UNIVERSITY of FLORIDA
IFAS Extension

EXTENSION
Institute of Food and Agricultural Sciences

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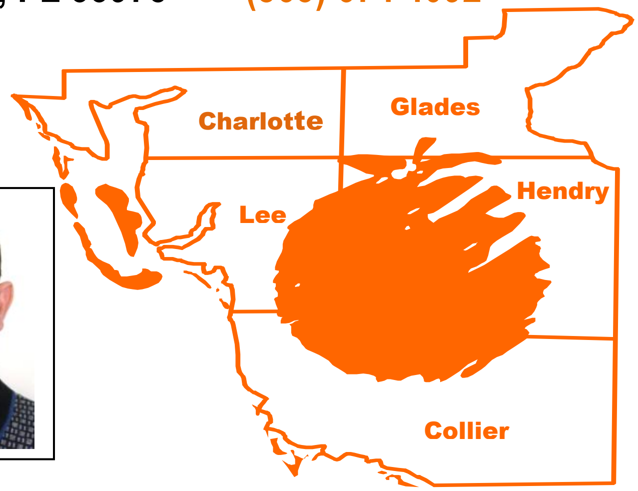
Flatwoods Citrus



Vol. 11, No. 6 **June 2008**

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

UPCOMING EVENTS

Seminar program

► Biological control of the psyllid
► Pheromone for the leafminer
► Chemical control of the psyllid and leafminer

Speakers: **Drs. Phil Stansly, Lukasz Stelinski, and Michael Rogers**
Location: **Immokalee IFAS Center**
Date: Tuesday, July 8, 2008, Time: 10:00 AM – 12:00 Noon
2 CEUs for Pesticide License Renewal, 2 CEUs for Certified Crop Advisors
Sponsor: **Rachel Walters**, **Bayer CropScience**
Following the seminar, we are planning a free lunch (Compliments of Bayer CropScience). **RSVP is required**. To RSVP, call 863 674 4092 or send an e-mail to maz@ifas.ufl.edu no later than 7 July 2008.

If you want to print a color copy of the **Flatwoods Citrus** Newsletter, get to the Florida Citrus Resources Site at http://flcitrus.ifas.ufl.edu/
You can also find all you need and all links to the University of Florida Citrus Extension and the Florida Citrus Industry

CITRUS EXPO

IN FORT MYERS

Wednesday, August 20 &
Thursday, August 21, 2008

54th Annual Meeting ISTH

12 to 17 October, 2008
Victoria, Espiritu Santo, Brazil
For more information visit the Website:
http://www.incaper.es.gov.br/congresso_fruticultura/index.htm
Or contact Noris Ledesma [nledesma@fairchildgarden.org]

INTERNATIONAL CITRUS CONGRESS

Location: Wuhan (Capital of Hubei province), **China**
Date: October 26-30 2008

http://ICC2008.hzau.edu.cn

Email:
ICC2008@mail.hzau.edu.cn

Greening Summit INFO

Missed the Greening Summit?
View guest presentations and learn about the event held in Avon Park April 8th, 2008
Go to the Citrus Agents website at:
http://citrusagents.ifas.ufl.edu/

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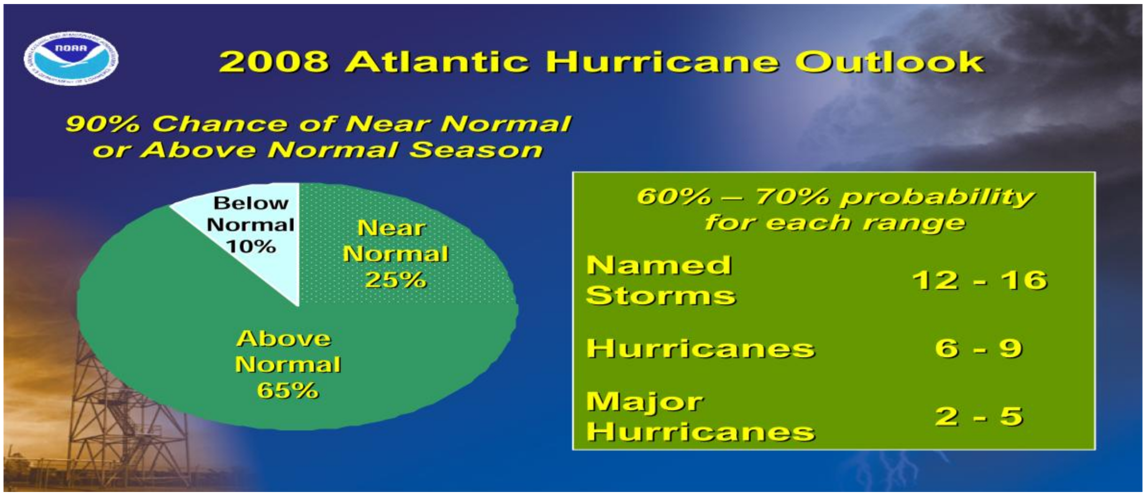
NOAA Predicts Near Normal or Above Normal Atlantic Hurricane Season

