ltd Lawn & Maintenance Ltd Lawn & Ornamental Ltd Urban Fertilizer Natural Areas Weed Mgmt. Ornamental & Turf Private Applicator Regulatory Pest Control Right-of-Way And More CCA GCSAA PDI ISA
9:00—9:50	Factors to Consider When Developing A Weed Management Program <i>Dr. Greg MacDonald</i>	
9:50—10:00	Break	
10:00 – 10:50	How Herbicides Work & Where They Go <i>Dr. Fred Fishel</i>	
10:50—11:00	Break	
11:00—11:50	Preventing Herbicide Failures <i>Dr. Stephen Enloe</i>	
11:50—1:00	Lunch (provided)	
1:00—1:50	Understanding Adjuvants <i>Dr. Jay Ferrell</i>	
1:50—2:00	Break	
2:00—2:50	BMP in Urban, Aquatic & Natural Systems <i>Susan Haddock</i>	
2:50—3:00	Break	
3:00—3:50	Identification & Integrated Management of Invasive Grasses <i>Dr. Lyn Gettys</i>	
3:50 – 4:00	Closing & CEU Distribution	

Participating IFAS Extension Offices

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Panama City 32401

Clay County
2463 FL 16
Green Cove Springs 32043

Collier County
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Naples 34120

Flagler County
150 Sawgrass Rd
Bunnell 32110

Ft. Lauderdale REC
3205 College Ave
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Hendry County
1085 Pratt Blvd.
LaBelle, FL 33935

Hillsborough County
5339 Count Road 539
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Martin County
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Palm Beach County
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W Palm Beach 33415

Walton County
732 N 9th St
DeFuniak Springs 32433

Washington County
1424 Jackson Ave Ste A
Chipley 32428

REGISTRATION INFORMATION

NAME

COMPANY

ADDRESS, CITY, ST, ZIP

PHONE

FAX

E-MAIL

IFAS LOCATION

LIST ADDITIONAL ATTENDEES

PRINT FIRST AND LAST NAME

Example: Jane Doe

IFAS COUNTY EXTENSION OFFICE (do not indicate the City)

Example: Collier County

1

2

3

4

5

6

7

8

PRICING INFORMATION (PER ATTENDEE)

IFAS EMPLOYEE

\$15 pre-registration | \$22.50 on-site

MUNICIPAL EMPLOYEES

\$30 pre-registration | \$45 on-site

INDUSTRY PROFESSIONAL

\$50 pre-registration | \$75 on-site

PAYMENT INFORMATION

ENTER ONE (1) FORM OF PAYMENT BELOW

PHONE REGISTRATIONS ARE NOT PERMITTED

Make check payable to: Florida Turfgrass Association

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AMOUNT INCLUDED

CREDIT CARD NO.

CHARGE AMOUNT

CARD TYPE

AMEX

Visa

MasterCard

Discover

EXPIRATION DATE

SECURITY CODE

CANCELLATION POLICY

Cancellations must be made 5 business days prior to seminar and are subjected to a 25% cancellation fee. Refunds will NOT be granted for not attending.

CONTACT INFORMATION

MAIL 411 E. Orange Street, Ste 205 | LAKELAND, FL 33801

PHONE (863) 688-9413

FAX (863) 688-9610

EMAIL Heather@FTGA.org

ONLINE REGISTRATION www.ftga.org/ceu-round-up

PRE-REGISTRATION DEADLINE:

JULY 15, 2015 (7/16/15 on-site pricing goes in effect)

REGISTRATION CLOSES:

JULY 20, 2015 (walk-in registrations available at IFAS location)

Seminar- WEED MANAGEMENT IN CITRUS GROVES AND UPDATE ON CITRUS BLIGHT

Date & time: Thursday, **July 16th, 2015, 10:00 AM – 12:00 Noon**

Location: Immokalee IFAS Center

Program Coordinator: Dr. Mongi Zekri, UF-IFAS

Program Sponsors: Stacey Howell with Bayer

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

1. **Weed Management in Citrus Groves.** Dr. Megh Singh, UF-IFAS

10:50 AM – 11:00 AM Break

----11:00 AM - 11:50 AM

2. **Update on Citrus Blight.** Dr. Ron Brlansky, 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 **Stacey Howell with Bayer.** To reserve a seat, call 863 674 4092, or send an e-mail to Dr. Mongi Zekri at: maz@ufl.edu

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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Very Important - For SW Florida Citrus Growers and
Production Managers

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 (below) and bring it with you on Tuesday June 16 at 9:00 AM to the Dallas B. Townsend Agricultural Center (the Hendry County Extension Office) in LaBelle.

We hope to see you on June 16 to collect the information from you at 9:00 AM.

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!

**Dr. Ariel Singerman
Assistant Professor and Extension Economist
Citrus Research and Education Center
University of Florida
700 Experiment Station Rd.
Lake Alfred, FL 33850
Phone: (863) 956 – 8870**

Dr. Mongi Zekri
Multi-County Citrus Agent IV
University of Florida, IFAS
Hendry County Extension Office, LaBelle
Phone: (863) 674 4092



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*	
		Ground	Aerial	Ground	Aerial
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	

Hurricane season started June 1 -- are you ready?

The Atlantic hurricane season is here. This summer isn't expected to be an especially busy one in the Atlantic. El Nino is active in the Pacific, and El Nino years typically translate into quiet hurricane seasons in the Atlantic.

But, as the [National Hurricane Center](#) continually stresses, it only takes one. The most-often example of that is 1992's Hurricane Andrew, a Category 5 storm that devastated part of South Florida and made a second landfall in Louisiana during an El Nino year.

