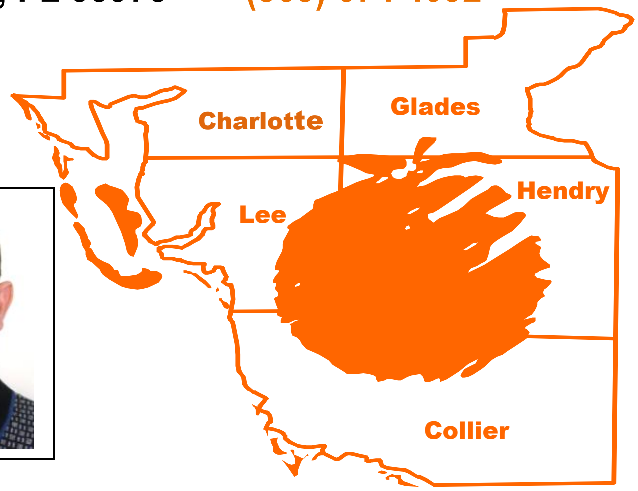
UNIVERSITY of FLORIDA
IFAS Extension

E X T E N S I O N

Institute of Food and Agricultural Sciences

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

Flatwoods Citrus



Vol. 11, No. 8 August 2008

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

U P C O M I N G E V E N T S

PESTICIDE LICENSE TRAINING & TESTING

CORE, PRIVATE APPLICATOR, Ag TREE CROP, AQUATIC

Monday, 18 August & Tuesday, 19 August 2008

Location: University of Florida, IFAS, Hendry County Extension Office, LaBelle

For more information and/or registration, call 863 674 4092

Florida Mini-Greening Summit (see enclosed details)

Meeting dates and locations:

Sep. 30th	Tavares	1951 Woodlea Rd	Lake County Extension
Oct. 2nd	Sebring	4509 W. George Blvd	Highlands County Extension
Oct. 7th	**Immokalee**	**2686 SR 29 N**	**SW Florida REC**
Oct. 8th	Arcadia	2250 NE Roan St.	Turner Exhibition Hall
Oct. 9th	Bartow	1710 Highway 17 South	Polk Co. Ext. Stuart Center
Oct. 14th	Ft. Pierce	2199 S Rock Rd	Indian River REC

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/

CITRUS EXPO

IN FORT MYERS

Lee Civic Center, 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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Florida Mini-Greening Summit

Presented by the Florida Cooperative Extension Service
Citrus Extension Agents

Program Agenda

9:45 AM	Registration
10:00 AM	Psyllid control research and management update
10:25 AM	Greening bacteria research update
10:50 AM	Break
11:05 AM	Horticultural greening management research update
11:30 AM	Citrus canker research update
12:00 PM	Adjourn

Attendees will receive 2 Continuing Education Units (CEU's) for the Restricted Pesticide and Certified Crop Advisory Program.

Speakers-Citrus Extension Agents:

Steve Futch
Lake Alfred, FL
863-956-1151

Mongi Zekri
Labelle, FL
863-674-4092

Chris Oswalt
Bartow, FL
863-519-8677 x 108

Gary England
Bushnell, FL
352-793-2728

Ryan Atwood
Tavares, FL
352-343-4101

Tim Hurner
Sebring, FL
863-402-6540

Tim Gaver
Ft. Pierce
772-462-1660

Meeting dates and locations:

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o register for a specific location of the following locations, please contact:

Bartow-	Polk County Extension Service	863-519-8677 ext. 111
Arcadia-	DeSoto County Extension Service	863-993-4846
Immokalee-	Hendry County Extension Service	863-674-4092
Tavares-	Lake County Extension Service	352-343-4101
Sebring-	Highlands County Extension Service	863-402-6540
Ft. Pierce-	St. Lucie County Extension Service	772-462-1660

Fall Classes Available at the CREC

LAKE ALFRED, Florida – The University of Florida, Institute of Food and Agricultural Sciences, (UF/IFAS) Citrus Research and Education Center (CREC) is offering fall 2008 courses in Citrus Pathology and Sensors and Data Acquisition in Biological Sciences. Classes run from Aug. 25, 2008 to Dec. 10, 2008.