As With Any Season, Preparation is Essential



NOAA's Climate Prediction Center announced that projected climate conditions point to a near normal or above normal hurricane season in the Atlantic Basin this year. The prediction was issued at a news conference called to urge residents in vulnerable areas to be fully prepared for the onset of hurricane season, which begins June 1.

"Living in a coastal state means having a plan for each and every hurricane season. Review or complete emergency plans now - before a storm threatens," said retired Navy Vice Adm. Conrad C. Lautenbacher, Ph.D., undersecretary of commerce for oceans and atmosphere and NOAA administrator. "Planning and preparation is the key to storm survival and recovery."

The Climate Prediction Center outlook calls for considerable activity with a 65 percent probability of an above normal season and a 25 percent probability of a near normal season. This means there is a 90 percent chance of a near or above normal season.

The climate patterns expected during this year's hurricane season have in past seasons produced a wide range of activity and have been associated with both near-normal and above-normal seasons. For 2008, the outlook indicates a 60 to 70 percent chance of 12 to 16 named storms, including 6 to 9 hurricanes and 2 to 5 major hurricanes (Category 3, 4 or 5 on the Saffir-Simpson Scale).

An average season has 11 named storms, including six hurricanes for which two reach major status.

"The outlook is a general guide to the overall seasonal hurricane activity," Lautenbacher said. "It does not predict whether, where or when any of these storms may hit land. That is the job of the National Hurricane Center after a storm forms."

Bill Read, director of NOAA's National Hurricane Center, said, "Our forecasters are ready to track any tropical cyclone, from a depression to a hurricane, which forms in the Atlantic Basin. We urge coastal residents to have a hurricane plan in place before the season begins and NHC will continue to provide the best possible forecast to the public."

When a storm forms in the tropics – and even before that stage – NOAA forecasters at the Miami-based National Hurricane Center are in continuous monitoring mode – employing a dense network of satellites, land- and ocean-based sensors and aircraft reconnaissance missions operated by NOAA and its partners. This array of data supplies the information for complex computer modeling and human expertise that serves the basis for the hurricane center's track and intensity forecasts that extend out five days in advance.

The science behind the outlook is rooted in the analysis and prediction of current and future global climate patterns as compared to previous seasons with similar conditions.

"The main factors influencing this year's seasonal outlook are the continuing multi-decadal signal (the combination of ocean and atmospheric conditions that have spawned increased hurricane activity since 1995), and the anticipated lingering effects of La Niña," said Gerry Bell, Ph.D., lead seasonal hurricane forecaster at NOAA's Climate Prediction Center. "One of the expected oceanic conditions is a continuation since 1995 of warmer-than-normal temperatures in the eastern tropical Atlantic."

"Americans in hurricane-prone states must get serious and be prepared. Government – even with the federal, tribal, state and local governments working perfectly in sync – is not the entire answer. Everyone is part of the emergency management process," said FEMA Administrator R. David Paulison. "We must continue to develop a culture of preparedness in America in which every American takes personal responsibility for his or her own emergency preparedness."

NOAA's Atlantic hurricane season outlook will be updated on August 7, just prior to what is historically the peak period for hurricane activity.

Tropical systems acquire a name – the first of which for 2008 will be Arthur – upon reaching tropical storm strength with sustained winds of at least 39 mph. Tropical storms become hurricanes when winds reach 74 mph, and become major hurricanes when winds reach 111 mph.