The Gulf of Mexico had a relatively quiet year in 2014, with only two named storms (Tropical Storm Dolly and Hanna) affecting the basin and not threatening the U.S. Gulf Coast.

The rest of the activity was in the Atlantic. There were eight named storms in 2014. Six of them were hurricanes and two -- Edouard and Gonzalo -- were major hurricanes, which is a Category 3 or stronger storm.

The only one to directly impact the U.S. coastline was [Hurricane Arthur](#), which came ashore July 3 in North Carolina as a Category 2 hurricane with 100 mph peak winds. Still, it was a below-average season.

The strongest hurricane of 2014 was [Gonzalo](#), which was the first Category 4 storm in the Atlantic since Ophelia in 2011. At its peak, it had sustained winds of almost 144 mph, according to the hurricane center. Gonzalo was named Oct. 12 and made landfall in Bermuda as a strong Category 2 hurricane.

Gonzalo was the second hurricane to strike Bermuda in a week. Hurricane Fay made landfall on the island as a Category 1 storm. The hurricane center wants to make sure the public doesn't forget how devastating these storms can be.

It's been almost 10 years since the last major hurricane made landfall on the U.S. mainland. That was [Hurricane Wilma](#), which hit southwest Florida on Oct. 25, 2005, as Category 3 storm and caused extensive damage. (It had been a Category 5 storm while in the Caribbean with a peak wind speed of over 184 mph.)

It only takes one storm to change your life and community. Tropical cyclones are among nature's most powerful and destructive phenomena. If you live in an area prone to tropical cyclones, you need to be prepared. Even areas well away from the coastline can be threatened by dangerous flooding, destructive winds and tornadoes from these storms. The National Hurricane Center issues watches, warnings, forecasts, and analyses of hazardous tropical weather.

Hurricane Hazards

The primary hazards from hurricanes are storm surge flooding, inland flooding from heavy rains, destructive winds, tornadoes, and high surf and rip currents. While hurricanes pose the greatest threat to life and property, tropical storms and depressions can also be devastating. Flooding from heavy rains can cause extensive damage and loss of life. For example, Tropical Storm Allison produced more than 40 inches of rain in the Houston area in 2001, causing about \$5 billion in damage and taking the lives of 41 people.

Storm surge has the potential to cause the largest loss of life in hurricanes. Since 1963, storm surge has caused nearly half of the deaths in the United States in tropical cyclones. Water, not wind, has accounted for nearly 90 percent of all tropical cyclone deaths in the U.S. during that time.

The strong winds of a hurricane can cause widespread destruction. Hurricane Hugo was a fast-moving, category 4 storm that made landfall near Charleston, South Carolina. Hugo brought destructive hurricane-force winds hundreds of miles inland, downing numerous trees and power lines over a swath from the Atlantic coast to the southern Appalachians. Millions were left without power and the resulting damage totaled in the billions of dollars.

Tornadoes are also common with landfalling tropical systems. In recorded history, almost every tropical storm and hurricane that has come onshore in the U.S. has produced a tornado. These tornadoes most often occur in thunderstorms embedded in the storm's rainbands, well away from the center of the hurricane.

The Time to Prepare is NOW!

What should you do to prepare for a hurricane?

Get a plan. The most important step is to identify your hurricane risk. Do you live in an evacuation zone? If so, you need to plan on where you and your family would ride out the storm if you are told to evacuate. Most people only need to evacuate a few miles from the coast to avoid the dangers of storm surge. Find a friend or relative that lives outside the storm surge evacuation zone and have a plan to ride out the storm with them. You should also establish a family communications plan in case you are not together when you need to evacuate.

Once a person understands their risk for hurricane impacts, an appropriate disaster safety plan should be developed to help ensure an individual's and a family's safety. A disaster safety plan is a comprehensive plan that identifies all of the steps a family needs to take before, during, and after a disaster to ensure maximum personal safety and property protection. For a step-by-step guide on creating a family disaster plan please see [Florida's "Get a Plan" guide](#). Citizens should also visit their [State Emergency Management Agency websites](#) for family disaster plan templates that may be more suited to a local area.

2015 Hurricane season should be calm, but still prepare

http://www.alligator.org/news/features/article_d5e4896c-0356-11e5-b94c-1760143044bd.html

How to prepare

Dr. Corene Matyas, a professor at UF who specializes in severe weather, advises people to have copies of important documents, extra medications, plenty of drinking water and nonperishable foods. Flashlights, batteries and a first-aid kit are also good ideas. A National Oceanic and Atmospheric Administration (NOAA) weather radio can be set to alert you of

any watches or warnings and also provide weather forecasts.

When going to the shelter, bring: Sufficient nonperishable food for 72 hours, medicine and baby needs, games for children, bedding and a change of clothes for the entire family, flashlight with extra batteries.

If you are unable to evacuate during a hurricane, go to your wind-safe room. If you do not have one, follow these guidelines:

Stay indoors during the hurricane and away from windows and glass doors. Close all interior doors — secure and brace external doors.

Keep curtains and blinds closed. Do not be fooled if there is a lull; it could be the eye of the storm — winds will pick up again.

Take refuge in a small interior room, closet or hallway on the lowest level. Lie on the floor under a table or another sturdy object.

Avoid elevators.

What to do with your pet during a hurricane:

Keep it inside with you unless you must evacuate your home.

If you have to evacuate, there are shelters that can care for your pet until the storm passes.

Have pictures of your pets in case they get lost during a storm.

Keep your pets up-to-date on their vaccinations. Many shelters require proof of vaccination.