Citrus Pathology (PLP 5115C) is a three credit graduate level course lead by Dr. Ron Brlansky, Professor of Plant Pathology. The course will be held at the UF/IFAS CREC Lake Alfred Campus on Mondays from 4 to 7 p.m. and via video conference (IP 128.227.177.98) to Gainesville. Citrus Pathology is a comprehensive course covering the major citrus diseases. It is taught by a team of citrus plant pathologists and other researchers involved in disease control from UF/IFAS CREC, Lake Alfred. Topics covered include the basic characteristics of virus and viroids, fungal pathogens, and bacterial pathogens, fungal diseases of fruit and foliage, diseases caused by systemic prokaryotes (citrus variegated chlorosis and citrus greening), diseases caused by viruses and viroids, bacterial diseases (citrus canker and citrus bacterial spot), root health and root diseases, diseases of unknown cause and postharvest diseases. Other topics include citrus nursery practices, regulatory practices, classical breeding and contemporary genetics for disease resistance, and genetic engineering of plants for resistances.

Sensors and Data Acquisition in Biological Sciences (FOS 6936) is a one credit graduate level course taught by Dr. Jose Reyes, Assistant Professor of Food Process Engineering. The course will be held at the UF/IFAS CREC Lake Alfred campus in the teaching lab on Wednesdays from 4 to 5 p.m. and via video conference (IP 128.227.177.98) to Gainesville. The objectives of this course are to better understand the principles of operation of common and not-so-common sensors, to improve research efficiency by learning the principles and tools used for data acquisition needed for computer-interfacing several laboratory instruments, and to learn different kinds of instruments and procedures used in different biological science disciplines.

Students registering for this course will have to prepare one or two (depending on the number of students) 50 minute seminars where they will describe the principle of operation of one or two instruments/methods they need to use for their research. Students will need to include the cutting edge technology as well as commercially available devices. They will need to explain how data is acquired, processed, and used for their research projects. There will be two midterm exams and a final exam. During the first four sessions, Dr. Reyes will teach the fundamentals of data acquisition and the basics of LabVIEW programming.

For more information call Christen Johnson, Public Relations Specialist, at 863-956-1151.

PESTICIDE RESISTANCE & RESISTANCE MANAGEMENT

http://edis.ifas.ufl.edu/CG026

By **M.E. Rogers, L.W. Timmer and C.W. McCoy**
From the 2008 Florida Citrus Pest Management Guide:

Many pest species, such as the citrus rust mite, are exceptionally well-equipped to respond to environmental stresses because of their short generation time and large reproductive potential. The use of chemical sprays to control insect, mite, and some fungal diseases of citrus pests creates a potent environmental stress. There are now many examples of pests that have responded by developing resistance to one or more pesticides. Pesticide-resistant individuals are those that have developed the ability to tolerate doses of a toxicant that would be lethal to the majority of individuals. The mechanisms of resistance can vary according to pest species and/or the class of chemical to which the pest is exposed. Resistance mechanisms include an increased capacity to detoxify the pesticide once it has entered the pest's body, a decreased sensitivity of the target site that the pesticide acts upon, a decreased penetration of the pesticide through the cuticle, or sequestration of the pesticide within the organism. A single resistance mechanism can sometimes provide defense against different classes of chemicals and this is known as ***cross-resistance***. When more than one resistance mechanism is expressed in the same individual, this individual is said to show ***multiple resistance***. Because the traits for resistance are passed from one generation to the next, continued stress from a pesticide may, over time, create resistance in the majority of individuals in a population. From an operational perspective, this process would be expressed as a gradual decrease and eventual loss of effectiveness of a chemical. Resistance to a particular chemical may be stable or unstable. When resistance is stable, the pest population does not revert to a susceptible state even if the use of that chemical is discontinued. When resistance is unstable and use of the chemical is temporarily discontinued, the population will eventually return to a susceptible state, at which time the chemical in question could again be used to manage that pest. However, in this situation, previously resistant populations may eventually show resistance again.

Of the factors that affect the development of resistance, which include the pest's biology, ecology and genetics, only the operational factors can be manipulated by the grower. The key operational factor that will delay the onset of pesticidal resistance and prolong the effective life of a compound is to assure the survival of some susceptible individuals to dilute the population of resistant individuals. The following operational procedures should be on a grower's checklist to steward sound pesticidal resistance management for acaricides, insecticides, fungicides, and herbicides:

1. Never rely on a single pesticide class.
2. Integrate chemical control with effective, complementary cultural and biological control practices.
3. Always use pesticides at recommended rates and strive for thorough coverage.
4. When there is more than one generation of pest, alternate different pesticide classes.
5. Do not use tank mixtures of products that have the same mode of action.
6. If control with a pesticide fails, do not re-treat with a chemical that has the same mode of action.