The National Oceanic and Atmospheric Administration, an agency of the U.S. Commerce Department, is dedicated to enhancing economic security and national safety through the prediction and research of weather and climate-related events and information service delivery for transportation, and by providing environmental stewardship of our nation's coastal and marine resources. Through the emerging Global Earth Observation System of Systems (GEOSS), NOAA is working with its federal partners, more than 70 countries and the European Commission to develop a global monitoring network that is as integrated as the planet it observes, predicts and protects.

Hurricanes and tropical storms can be very devastating to agriculture including the Florida citrus industry. In 2004 and 2005, growers and farmers have seen their groves, barns, equipment and homes destroyed. If another hurricane hit our state, damage to trees would be of varying degrees. Some trees would be uprooted. Others would have major limbs split off or would have major defoliation. Fruit would litter the ground and grapefruit trees would suffer the most loss because of the larger size and heavier weight fruit.

PLAN & PREPARE

Hurricanes can strike at any time during June to October. It is best to devise a hurricane plan and use it to make preparations far before the hurricane season. The hurricane plan should provide protection from a storm and recovery after the storm. For more details, go to "Hurricane Preparedness For Citrus Groves" at:

http://edis.ifas.ufl.edu/CH178

FROM http://edis.ifas.ufl.edu/IN668 and http://edis.ifas.ufl.edu/IN686

CITRUS PSYLLID AND GREENING MANAGEMENT

The presence of greening in Florida citrus creates a new situation where psyllid management is of primary importance for managing this disease. To effectively maintain psyllids at low levels throughout the year, it will be necessary to incorporate chemical, cultural, and biological control into a comprehensive management strategy for psyllid suppression. No one management strategy alone is likely to be able to provide the results desired in terms of reducing psyllid populations.

If insecticides are to be used for psyllid suppression, they should be applied earlier in the year when conditions are favorable for rapid buildup of psyllid populations. During the summer months, when temperatures and flush patterns are not favorable for psyllid development, insecticide applications made solely for psyllid management are less likely to reduce psyllid populations.

Predators and parasitoids of the psyllids are more likely to provide sustained control during these periods of low psyllid populations. Management of greening should include the use of disease-free nursery trees, removal of greening-infected trees, and control of psyllid populations.

Nonbearing Trees/Resets

Young trees that produce multiple flushes throughout the year are at greater risk of greening infection than mature trees because of the attraction of adult psyllids to the new flush. Even without greening, young trees in the field need to be protected for about 4 years from psyllids and leafminers to grow optimally. Soil-applied systemic insecticides will provide the longest lasting control of psyllids with the least impacts on beneficials. Drenches are best applied once in the spring and possibly again in the fall, when the trees are flushing most and rainfall is less likely to move the material past the root zone before it can be taken up by the plant. Foliar sprays with different types of materials including petroleum oil can be used during the rainy season if psyllids are observed on the new flush of young trees. When making multiple foliar insecticide applications within a season for psyllid control, rotate between products with different modes of action to reduce the likelihood of pesticide resistance development.

Bearing Trees

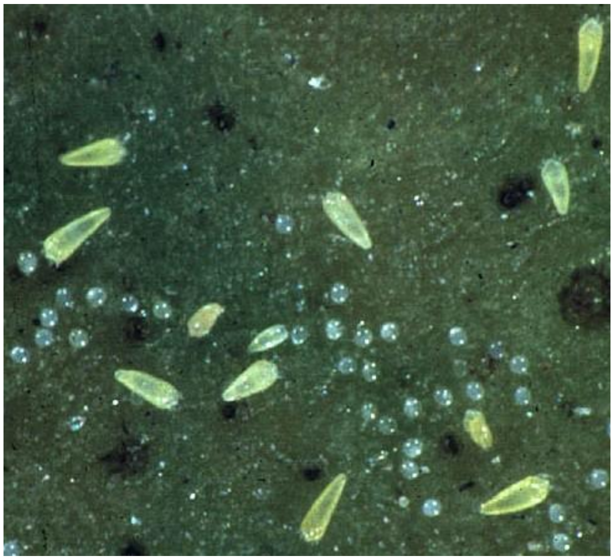
Management options for psyllid control on mature trees are much more limited than for smaller trees. Currently, the only soil-applied insecticide that has been shown to provide reduction in psyllid numbers on large trees is aldicarb. If aldicarb is applied to mature trees as a part of a program for psyllid management, application should be made about 30 days prior to the initiation of flushing. This timing will allow for the material to move from the roots up to the tree canopy.