Have a pet emergency kit with identification, immunization records, medication, supply of food and water, a muzzle, collar and leash.



HEDGING, TOPPING, AND SKIRTING CITRUS TREES

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

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

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

Hedging should be started before canopy crowding becomes a problem. As a general rule of thumb, pruning of branches greater than 0.13"- 0.25" in diameter should be avoided. Developing a pro-active pruning program should assist managers in removing the right-

sized branches. Removal of a significant portion of the tree will result in excessive vegetative growth and a drastic reduction in subsequent yield. Hedging is usually done at an angle, with the boom tilted inward toward the treetops so that the hedged row middles are wider at the top than at the bottom. This angled hedging allows more light to reach the lower skirts of the tree. Hedging angles being commonly used vary from 10 to 15 degrees from vertical.

Topping should be done before trees have become excessively tall and should be an integral part of a tree size maintenance program. Long intervals between topplings increase the cost of the operation due to heavy cutting and more brush disposal. Furthermore, excessively tall trees are more difficult and expensive to harvest and spray. Topping trees will improve fruit quality and increase size. Some common topping heights are 10 to 12 ft at the shoulder and 13 to 14 ft at the peak (Figure 2). As a general rule, topping heights should be two times the row middle width.

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

Large crops tend to deplete carbohydrates and results in a reduced fruit yield and increased vegetative growth the following year. Pruning after a heavy crop additionally stimulates vegetative growth and reduces fruit yield the following year. Pruning after a light crop and before an expected heavy crop is recommended because it can help reduce alternate bearing which can be a

significant problem in Valencia and Murcott production.

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



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

Valencia trees may be hedged in late fall with only minimal crop reduction when the hedging process removes only a small amount of vegetative growth. In cases where excessive growth is to be removed, the trees are usually harvested before hedging is conducted. Light maintenance pruning can be done throughout the summer and until early fall

with little or no loss in fruit production. Moderate to severe pruning should not continue into the winter in freeze-prone areas, as trees with tender regrowth are susceptible to cold injury.

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



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

Field Identification of Citrus Blight

<http://edis.ifas.ufl.edu/hs241>

S. H. Futch, K. S. Derrick and R. H. Brlansky²

Citrus blight is a disease that causes thousands of trees to become unproductive every year, resulting in losses in excess of \$60 million annually.

The cause of blight is unknown. The disease is found in many citrus-producing regions including North America, the Caribbean, South America, South Africa and Australia. Blight is found in mostly tropical or semitropical regions with moderate to heavy rainfall but is not reported in more arid regions such as the Mediterranean Basin and California. Blight has been present in Florida for more than 100 years and was frequently called young tree decline in the 1960s and 70s. Trees affected by blight grow normally until they reach five to six years of age or older and then begin to wilt and to exhibit leaf loss, reduced growth flushes, die back and general decline. In early stages of blight, the symptoms may be restricted to one sector of the tree and then expand to the entire tree. Trees remain in various stages of decline and become unproductive, but they rarely die. As the tree declines, vegetative sprouts may be produced on the trunk or on larger interior branches near the trunk. Trees affected with blight will not recover from the disease even if they are severely pruned. Pruning merely makes the tree look acceptable for a year or two before it declines again.

Blight affects all major rootstocks and seedlings to varying degrees but is most severe on rough lemon, Rangpur lime, trifoliolate orange and citrange rootstocks. Trees grown on sweet orange, sour orange, mandarin and some

citrumelo rootstocks usually have lower incidences of blight and usually do not exhibit symptoms before trees are 15 to 20 years old.

As the trees decline, water uptake within the xylem (wood) is reduced, zinc accumulates in the bark and outer xylem tissue, and zinc deficiency patterns develop in the leaves. As the xylem vessels in the trunk become plugged with amorphous occlusions, water transport is reduced, causing a general wilt appearance. New xylem vessels are produced in higher numbers but are smaller in size and eventually become plugged.

When blight first appears within a grove, the distribution pattern of affected trees appears to be random. Thereafter, the disease spreads to adjacent trees within the row more frequently than across rows. Blight has not been transmitted by ordinary budding or grafting practices. However, grafting roots of blight-infected trees to healthy ones will cause the healthy tree to develop blight symptoms in about two years. Natural root grafting of adjacent trees has been associated with the spread of the disease.

At present, the only control measure for blight is to replace declining trees with trees on rootstocks that are less susceptible to the disease. Trees on Cleopatra mandarin develop symptoms more slowly than other commonly used rootstocks, but symptoms will eventually occur with time. Blight is uncommon in trees on sweet orange rootstock.

An easy and rapid field test for blight is to inject water with a syringe into the trunk of the tree. Trees that have blight will not accept water via the syringe test method regardless of the amount of pressure applied to the syringe. To conduct this field test you will need the following tools: battery powered drill, 9/64-inch drill bit, 30 ml syringe and water (Figure 2). The drill bit diameter may vary

depending on syringe type but it must be slightly smaller than the tip on the end of the syringe to allow for a tight fit. This tight fit between the tree trunk and syringe will restrict water flow out of the drilled hole when pressure is applied to the syringe. To force water into the tree trunk, significant pressure must be applied to the syringe because injecting water into the tree requires more pressure than when injecting water into other types of tissue.



Figure 2. Items needed to check tree for citrus blight.

Steps To Use in Conducting a Field Blight Test

Step one: Drill a hole into the trunk of the tree above the bud union using a sharp drill bit and a battery powered drill (Figure 3). The hole should be at least one inch deep into the tree trunk.



Figure 3. Drilling hole into tree trunk above bud union.