Reports of resistance have been documented for certain acaricides used to control citrus rust mite and fungicides used to combat diseases in Florida. No resistance has developed to strobilurin fungicides at this time, however, strobilurin fungicides (Abound, Gem, and Headline) have potential for resistance development. Agri-mek tolerance in citrus rust mite is of concern and growers should follow sound resistant management practices when using this product.

The following tables are provided to aid in the rotation of pesticides with different modes of action within a season or from year to year. There is a separate table for insecticides/acaricides, fungicides, and herbicides. The information in these tables was derived from information produced by the Insecticide Resistance Action Committee (IRAC) (http://www.irac-online.org/), Fungicide Resistance Action Committee (FRAC) (http://www.frac.info/) and the Herbicide Resistance Action Committee (HRAC) (http://www.plantprotection.org/hrac/). Each table lists the number (or letter in the case of herbicides) of the group code for each pesticide class, the group name or general description of that group of pesticides, the common name of pesticides used in citrus production that belong to each group and examples of trade names of pesticides for each common name listed. When using the table to rotate between using products with different modes of action, choose products with a different group code than previously used in the grove during the current growing season. In the case of insecticides/ acaricides, many of these pesticides are broken into subgroups. It is unclear whether cross resistance will occur between these subgroups. When possible, it is recommended to rotate with an entirely different group. (Note: The IRAC and FRAC mode of action systems both use a similar numbering system. There is no cross resistance potential between the insecticides and fungicides.) Products with broad-based activity such as sulfur, copper, and oil are not included in this list because the development of resistance to them is not likely.

Tables

Table 1. Insecticides and miticides used in Florida citrus grouped by mode of action.

IRAC Group[1]	Subgroup	Group Name	Trade Name
1	1A	Carbamates	Temik, Sevin, Vydate
1	1B	Organophosphates	Orthene, Lorsban, Dimethoate, Nemacur, Malathion, Supracide, Dibrom, Imidan
2		Cyclodiene, Organochlorines	Phaser
3		Pyrethroids	Brigade, Danitol
4		Neonicotinoids	Assail, Admire, Advise, Alias, Couraze, Imida E-Ag, Impulse, Macho, Montana, Nuprid, Pasada, Prey, Torrent, Widow
5		Spinosyns	Spintor, Delegate
6		Avermectins	Abacus, Abba, Agri-mek, Clinch, Epi-mek, Reaper, Zoro
7	7A	Juvenile Hormone, Analogues	Extinguish Ant Bait
	7B	Fenoxycarb	Precision
	7C	Pyriproxyfen	Knack
9		Cryolite	Kryocide
10		Hexythiazox	Savey
11		*Bacillus thuringiensis* (B.t.)	Various
12	12B	Organotin miticides	Vendex
12	12C	Propargite	Comite
15		Benzoylureas	Micromite
16		Buprofezin	Applaud
18		Moulting disruptors	Neemix
21		METI acaricides	Nexter, Portal
23		Tetronic acid derivative	Envidor
25		Bifenazate	Acramite
UN		Unknown MOA	Kelthane

Table 2. Fungicides used in Florida citrus grouped by mode of action.

FRAC Group[1]	Group Name	Trade Name
1	MBC - fungicides	Benlate, Many (TBZ), Topsin
3	DMI - fungicides	Many, Banner Maxx, Bumper, Orbit, Propimax
4	PA - fungicides	Ridomil, Ultraflourish, Ridomil, Gold, Subdue
11	QoI - fungicides	Abound, Gem, Headline
12	PP - fungicides	Graduate
13	Phosphonates	Aliette, Phostrol, ProPhyt
M	M2	Ferbam Granuflo, ManKocide
M	M9	Many

Table 3. Herbicides used in Florida citrus grouped by mode of action.

HRAC Group[1]	Group Name	Trade Name
A	FOPs, DIMs	Fusilade, Prism, Select, Volunteer, Poast
C1	Triazine Uracil	Princep, Sim-Trol Hyvar, Krovar
C2	Urea	Direx, Karmex, Krovar
D	Bipyridylium	Reglone-Dessicant, Gramoxone
E	Diphenylether, N-phenylphthalimide, Triazolinone	Galigan, Goal, Oxiflo, Chateau, Suregard, Aim
F1	Pyridazinone	Solicam
G	Glycine	Many (Roundup)
K1	Dinitroaniline, Pyridine	Surflan, Oryza, Pendulum, Prowl, Treflan, Snapshot, Mandate
L	Benzamide	Gallery, Snapshot
N	Thiocarbamate	Eptam
Z	Organoarsenical	MSMA-6

Packinghouse Day

Sept. 11, 2008

Citrus Research and Education Center,
Lake Alfred, FL.