At present, the only other chemical control option for suppressing psyllids on mature trees is the use of broad-spectrum foliar insecticide applications. If greening is present in a grove or nearby, the best timing of foliar sprays for psyllid control is during the early season flush periods when temperatures are at or below 90°F and psyllids are most abundant. Foliar sprays should be timed to the presence of feather-leaf flush. Successfully controlling psyllids with foliar sprays on large trees after the spring flush is difficult because of the unsynchronized sporadic flushing patterns within a grove and the shortresidual effects of these foliar sprays. Successful suppression of psyllids during the early part of the year may result in lower populations throughout the rest of the summer when psyllid populations do not develop rapidly due to the higher temperatures, limited availability of new flush, and to abundant natural enemies.

Recommended Chemical Controls for Asian Citrus Psyllids. **Read the label**

Pesticide / Trade name[1,4]	**Rate / Acre**	**Comments**
Aldicarb		Restricted use pesticide. Notification of intent is required. Application permitted only between Nov. 15 and Apr. 30. See label for application restrictions. When psyllid control is required on mature trees, apply at least 30 days prior to anticipated flush.
Temik 15G	33 lbs	
Carbaryl		Highly toxic to bees. Sevin XLR Plus has a 2(ee) label for control of Asian citrus psyllid; other formulations of carbaryl not currently labeled for psyllid control.
Sevin XLR Plus	1.5 qts	
Chlorpyrifos		Restricted Use Pesticide. Highly toxic to bees. May increase spider mite populations. Lorsban 4E has a 2(ee) label for control of Asian citrus psyllid; other formulations of chlorpyrifos are not currently labeled for psyllid control.
Lorsban 4E	5 pts	
Fenpropathrin		Restricted use pesticide. Highly toxic to bees. May result in increased rust mite populations. May have significant negative effects on beneficial insect populations.
Danitol 2.4EC	1 pt	
Imidacloprid (foliar application)	10 to 20 fl oz	Limit of 0.5 lbs / AI per acre per growing season regardless of application type (soil and/or foliar) and trade name of imidacloprid product used. Do not apply during bloom or within 10 days of bloom or when bees are actively foraging.
Couraze 1.6F		
Nuprid 1.6F		
Pasada 1.6F		
Provado 1.6F		
Imidacloprid (soil-drench)		Limit of 0.5 lbs / AI per acre per growing season regardless of application type (soil and/or foliar) and trade name of imidacloprid product used. Recommended application is a soil drench made to base of trees up to 6 feet tall.
Admire Pro 4.6F	7 to 14 fl oz	
Admire 2F	16 to 32 fl oz	
Alias 2F		
Couraze 2F		
Nuprid 2F		

CITRUS RUST MITES



The citrus rust mite and the pink citrus rust mite are found on all citrus varieties throughout Florida. The pink citrus rust mite develops to greater damaging populations early in the season (April-May). Both rust mites are important pests 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 drop. Fruit damage is the main concern with other varieties.

Egg deposition begins within two days after the female reaches sexual maturity and continues throughout her life of 2-3 weeks. The pink citrus rust mite populations can begin to increase in April to early May on new foliage, reaching a peak in mid-June to mid-July, depending on geographical location and weather. The pink citrus rust mite is more abundant in drier weather conditions. The citrus rust mite 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. Generally, the north bottom of the tree canopy is preferred and supports the highest mite populations. 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 such as reduced size. Severe leaf injury to some specialty varieties (Ambersweet, Fallglo, and Sunburst can lead to leaf drop.

Citrus groves producing fruit designated for the fresh market may receive 3-4 miticides/year typically during April, June, August, and October. In contrast, groves producing fruit designated for processing may not need to be treated. 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 petroleum oil as a fungicide for greasy spot control and to suppress mites. Scouting for rust mite populations is very important for efficient control.

Citrus Miticide Selection*. ***Read the label.***

Supplemental (early Spring)	Post Bloom	Summer	Fall	Supplemental Fall
--	--	Agri-mek + oil	--	--
--	--	--	Comite	Comite
Dicofol	Dicofol	--	--	--
Envidor	Envidor	Envidor	Envidor	Envidor
--	Petroleum oil	Petroleum oil	Petroleum oil	--
--	--	--	Sulfur	Sulfur
--	--	Micromite	Micromite	--
--	--	--	Nexter	Nexter
Temik	--	--	--	--
Vendex	Vendex	--	Vendex	Vendex
*Except for petroleum oil, do not use the same miticide chemistry more than once a year.				