Step two: Fill the syringe with water, making sure all the air within the syringe is purged before inserting the tip of the syringe into the tree trunk.

Step three: Insert the tip of the syringe into the drilled hole, making sure that a tight fit between the tree trunk and syringe tip exists. Apply pressure to the syringe to see if water is accepted by the tree (Figure 4). As water is accepted, one can see the plunger of the syringe move slightly forward. Healthy trees with no visual symptoms in the canopy should accept at least 3 ml in 10 seconds, whereas fully blighted trees will accept less than 0.5 ml of water in the same 10 second period. Trees in early stages of the disease will accept 1 to 2 ml per 10 seconds. Trees infected with blight will accept very little or no water, whereas a tree declining from other diseases or disorders will accept water readily, thus providing an easy field diagnostic test for citrus blight.



Figure 4. Determining water uptake.

Summary from Causes and Prevention of Emitter Plugging In Microirrigation Systems

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In the past two decades, the use of microirrigation to provide water to citrus trees has increased dramatically. Microirrigation, properly managed, offers several potential advantages over other methods of irrigation:

- greater water application uniformity.
- improved water use efficiency.
- minimized deep percolation and runoff.
- reduced bacteria, fungi, disease, and other pests that require a moist environment and a wet canopy.
- efficient delivery of fertilizer (fertigation) and other chemicals (chemigation) through the irrigation system.
- ability to irrigate land too steep for other means of irrigation.

The plugging of emitters is one of the most serious problems associated with microirrigation use. Emitter plugging can severely hamper water application uniformity.

I. Causes of Emitter Plugging

Emitter plugging can result from physical (grit), biological (bacteria and algae), or chemical (scale) causes. Frequently, plugging is caused by a combination of more than one of these factors.

Influence of the Water Source

The type of emitter plugging problems will vary with the source of the irrigation water. Water sources can be grouped into two categories: surface or ground water. Algal/bacterial growth is a major problem associated with the use of surface water. Whole algae cells and organic residues of algae are often small enough to pass through the filters of an irrigation system. These algal cells can then form aggregates that plug emitters. Chemical precipitation is normally not a major problem when using surface water. Groundwater, on the other hand, often contains high levels of minerals in solution that can precipitate and form scale. Water from shallow wells (less than 100 ft) often will produce plugging problems associated with bacteria. Chemical precipitation is more common with deep wells. Physical plugging problems are generally less severe with groundwater.

Physical

Sources of physical plugging problems include particles of sand and suspended debris that are too large to pass through the openings of emitters. Sand particles, which can plug emitters, are often pumped from wells. Water containing some suspended solids may be used with microirrigation systems if these suspended solids consist of clay-sized particles, and flocculation does not occur. Research has shown that using water with over 500 ppm suspended solids did not cause emitter plugging as long as the larger particles were filtered. Under some conditions, however, clay will flocculate and form aggregates causing plugging. Unflocculated clay and silt-sized particles are normally too small to plug emitters. Turbidity is an indicator of suspended solids, but turbidity alone is not an accurate predictor of the plugging potential of a water source. Turbidity should be combined with a laboratory filtration test to measure plugging potential.

Biological

A microirrigation system can provide a favorable environment for bacterial growth, resulting in slime buildup. This slime can combine with mineral particles in the water and form aggregates large enough to plug emitters. Certain bacteria can cause enough precipitation of manganese, sulfur, and iron compounds to cause emitter plugging. In addition, algae can be transported into the irrigation system from the water source and create conditions that may promote the formation of aggregates. Emitter plugging problems are common when using water that has high biological activity and high levels of iron and hydrogen sulfide. This is a frequent problem in Florida, because iron and sulfur are common constituents of many Florida waters.

Soluble ferrous iron is a primary energy source for certain iron-precipitating bacteria (Gilbert and Ford, 1986). These bacteria can attach to surfaces and oxidize ferrous iron to its insoluble ferric iron form. In this process, the bacteria create a slime that can form aggregates called ochre, which

may combine with other materials in the microirrigation tubing and cause emitter plugging. Ochre deposits and associated slimes are usually red, yellow, or tan. Sulfur slime is a yellow to white stringy deposit formed by the oxidation of hydrogen sulfide commonly present in shallow wells in Florida. Hydrogen sulfide (H₂S) accumulation in groundwater is a process typically associated with reduced conditions in anaerobic environments. Sulfide production is common in lakes and marine sediments, flooded soils, and ditches; it can be recognized by the rotten egg odor. Sulfur slime is produced by certain filamentous bacteria that can oxidize hydrogen sulfide and produce insoluble elemental sulfur.

The sulfur bacteria problem can be minimized if there is not air-water contact until water is discharged from the system. Defective valves or pipe fittings on the suction side of the irrigation pump are common causes of sulfur bacteria problems (Ford and Tucker, 1975). If a pressure tank is used, the air-water contact in the pressure tank can lead to bacterial growth in the tank, clogging the emitter. The use of an air bladder or diaphragm to separate the air from the water should minimize this problem.

Chemical

Water is often referred to as the universal solvent since almost everything is soluble in it to some extent. The solubility of a given material in water is controlled by variations in temperature, pressure, pH, redox potential, and the relative concentrations of other substances in solution. Three gases (oxygen, carbon dioxide, and hydrogen sulfide) are important in determining the solubility characteristics of water. These gases are very reactive in water, and they determine to a significant extent the solubility of minerals within a given water source.