Postharvest Workshop

Sept. 16, 2008

Indian River Research and Education Center,
Fort Pierce, FL.

Both with presentations on:

- The latest information on citrus canker related to fresh citrus
- Development of new fresh citrus varieties
- National efforts to create commodity specific GAPs
- Changes in the maximum residue limits (MRLs) for important export markets
- Practices to reduce peel breakdown on fresh grapefruit
- Use of laser labeling on citrus

For more information, contact Mark Ritenour at 772-468-3922 , ext. 167

or visit http://postharvest.ifas.ufl.edu

International Research Conference On Huanglongbing: *Reaching Beyond Boundaries,* Orlando, Florida, Dec. 1-5, 2008

We anticipate a $200 USD registration fee **or less** to offset a portion of the Conference, costs which will be paid at the time of registration.

Pre-Registration Information Requested Immediately

If you plan to attend, please fill out the following form below and email it to: Ms. Penny McCurry, **mccurrp@doacs.state.fl.us**

Pre-Registration Information Requested:

Name: ____

Affiliation: ____

Address: ____

Country: ____

Email address: ____

Telephone: ___________________________

CHRP Compliance for 2008-2009

• **2007-2008 DACS Compliance Agreements are extended for the 2008-2009 harvest season**

o Continue to use DACS 2007-2008 Compliance Agreements until further notice

• **All stakeholders are urged to remain engaged in the CHRP Program**

o Stay in touch with DPI and UF-IFAS through newsletters and websites

o Report changes in ownership or management of citrus groves

o Call your local CHRP Office if you have any questions (See attached list)

• **Grower self-survey and disease management are critical to your success**

o Report findings of grower self-surveys to your local CHRP office

o Choose to actively manage citrus greening and canker diseases

o Decontaminate to prevent the spread of canker to disease-free groves

• **Business Plans submitted in 2007-2008 may also be carried forward for 2008-2009**

• **Grower Compliance Agreement Number (C/A Number) assigned for the 2007–2008 citrus harvesting season is required on all field trip tickets**

o C/A Numbers will remain unchanged for the majority of growers

o Only growers who change managers, caretakers or cooperatives may experience a change in C/A Number [Affected parties will be notified]

• **FDACS/ DPI will provide services to the extent resources permit**

o Assistance with Business Plan development, as requested

o Grower requested training and supplemental grove surveys

o Data entry and feedback from grower self-survey records

• **We can be reached at the Division of Plant Industry/ PE&C/ CHRP**

o Tel: 863-298-7777 / Fax: 863-291-5219/ Web: www.doacs.state.fl.us/pi/chrp

For Collier, Hendry, Lee, Charlotte, Broward, Miami-Dade, Monroe, Sarasota, Palm Beach, Broward and Glades

424 E Market Road, Unit 10, **Immokalee**, FL 34142
TEL: 239-658-3684, FAX: 239-658-3692

CITRUS BROWN ROT

Management of brown rot, caused by *Phytophthora nicotianae* or *P. palmivora*, is needed on both processing and fresh market fruit. While the disease can affect all citrus types, it is usually most severe on Hamlin and other early maturing sweet orange cultivars. Phytophthora brown rot is a localized problem usually associated with restricted air and/or water drainage. It commonly appears from mid-August through October following periods of extended high rainfall. It can be confused with fruit drop due to other causes at that time of the year. If caused by *P. nicotianae*, brown rot is limited to the lower third of the canopy because the fungus is splashed onto fruit from the soil. *P. palmivora* produces airborne sporangia and can affect fruit throughout the canopy. Early season inoculum production and spread of Phytophthora spp. are minimized with key modifications in cultural practices.

Skirting of the trees reduces the opportunity for soil-borne inoculum to contact fruit in the canopy. The edge of the herbicide strip should be maintained just inside of the dripline of the tree to minimize the exposure of bare soil to direct impact by rain. This will limit rain splash of soil onto the lower canopy. Boom application of herbicides and other operations dislodge low-hanging fruit. Fruit on the ground becomes infected and produces inoculum of *P. palmivora*, which can result in brown rot infection in the canopy as early as July while fruit are still green. The decay initially occurs as a light brown discoloration of the rind at any location on the fruit surface. The affected area is firm and leathery, and it retains the same degree of firmness and elevation as the adjacent healthy rind. At a later stage, a delicate white mycelium will form on the lesion surface. Fruit with brown rot have a characteristic pungent, rancid odor, which distinguishes the disease from the stem-end rots.