For more information, go to http://edis.ifas.ufl.edu/CG002
2008 Florida Citrus Pest Management Guide: Rust Mites, Spider Mites, and Other Phytophagous Mites

From The Florida Citrus Pest Management Guide

WEED CONTROL IN CITRUS GROVES

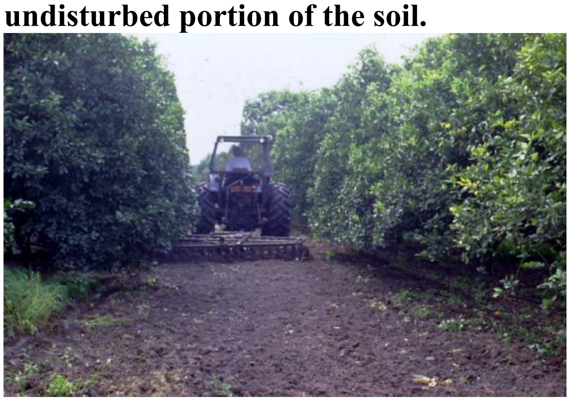
Weeds can reduce the growth, health and survival of young trees, or the time to come into bearing and ultimately fruit production. The more competitive the weeds, the more adversely they alter tree physiology, growth, fruit yield and quality. The attainment of early crop production requires controlling the growth of weeds. Weeds alter economic status by competing with trees, particularly young trees, for water, nutrients and even light in the case of climbing vines, which can easily cover trees if left uncontrolled.

Weeds also have various effects on tree performance including reduced efficacy of low volume irrigation systems, and interception of soil-applied pesticides.

Management Methods

Cultural & mechanical

Cultural methods include off-target irrigation and fertilizer applications. Mechanical methods include cultivation in row middles. However, **constant cultivation results in the destruction of citrus fibrous roots, which normally would grow in the undisturbed portion of the soil.**



Mowing is practiced between the tree rows and away from the trees in combination with herbicide applications in the tree row over the major root zone of trees. It is appropriate where a cover crop is desired in bedded groves to prevent soil erosion. Weeds can also be spread by seed and vegetatively during mowing operations, reinfesting tree rows where herbicides have been applied. **Mowing before seedhead formation is necessary to reduce seed dissemination and reinfestation.**

Chemical mowing

Chemical mowing, utilizing Low Rate Technology (LRT) postemergence herbicide spray applications and wiping in combination with mechanical mowing, is used for the suppression of vegetation in row middles. With the high frequency and cost of mechanical mowing required to maintain vegetation control in row middles, chemical mowing and wiping with low rates of glyphosate has increased. Weed management in Middles by chemical applications results in the elimination of tall growing species and establishment of more manageable sod type species such as Bermuda and Bahia grasses.

Chemical

Generally speaking, all weed species listed as susceptible on the herbicide product label will be controlled by that herbicide at the appropriate rate, time of application and stage of growth. Environmental and plant conditions before, during and following the application are also important including moisture in the form of rainfall and/or irrigation.

Poor control can sometimes be expected from postemergence applications to weeds under stress conditions due to poor uptake and translocation of applied herbicides. Assuming that the appropriate herbicide or herbicide mixtures are selected for the weed species present, failures in the program will usually be due to one of the above factors or to the actual application including calibration and/or equipment design and operation.

Herbicides may be classified as foliar or soil-applied. Foliar applied materials may have systemic or contact activity. Soil applied preemergence herbicides are absorbed through weed root systems, being most effective during germination and early seedling growth stages. Systemic herbicides are those that are absorbed by either roots or aboveground plant parts and are translocated throughout the plant. Contact herbicides act as desiccants, damaging or killing all plant parts actually sprayed with little if any translocation.

For the control of well-established perennial weeds, a postemergence herbicide with systemic metabolic activity should be used with preemergence soil residual products.

Timing and frequency of application are the keys to good vegetation management. **Increased application frequency of lower rates of soil residual herbicides is more effective in young groves where vegetation presence is greater due to more exposure of the grove floor to sunlight and where a greater herbicide safety factor is required**.