In order to predict what might cause chemical plugging of microirrigation system emitters, the process of mineral deposition must be understood. Carbon dioxide gas (CO₂) is of particular importance in the dissolution and deposition of minerals. Water absorbs some CO₂ from the air, but larger quantities are absorbed from decaying organic matter as water passes through the soil. Under pressure, as is groundwater, the concentration of CO₂ increases to form carbonic acid. This weak acid can readily dissolve mineral compounds such as calcium carbonate to form calcium bicarbonate which is soluble in water. This process allows calcium carbonate to be dissolved, transported, and under certain conditions, again redeposited as calcium carbonate.

Calcium carbonate is the most common constituent of scale. Calcite, aragonite, and vaterite are mineral forms of calcium carbonate that have been found in carbonate scale. Calcite is formed at temperatures common within microirrigation systems, and is the most common and stable of the mineral forms.

Calcium minerals occur extensively in the form of limestone and dolomite (magnesium-calcium carbonate). Calcite is the principal constituent of limestone, and occurs in many calcareous metamorphic rocks such as marble. Therefore, it is not surprising to encounter calcium carbonate in solution in almost all surface and ground waters, especially in Florida where much of the groundwater is pumped from large underlying limestone formations. As groundwater passes through these limestone formations it dissolves the limestone and carries calcium carbonate with it. Chemical plugging usually results from precipitation of one or more of the following minerals: calcium, magnesium, iron, or manganese. The minerals precipitate from solution and form encrustations (scale) that may partially or completely block the flow of water through the emitter. Water containing significant amounts of these minerals and having a pH greater than 7 has the potential to plug emitters. Particularly common is the precipitation of calcium carbonates, which is temperature and pH dependent. An increase in either pH or temperature reduces the solubility of calcium in water, and results in precipitation of the mineral.

When groundwater is pumped to the surface and discharged through a microirrigation system, the temperature, pressure, and pH of the water often changes. This can result in the precipitation of calcium carbonates or other minerals to form scale on the inside surfaces of the irrigation system components. A simple test for identifying calcium scale is to dissolve it with vinegar. Carbonate minerals dissolve and release carbon dioxide gas with a fizzing, hissing sound known as effervescence.

Iron is another potential source of mineral deposit that can plug emitters. Iron is encountered in practically all soils in the form of oxides, and it is often dissolved in groundwater as ferrous bicarbonate. When exposed to air, soluble ferrous bicarbonate oxidizes to the insoluble or colloidal ferric hydroxides and precipitates. The result is commonly referred to as 'red water,' which is sometimes encountered in farm irrigation wells. Manganese will sometimes accompany iron, but usually in lower concentrations.

Hydrogen sulfide is present in many wells in Florida. Precipitation problems will generally not occur when hard water, which contains large amounts of hydrogen sulfide, is used. Hydrogen sulfide will minimize the precipitation of calcium carbonate (CaCO_3) because of its acidity.

Fertigation

Fertigation is the application of plant nutrients through an irrigation system by injection into the irrigation water. Fertilizers injected into a microirrigation system may contribute to plugging. Field surveys have indicated considerable variation in fertilizer solubility for different water sources. To determine the potential for plugging problems from fertilizer injection, the following test can be performed:

Add drops of the liquid fertilizer to a sample of the irrigation water so that the concentration is equivalent to the diluted fertilizer that would be flowing in the lateral lines.

If no apparent precipitation has occurred, the fertilizer source will normally be safe to use in that specific water source.

II. Prevention of Emitter Plugging

A properly designed microirrigation system should include preventive measures to avoid emitter plugging. Differences in operating conditions and water quality do not allow a standardized recommendation for all conditions. In general, however, the system should include the following:

- a method of filtering the irrigation water.
- a means of injecting chemicals into the water supply.
- in some cases a settling basin to allow aeration and the removal of solids.
- equipment for flushing the system.

Prevention of plugging can take two basic approaches: 1) removing the potential source of plugging from the water before it enters the irrigation system; or 2) treating the water to prevent or control chemical and biological processes from occurring. Both approaches will be discussed. In many cases, a combination of both approaches will be applicable.

Water Quality Analysis

Knowing the quality of proposed irrigation water is necessary before designing a microirrigation system. Water quality analyses are performed at water testing laboratories. A water analysis specifically for microirrigation should be requested. The analysis should include the factors listed in Table 1. If the source is groundwater from a relatively deep well (over 100 ft), analysis for bacteria population may be omitted. Conversely, if the source is surface water, hydrogen sulfide will not be present and can be omitted. Table 1 provides concentration levels for evaluating the water quality analysis in terms of the potential for emitter plugging.

part per million (ppm) = mg/L = mg/kg

dS/m = mmho/cm

mmho/cm x 700 = dS/m x 700 = ppm (for salts typically found in Florida surface and ground water)

mmho/cm = 1000 μ mhos/cm

μ S/cm = μ mho/cm

μ mho/cm x 0.7 = μ S/cm x 0.7 = ppm

A water quality analysis usually lists electrical conductivity in micromhos per centimeter (μ mho/cm). To estimate parts per million (ppm) dissolved solids, multiply μ mho/cm by 0.7. For example, if the electric conductivity meter reads 1000 μ mho/cm, then dissolved solids can be estimated as 700 ppm.

Hardness is primarily a measure of the presence of calcium (Ca) and magnesium (Mg), and is another indicator of the plugging potential of a water source. If Ca and Mg are given in ppm rather than hardness, hardness can be estimated from the relationship shown in Equation 1: where calcium (Ca) and magnesium (Mg) are given in milligrams per liter (mg/L or ppm).