The beginning stages of the epidemic are very difficult to detect before the fruit are colored and showing typical symptoms. Application of residual herbicides earlier in the summer may reduce the need for post-emergence materials later and minimize fruit drop throughout this early stage of inoculum production from fallen fruit.

Usually a single application of a copper fungicide or Aliette late in August is sufficient to protect fruit through most of the normal infection period. No more than 20 lb/acre/year of Aliette should be applied for the control of all Phytophthora diseases. Aliette, a systemic fungicide at the rate of 5 lbs/acre protects against postharvest infection and provides 60-90 days control. Copper fungicides are only protective but are capable of killing sporangia on the fruit surface and thus reducing inoculum. They provide protection for 45-60 days. Use the label rate. With average quality copper products, usually 3-4 lb of metallic copper per acre are needed for the control of brown rot. When the disease has already spread, do not apply Aliette; spray copper only. Precautions should be taken during harvesting not to include brown rot-affected fruit in the field containers as this could result in rejection at the processing or packing facility.

MAGNESIUM NUTRITION

Magnesium (Mg) deficiency is a problem in Florida. Trees with inadequate Mg supply have no symptoms in the new spring flush, but leaf symptoms will develop as the leaves age and the fruit expand and mature in the summer and fall. Leaves that have lost most of their green color due to Mg deficiency drop freely under unfavorable conditions. Defoliated twigs become weak and usually die by the following spring. Severe defoliation will reduce the average size of individual fruit and cause a general decline in fruit production. In Florida, Mg deficiency in citrus is caused primarily by low levels of Mg on acid light sandy soils and on calcareous soils. Leaching of added Mg is particularly serious and substantially rapid when the soil pH is 4.5 to 5.0. Under such conditions, the use of dolomite to bring the pH to 6.5 will furnish Mg at the same time.

FIXING Mg DEFICIENCY

Soil application of Mg sulfate or oxide to provide 50-60 lbs of Mg per acre can be successful in correcting Mg deficiency when the soil pH is adjusted. Under calcareous soils, the amounts of Mg applied must be greater than those applied on soils low in calcium or potassium. Foliar spray applications of Mg nitrate (3-5 gallons/acre) can be very effective when applied on the spring and summer flush leaves when they are about fully expanded. Remember that Magnesium should be applied regularly at 1/5 (or 20%) of the N rate unless leaf analysis shows more than 0.50% Mg. If leaf Mg deficiency symptoms occur, Mg should be applied in the fertilizer, and the rate should be increased up to 30% of the N rate until symptoms are no longer present in mature leaves of subsequent flushes. If both potassium (K) and Mg status are low, sulfate of potash-magnesia (SPM), which contains both K and Mg in the sulfate form is a very good option.

IMPROVING Mg and K NUTRITION UNDER HIGH SOIL pH

It is often difficult to increase Mg and K uptake with fertilizer applied to calcareous soils. High Ca levels suppress Mg and K uptake by citrus trees through the competition of Ca, Mg, and K. In cases where soil-applied fertilizer is ineffective, the only means of increasing leaf Mg or K concentration is through foliar application of water-soluble fertilizers, such as magnesium nitrate, potassium nitrate (KNO_3), or monopotassium phosphate. A solution of 20 lbs KNO_3 per 100 gallons of water has been shown to raise leaf K, especially if applied several times during the year. For citrus on noncalcareous soils, nitrogen and potassium fertilizer applications with a 1:1 ratio of N to K_2O are recommended. If leaf testing on calcareous soils reveals that high levels of soil Ca may be limiting K uptake, the K_2O rate should be increased by 25% to have a N:K_2O ratio of 1:1.25.

FLOODING INJURY

Almost all citrus trees grown in southwest Florida are located on high water table, poorly drained soils. Water management on poorly drained soils is difficult and expensive because during heavy rains in the summer, excess water must be removed from the rootzone and in periods of limited rainfall, irrigation is needed. On these soils, drainage is as important as irrigation. The concept of total water management must be practiced. If either system—irrigation or drainage—is not designed, operated, and maintained properly, then the maximum profit potential of a grove cannot be achieved. Both surface and subsoil drainage is necessary to obtain adequate root systems for the trees.