Application Technology

Rapid advances in herbicide application technology have resulted in the development of sophisticated equipment. Application equipment is now capable of selective delivery of multiple herbicide products, each directly injected into booms. In a single application, tree rows and row middles may be treated with soil residual and postemergence products with selectivity for tree age, soil type and vegetation species.

Well-maintained, accurately calibrated equipment with good filtration and agitation systems capable of uniform distribution of prescribed spray volumes and droplet size is essential for efficiency, cost-effective vegetation management. Worn nozzle tips result in increased spray delivery rates and distortion of distribution patterns and should be checked regularly. Improved herbicide boom design to reduce tree skirt contact, spray drift and interference of heavy weed cover with nozzle output will reduce tree damage and fruit drop while improving control of target vegetation. Tree skirt pruning and timing of postemergence applications will also reduce boom and spray contact with low hanging limbs and fruit.

Environmental Considerations

In determining management options, herbicide selection should be based not only on species and stage of vegetation development, but product solubility and leaching potential, soil type and rainfall distribution. Objectives are to reduce weed competition and interference through measured vegetation control/suppression with inputs having reduced potential for leaching through over-irrigation, runoff and erosion, chemical drift, or other off-target impacts. CAUTION: Herbicides may move through the soil to groundwater. Several factors influence the rate of this movement. Lower rates applied more frequently combined with sound irrigation management practices will reduce herbicide movement. **The use of bromacil-containing herbicides is prohibited on deep, sandy Ridge-type soils**. For more information and for the list of herbicides registered for citrus in Florida, go to: **http://edis.ifas.ufl.edu/CG013**

2008 Florida Citrus Pest Management Guide: Weeds.

ACIDIFICATION TO REMOVE MINERAL DEPOSITS IN IRRIGATION SYSTEMS

Acid Injection

Mineral precipitates can form deposits (scale) that clog emitters. The most common deposits are calcium or magnesium carbonates and iron oxides. Since precipitation occurs more readily in water with a high pH (above 7.0), precipitation of these compounds can be prevented by continuous injection (whenever the system is operating) of a small amount of acid to maintain water pH just below 7.0. A more popular control method is to remove deposits as they are formed by periodic injection of a greater volume of acid. Enough acid should be injected continuously for 45 to 60 minutes to reduce the water pH to 4.0 or 5.0.

Phosphoric acid (which also supplies phosphate to the root zone), sulfuric acid, or hydrochloric acids are commonly used. The selection of a specific acid depends on cost and availability, water quality, the severity of clogging, and nutrient needs of the crop. The amount of acid required to treat a system depends on (1) the strength of the acid being used, (2) the buffering capacity of the irrigation water and (3) the pH (of the irrigation water) needed to dissolve mineral precipitates in lines and emitters. The required pH of the irrigation water (target pH) depends on the severity of mineral deposits. Experience is helpful when estimating target pH.

To determine the volume of a selected acid needed at a specific site, estimate the target pH and run a "titration" test (as described below) using the selected acid and irrigation water from the site. This test will indicate the volume of acid required to lower the pH of a selected volume of water to the target pH. Titration provides an acid volume:water volume ratio that can be used in conjunction with the system flow rate to determine the appropriate acid injection rate. The acid injection rate is determined by dividing the volume of water by the flow rate of the irrigation system and multiplying the result by the volume of acid added to reach the target pH.

Titration

A water container, a non-corrosive measuring cup, beaker or pipette calibrated in small increments such as milliliters, and a portable pH meter are needed to run the titration test. The volume of the container may be as small as 10 liters (about 3 gallons) or as large as 55 gallons. In general, the smaller the increments used when measuring and dispensing the acid into water, the smaller the required container.

To run the titration test, put a known volume of water (from the site) into the container and check the pH. Add a small amount of acid (1-3 ml for 3 gallons, 4-8 ml for 30 or more gallons) to the water, stir and re-check the pH. Continue this process until the target pH is attained. As the acidity of the water gets near to the target pH, add acid in very small increments (1 ml) so that the pH does not quickly drop below the target pH and necessitate repeating the test. Always add acid to water.

Caution: Never add water to acid.

The following example illustrates how to determine the required volume of acid and the appropriate acid injection rate.