Equation 1:

$$\text{Hardness} = (2.5 \times \text{Ca}) + (4.1 \times \text{Mg})$$

Note that 1 mg/L equals 1 ppm. If the analysis lists the Ca and Mg concentrations in milliequivalents per liter (meq/l), they can be converted to ppm by the factors shown in Equation 2:

Equation 2:

$$\text{Ca (meq/L)} \times 20 = \text{Ca (ppm)}$$

$$\text{Mg (meq/L)} \times 12 = \text{Mg (ppm)}$$

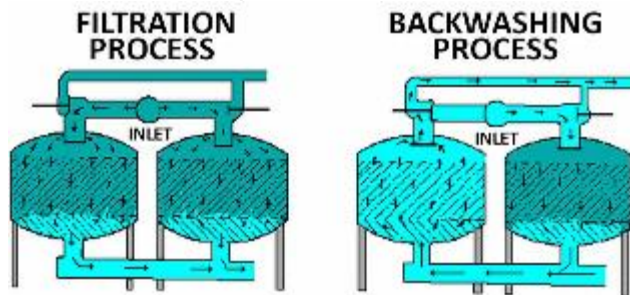
Filters for Prevention of Physical Plugging

Many types of microirrigation filter systems that will perform adequately are available commercially. Important factors to consider in selecting a filtering method are emitter design and quality of the water source. Consider the emitter's minimum passageway diameter when selecting the filter mesh size. Filters should be sized according to the emitter manufacturer's recommendations. In the absence of manufacturer's recommendations, remove any particles larger than one-tenth the diameter of the smallest opening in the emitter flow path.

Screen filters come in a variety of shapes and sizes. Screen material may be slotted PVC, perforated stainless steel, or synthetic or stainless steel wire. Mesh size-- the number of openings per inch--determines the fineness of the material filtered.

Surface water sources should have a coarse screen filter installed on the pump inlet (suction) line to block trash and large debris. To avoid floating debris, the pump inlet should be located two feet below the water surface but suspended above the bottom.

Media (sand) filters are available with the capacity to efficiently remove most types of physical plugging sources. These filters will remove colloidal and organic material usually present in surface waters. The size and type of media used determines the degree of filtration. The finer the media, the smaller is the particle size that will be removed.



Size of the media filter required is determined by the flow rate of the system, and is measured by the top surface area of the filter. Media filters should be sized to provide a minimum of one square foot of top surface area for every 20 GPM of flow, or as the manufacturer recommends.

Filters are cleaned by reversing the direction of water flow through them; this procedure is called backwashing. Backwashing can be manual or automatic, on a set time interval or at a specific pressure drop. When using a media filter, install it with an additional screen filter (200-mesh or manufacturer's recommendation) downstream to prevent the transport of sand to the irrigation system during the backwash procedure.

Settling Ponds

In addition to filtration, the quality of water with high levels of solids can be improved with settling ponds or basins to remove large inorganic particles. Settling ponds can also be used for aeration of groundwater containing high amounts of iron or manganese.

Experiments have shown that a ferrous iron content as low as 0.2 ppm can contribute to iron deposition. Iron is very common in shallow wells in many parts of Florida, but it can often be economically removed from irrigation water by aeration (or by some other means of oxidation), followed by sedimentation and/or filtration.

Existing ponds can sometimes be used as settling basins. They should be accessible for cleaning and large enough that the velocity of the flowing water is sufficiently slow for particles to settle out.

Experience based on municipal sedimentation basins indicates that the maximum velocity should be limited to 1 foot per second.

A settling basin should be designed to remove particles having equivalent diameters exceeding 75 microns, which corresponds to the size of a particle removed by a 200-mesh screen filter. The basin works on the principle of sedimentation, which is the removal of suspended particles that are heavier than water by gravitational settling. Materials held in suspension due to the velocity of the water can be removed by lowering the velocity. In some cases, materials that are dissolved in solution oxidize (through exposure to a free air surface), precipitate, and flocculate to form aggregates large enough to settle out of the water.

Settling ponds are also recommended when the irrigation water source is a fast-moving stream. Velocity of the water is slowed in the settling pond, thus allowing many particles to settle out.

Flushing

To minimize sediment build up, regular flushing of microirrigation pipelines is recommended. Valves large enough to allow sufficient velocity of flow should be installed at the ends of mains, submains, and manifolds. Also, allowances for flushing should be made at the ends of lateral lines. Begin the flushing procedure with the mains, then proceed to submains, manifolds, and finally to the laterals. Flushing should continue until clean water runs from the flushed line for at least two minutes. A regular maintenance program of inspection and flushing will help significantly in preventing emitter plugging.

To avoid plugging problems when fertigrating, it is best to flush all fertilizer from the lateral lines prior to shutting the irrigation system down.

Chemical Treatment

Chemical treatment is often required to prevent emitter plugging due to microbial growth and/or mineral precipitation. The attachment of inorganic particles to microbial slime is a significant source of emitter plugging. Chlorination is an effective measure against microbial activity. Acid injection can remove scale deposits, reduce or eliminate mineral precipitation, and create an environment unsuitable for microbial growth.

Chlorine Injection

Chlorination is the most common method for treating bacterial slimes. If the microirrigation system water source is not chlorinated, it is a good practice to equip the system to inject chlorine to suppress microbial growth. Since bacteria can grow within filters, chlorine injection should occur prior to filtration.

Liquid sodium hypochlorite (NaOCl)--laundry bleach--is available at several chlorine concentrations. The higher concentration products are often more economical. Powdered calcium hypochlorite (CaCOCl_2), also called High Test Hypochlorite (HTH) is not recommended for injection into microirrigation systems since it can produce precipitates that can plug emitters, especially at high pH levels.