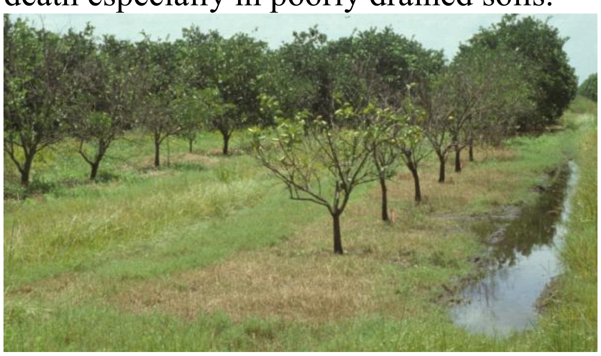
Roots, like the rest of the tree, require oxygen for respiration and growth. Soils in Florida typically contain 20-21 % oxygen. When flooding occurs, the soil oxygen is replaced by water. This condition causes tremendous changes in the types of organisms present in the soil and in the soil chemistry.

Flooding injury would be expected if the root zone were saturated for 3 days or more during extended summer rains at relatively high soil temperatures (86-95° F). Flooding during the cooler December-March period can be tolerated for several weeks at low soil temperatures (< 60° F). The rate of oxygen loss from the soil is much greater at high vs. low temperatures. The potential for damage to roots is less obvious but equally serious when the water table is just below the surface. Flooding stress is usually less when water is moving than when water is stagnant. The use of observation wells is a very reliable method for evaluating water-saturated zones in sites subject to chronic flooding injury.

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

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

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



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

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

It is both difficult and costly to improve drainage in existing groves, so drainage problems should be eliminated when the grove area is prepared for planting by including a system of ditches, beds and/or tiling. Growers should not depend on the slight and often unpredictable differences in rootstock tolerance to waterlogging to enable trees to perform satisfactorily under such conditions. Trees, irrespective of scion and rootstock cultivars, should be planted under the best drainage conditions possible. Drainage ditches should be kept free of obstruction through a good maintenance program including chemical weed control. Tree recovery from temporary flooding is more likely to occur under good drainage structure maintenance conditions.

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

WATER TABLE MEASUREMENT AND MONITORING

Most flatwoods citrus soils have a restrictive layer that can perch the water table and significantly affect tree water relations. To optimize production and tree health, the level of this water table should be monitored and maintained within an optimal zone. Simple and practical observation wells can normally produce adequate information.

Water Table Behavior. The water table under flatwoods citrus may rise rapidly in response to either rainfall or irrigation because sandy soils are highly conductive to water flow. A general rule of thumb is that 1 inch of rain will cause the water table to rise about 10 inches in fine textured soils, 6 inches in most of the flatwoods sandy soils, and 4 inches in coarse sands. It may take 4 to 6 days for the water table to return to its desired levels following rains of 1 inch or more.

Observation Wells. A water table observation well is made with a porous casing buried vertically in the ground. It permits the groundwater level to rise and fall inside it as the water level in the adjacent soils. Observation wells with a simple float indicator can provide rapid evaluation of shallow water table depths. The float and indicator level move with the water table, allowing an above-ground indication of the water level. Water table observation wells installed in flatwoods soils usually penetrate only to the depth of the restrictive (argillic or spodic) layer. Typically this layer is within 30 to 48 inches of the soil surface.

Well Construction. The basic components of the well itself include a short section of 3-inch perforated PVC pipe (3-5 ft long), 3-inch PVC cap, screening material, a float, indicator rod, and small stopper.

The indicator rod can be a dowel, ½ -inch PVC pipe (thin wall) or microsprinkler extension stake. Dowels are a poor choice since they require painting and will rot out near the float within a few years. The float is typically a 2½- inch fishing net float or a 500 ml (approximately 2½ in. diameter x 6 in. high) polyethylene bottle with a 28-mm (1.1 in.) screw cap size. The float assembly can be constructed by inserting the microsprinkler extension stake into the fishing float or ½-inch pipe into the polyethylene bottle.

The bottle neck provides a snug fit for the stake and no sealant is required. The hole in the cap should be drilled slightly larger than the indicator stake to serve as a guide for the float assembly. Fittings should not be glued so that components can be easily disassembled for cleaning or replacement. Observation well casings are constructed from 3-in. diameter PVC pipe (Class 160). A circular saw or drill can be used to perforate the pipe prior to installation. Perforations should be staggered in rows around the pipe to allow flow into the well from the sides in addition to the bottom. Perforations totaling about 5% of the well's surface area are adequate for sandy soils encountered in the flatwoods. No perforations should be made within 12 inches of the surface in order to minimize the chances of ponded water from high intensity storms creating flow channels into perforations near the soil surface.