Example: For a system with a flow rate of 200 gal/min.
Based on the severity of mineral deposits in the system, a target pH of 4.5 and an injection period of one hour are selected.
--Put 50 gallons of water into a 55-gal drum. Check the pH. Meter indicates pH of 7.4.
--Add 8 ml phosphoric acid. Check the pH. Meter indicates pH of 6.9.
--Add 7 more ml phosphoric acid. Check the pH. Meter indicates pH of 6.0.
--Add 4 more ml phosphoric acid. Check the pH. Meter indicates pH of 5.3.
--Add 1 more ml phosphoric acid. Check the pH. Meter indicates target pH of 4.5.
20 ml (8+7+4+1) of phosphoric acid were required to lower the pH of 50 gal of water to the target pH of 4.5.
--Divide 50 gal by the system flow rate of 200 gal/minute and multiply the result by the ml of phosphoric acid required to reach the target pH. 200 gal divided by 50 gal = 4 x 20 ml = 80 ml phosphoric acid. Therefore, the required acid injection rate is 80 ml per minute.
--Multiply 80 ml per minute by the injection time to determine the required volume of acid needed during the 1-hour injection period. 80 ml x 60 min = 4,800 ml (approximately 1.3 gal/hr, since there are 3785 ml in 1 gallon)

Note: Acid injection rates are usually very low (ml/hour or oz/hour). Although injection pumps with low flow rates may be suitable for acid injection, they may not have enough capacity for injecting fertilizers.

After the desired amount of acid has been injected and distributed throughout the irrigation system, turn the system off and let the low pH water remain in the lines for several hours, preferably overnight. This allows sufficient reaction time for the acidified water to dissolve mineral precipitates. After the setting period, flush the lines to remove dislodged and solubilized materials. To flush the lines, bring the system to full charge by running the irrigation pump (injection pump off) until the system reaches normal operating pressure. With the irrigation pump running, begin sequentially opening the ends of the PVC lines and emitter lines to flush the system. To ensure proper flushing, do not open so many lines at one time that system pressure drops below normal levels. If too many lines are opened at one time, the pressure drops too low and the system will not flush adequately. Improperly flushed lines after acidification will likely result in severe clogging problems. Keep in mind that routinely flushing lines with non-acidified irrigation water will also help remove mineral precipitates from the system.

A CHLORINE-ACID INJECTION SYSTEM

CHLORINATION TO CONTROL ALGAE AND BACTERIA IN IRRIGATION SYSTEMS

Chlorine Injection Interval

Chlorine injection will prevent clogging of lines and emitters by algae and bacterial slime. Continuous injection of small amounts of chlorine can keep algae and bacterial slime under control. However, periodic injection of larger amounts of chlorine is the preferred treatment for controlling algae and bacteria in microirrigation systems. You do not need to inject chlorine if you are using municipal water that is already chlorinated. However, if your irrigation water has not been chlorinated, you should be prepared to inject chlorine as needed. If water quality is extremely poor, it may be necessary to chlorinate at the end of each irrigation cycle. Experience is helpful when determining the appropriate intervals between chlorine injections.

Recommended Chlorine Formulations

Liquid sodium hypochlorite (NaOCl) is the easiest form of chlorine to handle and is the type most often used for treatment of microirrigation systems. It is readily available in supermarkets and other stores as common household bleach (5.25% chlorine). Liquid chlorine is also available from some swimming pool companies as a 10% chlorine solution. Caution: Powdered calcium hypochlorite $Ca(OCl_2)$, also called High Test Hypochlorite (H.T.H.) is a dry powder commonly used in swimming pools. This material is not recommended for injection into microirrigation systems. When mixed with water (especially at high pH), the calcium contained in H.T.H. can form precipitates.

Initial Chlorine Injection Rate

As chlorine is injected, some of it reacts with bacteria (as it destroys the bacteria) and other forms of organic matter in the irrigation lines. This "reacted" chlorine is chemically bound or "tied up" and is no longer antibacterial. Chlorine that has not reacted remains as "free residual chlorine." Only this free chlorine is available to destroy bacteria and to continue treatment of the system. For chlorination to be effective, you should maintain 1 to 2 ppm free chlorine in the system for 30 to 60 minutes. Usually, an initial concentration of 5 to 6 ppm is required in order to maintain 1 to 2 ppm free chlorine. Samples for determining the initial chlorine concentration should be taken near the point of injection. However, samples should be taken far enough past the point of injection that the chlorine is uniformly mixed in the irrigation water.