The following are several possible chlorine injection schemes:

Inject continuously at a low level to obtain 1 to 2 ppm of free chlorine at the ends of the laterals.

Inject at intervals (once at the end of each irrigation cycle) at concentrations of 20 ppm and for a duration long enough to reach the last emitter in the system.

Inject a high concentration (50 ppm) weekly at the end of an irrigation cycle and for a duration sufficient to distribute the chlorine through the entire piping system.

The method used will depend on the growth potential of microbial organisms, the injection method and equipment, and the scheduling of injection of other chemicals.

The amount of liquid sodium hypochlorite required for injection into the irrigation water to supply a desired dosage in parts per million can be calculated by the simplified method in Equation 3:

Equation 3:

$$I = (0.006 \times P \times Q) / m$$

where,

I = gallons of liquid sodium hypochlorite injected per hour,

P = parts per million desired,

Q = system flow rate in gpm,
m = percent chlorine in the source, usually 5.25% or 10%.

When chlorine is injected, a test kit should be used to be sure that the injection rate is sufficient. Color test kits (D.P.D.) that measure 'free residual' chlorine, should be used. The orthotolidine-type test kit, which is often used to measure total chlorine content in swimming pools, is not satisfactory for this purpose. D.P.D. test kits can be purchased from irrigation equipment dealers. Check the water at the outlet farthest from the injection pump. There should be a residual chlorine concentration of 1 to 2 ppm at that point. Irrigation system flow rates should be closely monitored and action taken (chlorination) if flow rates decline.

Chlorination for bacterial control is relatively ineffective above pH 7.5, so acid additions is necessary to lower the pH to increase the biocidal action of chlorine for more alkaline waters. This may be required when the water source is the Floridian aquifer.

Since sodium hypochlorite can react with emulsifiers, fertilizers, herbicides, and insecticides, bulk chemicals should be stored in a secure place according to label directions.

Acid Treatment

Acid can be used to lower the pH of irrigation water to reduce the potential for chemical precipitation and to enhance the effectiveness of chlorine injection. Sulfuric, hydrochloric, and phosphoric acids are all used for this purpose. Acid can be injected in much the same way as fertilizer; however, extreme caution is required. The amount of acid to inject depends on how chemically base (the buffering capacity) the irrigation water is and the concentration of the acid to be injected.

If acid is injected on a continuous basis to prevent calcium and magnesium precipitates from forming, the injection rate should be adjusted until the pH of the irrigation water is just below 7.0. If the intent of the acid injection is to remove existing scale buildup within the microirrigation system, the pH will have to be lowered more. The release of water into the soil should be minimized during this process since plant root damage is possible. An acid slug should be injected into the irrigation system and allowed to remain in the system for several hours, after which the system should be flushed with irrigation water. Acid is most effective at preventing and dissolving alkaline scale. Avoid concentrations that may be harmful to emitters and other components of the irrigation system.

Phosphoric acid, which is also a fertilizer source, can be used for water treatment. Some microirrigation system operators use phosphoric acid in their fertilizer mixes. Caution is advised if phosphoric acid is used to suppress microbial growth. Care should be used with the injection of phosphoric acid into hard water since it may cause the precipitation of calcium carbonate at the interface between the injected chemical and the water source.

For safety, dilute the concentrated acid in a non-metal, acid-resistant mixing tank prior to injection into the irrigation system. When diluting acid, always add acid to water, never water to acid. The acid injection point should be beyond any metal connections or filters to avoid corrosion. Flushing the injection system with water after the acid application is a good practice to avoid deterioration of irrigation system components in direct contact with the acid.

Acids and chlorine compounds should be stored separately, preferably in epoxy-coated plastic or fiberglass storage tanks. Acid can react with hypochlorite to produce chlorine gas and heat; therefore, the injection of acid should be done at some distance (2 feet), prior to the injection of chlorine. This allows proper mixing of the acid with the irrigation water before the acid encounters the chlorine.

Hydrochloric, sulfuric, and phosphoric acids are all highly toxic. Always wear goggles and chemical-resistant clothing whenever handling these acids. Again, acid must be poured into water; never pour water into acid.

Pond Treatment

Algae problems which often occur with surface water sources such as a pond can be effectively treated with copper sulfate (CuSO_4). Dosages of 1 to 2 ppm (1.4 to 2.7 pounds per acre foot) are sufficient and safe to treat algae growth. Copper sulfate should be applied when the pond water

temperature is above 60°F. Treatments may be repeated at 2 to 4-week intervals, depending on the nutrient load in the pond. Copper sulfate should be mixed into the pond (i.e., sprinkled into the wake of a boat). The distribution of biocides into surface water must be in compliance with EPA regulations.

Copper sulfate can be harmful to fish if alkalinity, a measure of the water's capacity to neutralize acid, is low. Alkalinity is measured volumetrically by titration with H₂SO₄ and is reported in terms of equivalent CaCO₃.

Backflow Prevention

To ensure that the water source does not become contaminated, Florida law, EPA regulations, and county and municipal codes require backflow prevention assemblies on all irrigation systems injecting chemicals into irrigation water. Appropriate backflow prevention should include the following setup:

- a check valve upstream from the injection device to prevent backward flow
- a low pressure drain to prevent seepage past the check valve
- a vacuum relief valve to ensure a siphon cannot develop
- a check valve on the injection line

If an externally-powered metering pump is used for injection, it should be electrically interlocked with the irrigation pump. This interlock should not allow the injection pump to operate unless the irrigation pump is operating. If irrigation water is being used from municipal or other public water supply systems, special backflow precautions must be taken.