The pipe should be wrapped (sides and bottom) with a screening material to prevent soil particles from moving into the well. Materials such as cheesecloth, polyester drain fabric, and fiberglass screen have been used successfully as filters. The filter material should be taped in place with duct tape. A 3-inch soil auger can be used to bore holes for the wells. When possible, the observation wells should be installed when no water table is present in order to minimize chances of the well sides sloughing into the bore as it is dug.

When a water table is present, it is easiest to install the well by starting off with a larger diameter pipe. For a 3-inch observation well, a 4-inch installation pipe (Sch 40 preferred) will be needed. The installation pipe should be cut at least 6 inches longer than the intended depth of well.

Holes (½-inch diameter) should be drilled in the sides of the pipe opposite each other about 1½ inches from the top of the pipe. These will be used to aid in removing the pipe from the soil after the observation well is installed. Auger a hole in the soil until it begins to slough in (when the water table is reached). The 4-inch pipe should then be forced into the hole. A 3-inch auger can then be used to remove soil from within the 4-inch casing. As soil is removed, the casing needs to be forced downward to keep the hole from sloughing. Continue to remove soil from inside the casing until the appropriate depth is achieved (typically when hardpan material begins to be excavated).

The well casing pipe should be cut to length and installed in the hole so that it extends 2 to 6 inches above the soil surface. Care should be taken to ensure that the casing is installed plumb to minimize binding of the float assembly. If a 4-inch installation pipe was used to excavate the hole, it needs to be removed. A ½-inch rod can be inserted through the holes that were drilled in the top of the 4-inch pipe. If the pipe cannot be removed easily by hand, a chain can be attached to the rod and attached to a high-lift jack. Usually, after jacking the installation pipe up about a foot, the pipe can be easily removed by hand. The soil should be backfilled around the observation well casing and tamped to compact the soil and get a tight fit between the soil and the sides of the pipe.

A measurement should be taken of the distance from the bottom of the well to the soil surface. The float assembly can then be lowered into the well. Make sure that the indicator rod and float do not bind against the sides of the observation well. The well is now ready for calibration.

Calibration. A mark on the indicator stake or rod should be made at the top of the well when the float is at the bottom of the well. This level is the reference mark for the well depth. The indicator stake or rod can then be marked with major divisions (feet) and minor divisions (inches) for easy reading of the water table depth. These rings can be painted at appropriate intervals using different colors for major and minor divisions. Marks painted at 2-inch increments provide enough accuracy for most users.

The mark at the upper level is dependent on the depth of the water furrow and root depth. The upper depth should be selected so that water does not pond in water furrows and it should be at least 6 inches below the bottom of the root zone to prevent root pruning. Observations over time will help to determine the water table level depth that will prevent root damage or excessive wetness in the root zone.

For more details, go to Water Table Measurement and Monitoring for Flatwoods Citrus, Circular 1409,
By Brian Boman and Thomas Obreza
http://edis.ifas.ufl.edu/pdffiles/CH/CH15100.pdf

NITROGEN MANAGEMENT AND WATER QUALITY

Whatever its source, nitrogen (N) is essential for achieving optimum crop yields. The same is true of phosphorus (P) and other nutrients. However, applying too much nitrogen or phosphorus to cropland can have adverse effects on the environment. Achieving optimum yields without applying excessive nutrients should therefore be a goal of all growers. Excess nitrogen and phosphorus in surface waters, and nitrogen in groundwater cause eutrophication (excess algae growth) in surface waters and health problems in humans and livestock as a result of high intake of nitrogen in its nitrate form.

Effect of Nitrogen on Water Quality

Eutrophication is the slow, natural nutrient enrichment of streams and lakes and is responsible for the "aging" of ponds, lakes, and reservoirs. Excessive amounts of nutrients, especially nitrogen and phosphorus, speed up the eutrophication process. As algae grow and then decompose they deplete the dissolved oxygen in the water. This condition usually results in fish kills, offensive odors, unsightliness, and reduced attractiveness of the water for recreation and other public uses. Excessive nitrate (NO_3) in drinking water can cause human and animal health problems, particularly for small babies. The United States Public Health Service has established a specific standard of 10 (ppm) milligrams of nitrate nitrogen per liter as the maximum concentration safe for human consumption.

Fate of Nitrogen in the Environment

The long-term fate of land-applied nitrogen is the same whether it comes from field-applied fertilizer, plant residues, animal, industrial, or municipal wastes, or other sources.