The following equation can be used to calculate the injection rate.

Injection rate (gal/hr) = 0.03 x GPM divided by % chlorine.

Example: The desired initial chlorine concentration in irrigation water just past the point of injection is 5 ppm. Assume a drip irrigation system with a total flow rate of 100 gallons per minute (gpm) and that common chlorine bleach (5.25% chlorine) will be injected.

Injection rate (gal/hr) = 0.03 x GPM divided by %chlorine
= 0.03 x 100 divided by 5.25
= 0.57 gal/hr

The chlorine solution must be in contact with algae and bacteria for at least 30 minutes to successfully treat the drip irrigation system. To ensure that all parts of the system receive a minimum of 30 minutes' contact time, inject chlorine for one hour.

For convenience, the injection rates (gal/hr and oz/hr) required to give an initial concentration of 5 ppm chlorine have been calculated for selected flow rates in the following Table.

	5.25% Chlorine Solution		10% Chlorine Solution	
Water Flow (gpm)	**gal/hr**	**oz/hr**	**gal/hr**	**oz/hr**
10	0.06	7.7	0.03	3.8
20	0.11	14.1	0.06	7.7
30	0.17	21.8	0.09	11.5
40	0.23	29.4	0.12	15.4
50	0.29	37.1	0.15	19.2
75	0.43	55.0	0.22	28.2
100	0.57	73.0	0.30	38.4
150	0.86	110.1	0.45	57.6
200	1.14	145.9	0.60	76.8
250	1.43	183.0	0.75	96.0
300	1.71	218.9	0.90	115.2
350	2.00	256.0	1.05	134.4
400	2.29	293.0	1.20	153.6

Maintaining Free Residual Chlorine Concentration

During chlorination, maintain 1 to 2 ppm free chlorine at the point in the system where the concentration is lowest (usually at the point farthest from injection). If the irrigation water has a pH of 7.5 or less, 1 ppm free chlorine may be sufficient. However, for alkaline water with a pH above 7.5, maintain 2 ppm. Chlorination for bacterial control may be ineffective above pH 7.5. Therefore, it is recommended to inject acid to lower the pH to increase the efficacy of chlorine. The free chlorine concentration drops as the chlorine reacts with organic matter in the lines. Therefore, to maintain 1 to 2 ppm free chlorine in the lines farthest from injection, it is often necessary to maintain a concentration of 5 to 6 ppm free chlorine near the point of injection. The specific concentration necessary (near the point of injection in a given zone) depends on water quality and the quantity of bacteria, algae and other organic matter in the lines. Maintain the recommended free chlorine concentration at the most distant emitter for 60 minutes. This requires frequent testing of the free chlorine concentration and subsequent adjusting of the chlorine injection rate if needed.

To ensure that the free chlorine concentration is maintained at 1 to 2 ppm, measure free chlorine concentration at the emitter most distant from the injection point 10 to 20 minutes after injection is initiated. This can be done by using a D.P.D. (N,N Diethyl-P-Phenylenediamine) test kit, which measures only free residual chlorine. These test kits are available from chemical suppliers and from most irrigation dealers. Caution: The orthotolidine type test kit, often used for swimming pools, measures total chlorine content (not free residual chlorine) and, therefore, cannot be used satisfactorily for microirrigation systems.

In cases where the injection pump cannot be calibrated low enough to inject 5.25 percent or 10 percent liquid chlorine at the desired rate, dilute the chlorine solution prior to injection. This permits the use of a higher injection rate within the capacity of the injector pump.

Example: Assume you need to inject 1 gallon of 5.25 percent chlorine into your drip system during a one-hour injection period. If your injection pump can inject no less than 2 gallons per hour, add 1 gallons of water to the 5.25 percent chlorine to give a total chlorine solution of 2 gallons. Then set the injector pump to inject 2 gallons per hour.

Flatwoods Citrus

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Multi-County Citrus Agent
Hendry County Extension Office
P.O. Box 68
LaBelle, FL 33975

Subscriber's Name:____

Company:____

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Racial-Ethnic Background

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

Gender

__Female

__Male