Summary

Emitter plugging can occur from physical, biological and chemical causes.

A water quality analysis is vital to the proper design and operation of the microirrigation system.

Every microirrigation system needs some method of filtration.

Regular flushing of the lateral and main lines will help to prevent plugging.

Most microirrigation systems will require a method of chemical treatment of the water source, and a backflow prevention system will also be required.

Table 1. Criteria for plugging potential of microirrigation water sources.

Factor	Plugging Hazard Based on Concentration		
	Slight	Moderate	Severe
<u>Physical</u>			
Suspended solids(filterable)	< 50	7.0 to 7.5	> 7.5
<u>Chemical</u>			
pH	< 7.0	7.0 to 7.5	> 7.5
Dissolved solids (ppm)	< 500	500 to 2000	> 2000
Manganese (ppm)	< 0.1	0.1 to 1.5	> 1.5
Iron (ppm)	< 0.1	0.1 to 1.5	> 1.5
Hydrogen sulfide (ppm)	< 0.5	0.5 to 2.0	> 2.0
Hardness* (ppm)	< 150	150 to 300	> 300
<u>Biological</u>			
Bacteria (population)	< 10,000	10,000 to 50,000	> 50,000
*Hardness as ppm CaCO ₃			



High Bicarbonates in Irrigation Waters

Bicarbonate (HCO ₃) hazard of irrigation water (meq/L)			
	None	Slight to Moderate	Severe
(meq/L)	<1.5	1.5-7.5	>7.5

Some practices to solve problem of carbonates and bicarbonates in irrigation water

- Injection of sulfuric acid to dissociate the bicarbonate ions (pH around 6.2) giving off carbon dioxide. It allows the calcium and magnesium to stay in solution in relation with the sodium content.
- Add gypsum when soils have low free calcium plus leaching
- Add sulfur to soils with high lime content plus leaching

Potential Bicarbonate Hazard (ppm HCO₃)

None/slight	Moderate	Severe	Very Severe
0-120	121-180	181-600	>600

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

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 crop.

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.

--Determine the proper amount of acid to apply.

--Monitor the irrigation system to ensure that the correct amount is applied.

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 or with pH papers (both methods require some experience to give reliable results). Add acid to bring the water pH to 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. ([See previous issue of this Flatwoods Citrus newsletter](#))

Fertigation Practical Example

Use only complete soluble fertilizers for fertigation

Enter your numbers:

- The percentage of nitrogen in your fertilizer (example 8% = 0.08)
- Weight in pounds of one gallon of your fertilizer (example 10 lb/gal)
- How many pounds of nitrogen you want to apply per acre (example 5 lb N/acre)
- The total acreage of your block (example 20 acres)
- Your irrigation flow rate of your irrigation system in gallons per minute (example 1,000 gal/min)
- The nitrogen concentration in parts per million you want to inject (example 200 ppm)

Here is an example

We will use a fertilizer (8% N or 0.08 N, 10 pounds per gallon) to apply 5 lb N per acre to a 20-acre field. The irrigation flow rate is 1,000 gallons per minute and the target N concentration in the irrigation line is 200 ppm. To calculate the injection rate and time:

Step 1: Total N: 5 lb/acre N × 20 acres = 100 lb N

Step 2: Pounds of Fert-8: 100 lb N ÷ 0.08 = 1250 lb of the fertilizer

Step 3: Gallons of Fert-8: 1250 lb ÷ 10 lb/gal = 125 gal

Step 4: Dilution factor: 0.08 × 1,000,000 ppm ÷ 200 ppm = 400

Step 5: Injection rate: 1000 gal/min ÷ 400 = 2.5 gal/min

Step 6: Injection time: 125 gal ÷ 2.5 gal/min = 50 min

Therefore, in this particular case, we need 125 gallons of fertilizer to be injected in 50 minutes.

Assume it takes 10 minutes for the water to travel from the injection point to the farthest emitters and reach full system pressure. Then, we need 50 minutes to inject the fertilizer and 15 minutes to flush the remaining fertilizer through the system.

As a result, a total fertigation event should have:

- 10 minutes for water to travel from the injection point to the farthest emitter and reach full pressure +
- 50 minutes to inject the fertilizer solution +
- 10 minutes for the last bit of fertilizer solution to reach the farthest emitter +
- 5 minutes extra to be sure that the system is flushed=
- Total time of 75 minutes (1hour 15 minutes)**

When preparing to inject fertilizer, first allow time for the irrigation system to fully pressurize. In most small irrigation zones, the full system pressure is reached in 10 minutes or less, but you should check each zone to determine the actual time. Once the system reaches full pressure, you can begin fertigation. For most sandy soils, the total run time of a single irrigation event should not be more than 2 hours in duration to avoid fertilizer leaching. Calculations may be done by timing an actual injection, or by calculations. After fertigation, continue to run water to evenly distribute all of the fertilizer throughout the zone. The length of this run is generally a little longer than the time required initially to bring the system up to full pressure. After each fertigation application, flush the system and be sure that all the fertilizer is flushed from the lines. Determine the time required to inject the quantity of fertilizer needed. In summary, the total time for an entire fertigation event includes the following:

- Time for water to travel from the injection point to the farthest emitter and bring the system up to full pressure
- Time to inject the fertilizer solution
- Time for the last bit of fertilizer solution to reach the farthest emitter
- Additional time to flush the system

Fertilizer must be completely flushed from the system after fertigation in order to keep microirrigation lines clean and prevent emitters from clogging.

Flatwoods Citrus

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Hispanic

White, non-Hispanic

Black, non-Hispanic

Gender

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Male