Nitrogen Remaining in the Soil

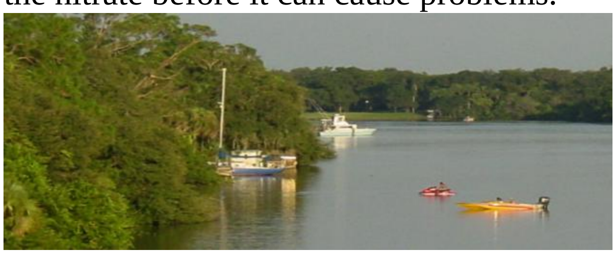
Regardless of how much nitrogen from fertilizers, manure, compost or other sources is used on a particular soil, nitrogen does not normally accumulate in the soil. Most of the nitrogen is lost from the soil in one way or another. Regardless of whether nitrogen is in the organic or inorganic form when applied to crops, it undergoes transformation to yield nitrate as an end product.

Recovery of Nitrogen in Harvested Crop

The amount of nitrogen harvested by crops is less than most people assume. Recovery of 50 percent of the applied nitrogen is a good average. However, the recovery rate varies for different crops and soils. The recovery of nitrogen applied to citrus largely depends on the amount applied, application frequency and method, fertilizer source, timing, and the yield obtained. In most seasons, the crop may not use 30 to 60 percent of applied nitrogen. This nitrogen may be lost through volatilization, leaching or runoff and may represent a potential source of pollution. Volatilization is the loss of ammonia gas (NH_3) to the atmosphere from urea and ammonium nitrogen sources. Nitrogen fertilizer sources prone to nitrogen volatilization should be incorporated into the soil or applied prior to a rainfall. Nitrogen losses are minimized through best management practices (BMPs).

Fertilizer Nitrogen Lost to the Air as Gas

It is well documented that some of the nitrogen that moves below the plant root zone is lost to the atmosphere through a process called *denitrification*. This process is the breakdown of nitrate to simple nitrogen (N_2) and oxygen (O_2) gases that return to the atmosphere. Loss of nitrogen as a gas by this process is not extensive in well-aerated, cultivated soils. Nitrogen applications to high-water-table soils that are poorly drained and high in organic matter are the least likely to contribute to contamination of groundwater by nitrate. The organic matter in the shallow groundwater provides energy for microorganisms that promote denitrification and thus much of the nitrogen is lost in the gaseous form rather than as nitrate. In many places throughout Florida, much of the nitrate flowing laterally to an outlet is either used by plants in these wet natural areas or is lost through denitrification. Thus, nature has a very effective way of removing much of the nitrate before it can cause problems.



Fertilizer Nitrogen Removed from the Soil in Surface and Subsurface Drainage

Nitrogen from fertilizers may enter streams through surface or subsurface drainage (leaching). Considerable loss of nitrogen may occur if heavy rains immediately follow a surface application of fertilizer on a moist soil surface, particularly if there is considerable slope. The loss of organic nitrogen (contained in crop residues, animal waste, or soil material) could be significant if intense rainfall results in substantial soil and debris movement. Because it has a high solubility, nitrate nitrogen normally moves readily into the soil with the initial rainfall. Thus, if fertilizer nitrogen is a source of pollution, it is usually from leaching or subsurface drainage. Because nitrogen does not accumulate in the soil and 30 to 60 percent of the applied fertilizer is not harvested with the crop, this nitrogen must be escaping into the air or water.

Management of Nitrogen to Uphold Water Quality

Because nitrate in groundwater and surface water is a potential health hazard and contributes to eutrophication problems, fertilizer nitrogen must be used prudently on crops. Listed below are some techniques for guarding against the possibility of unused nitrate contaminating surface water and groundwater supplies.

- Apply your fertilizer just before a major flush and/or bloom and during leaf and fruit expansion and growth. Avoid applying nitrogen during the rainy season. Proper timing ensures maximum nitrogen uptake and minimizes the likelihood of nitrogen leaching below the plant roots.
- Apply a reasonable amount of nitrogen to your crop. Do not apply nitrogen above recommended rates. When crop load is low, less nitrogen will be needed and removed with the crop.
- Consider collecting leaf samples for mineral analysis to check the nitrogen status and adjust the fertilizer program.
- Be sure to analyze animal, municipal, and industrial wastes for nitrogen content when applied to cropland.
- Develop and use a comprehensive record keeping system for fertilizer rates and yield.
- Calibrate applicators, apply fertilizer products and manure accurately, and use the correct application method. When possible, inject or incorporate urea-containing materials into the soil to minimize loss to the atmosphere (volatilization).

Flatwoods Citrus

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