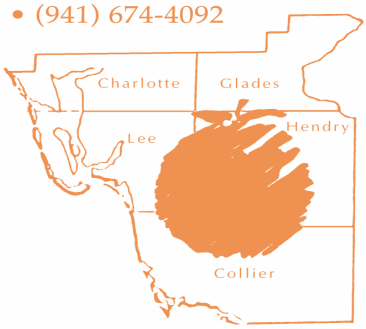
UNIVERSITY OF FLORIDA
EXTENSION
Institute of Food and Agricultural Sciences

Hendry County Extension • P.O. Box 68 • LaBelle, Florida 33975-0068 • (941) 674-4092

Flatwoods Citrus



Vol. 4, No. 9 September 2001 | **Dr. Mongi Zekri, Multi-County Citrus Agent**

UPCOMING EVENTS

Seminar in SW Florida: Phytophthora diseases including Brown Rot

Date: Tuesday, September 18, 2001, 10:00 AM – 12:00 Noon
Location: Immokalee IFAS Center
Speaker: Dr. Jim Graham, Lake Alfred Citrus Research & Education Center
Sponsor: Rachel Martin, Aventis CropScience, Cape Coral
2 CEUs for Pesticide License Renewal & 2 CEUs for Certified Crop Advisors
Following the seminar, we are planning a free lunch (Compliments of Aventis CropScience) for only who call Sheila at 863 674 4092 no later than Friday, 14 September 2001.

Florida Agricultural Conference & Trade Show (FACTS)

Date: October 1-3, 2001, **Location:** Lakeland Center, Lakeland.
See enclosed brochure

Hendry County Extension Ag Tour

Date: December 8, 2001. For more information, call Inez at 863 674 4092

Get to the New Home of the Florida Citrus Resources Site at http://www.fcprac.ifas.ufl.edu/
You can also get access to several newsletters electronically including Flatwoods Citrus. You can find all you need and all links to the University of Florida Citrus Extension and the Florida Citrus Industry.

FACTS 2001

The 2001 Florida Agricultural Conference & Trade Show (FACTS) will be held on October 2 & 3 at Lakeland Civic Center. FACTS brings benefits to growers, educators, and vendors with its educational program/trade show combination. In 1993, the Florida Irrigation society came together with citrus and vegetable interests to create FACTS. FACTS contributes in supporting the state's citrus and vegetable industry and allocates some money to in-service training programs for citrus and vegetable agents.

Enclosed you will find a brochure for FACTS 2001 including all the details on the meeting. This year, the citrus program will focus on citrus canker, grower involvement in research, adjusting to changing world markets, mechanical harvesting, nutrition, water, and other issues related to the Florida citrus industry. The program is approve d for CEUs for Certified Crop Advisers and pesticide license renewal.

Gulf Citrus Growers Scholarships

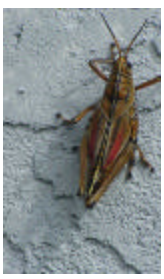
An important function of the Gulf Citrus Growers Association (GCGA) is support of degree seeking students in Citrus Production Technology or other citrus degree programs. The Association has presented one or more $1,000 scholarships annually at the Citrus Expo Banquet to deserving students. Selection of scholarship recipients is made by a scholarship committee, comprised of academic and industry members. *Deadlines for scholarship applications are February 1 and August 1.* To receive an application form, contact Dr. Mongi Zekri at the Hendry County Extension Office.

The Gulf Citrus Growers Association Scholarship Foundation

The citrus growers of southwest Florida have been committed to education as an investment in the long-term success of our industry. As part of this ongoing commitment, the association created Gulf Citrus Scholarships to assist college students pursuing citrus-related degrees. Since 1992, over $30,000 has been distributed through this program. The Gulf Citrus Growers Association Scholarship Foundation, Inc. was established in 1999 as a non-profit organization to oversee the distribution of these scholarships. Any member of the Gulf Citrus Growers Association (GCGA) is eligible to become a member of the Scholarship Foundation; all donations to the foundation are tax deductible.
Please contact GCGA at 863 675 2180.

Pesticide Applicator's License Training

*Please take note of the upcoming opportunities for **train the trainer** on Monday 24 September 2001 and for **obtaining a pesticide applicator's license** and/or earning CEUs for renewing a commercial/public pesticide applicator pesticide license for the Tree Crops, Row Crops, and Aquatic Categories on Tuesday and Wednesday, 25 & 26 September 2001. These programs will be held at the Hendry County Extension Office "Dallas B. Townsend Agricultural Center" in LaBelle. For more information, call 863 674 4092.*



Special Thanks to the following sponsors of the Faltwoods Citrus Newsletter for their generous contribution and support. If you would like to be among them, please contact me at 863 674 4092.

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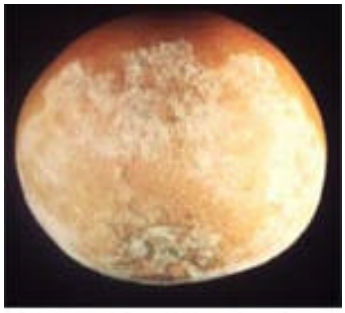
Brown Rot of Citrus Fruit

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.



Brown Rot of Grapefruit

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 in mid-late 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.

Special Thanks to these sponsors of the Flatwoods Citrus Newsletter for their generous contribution and support. If you would like to be among them, please contact me at Phone 863 674 4092, Fax: 863 674 4636, or maz@gnv.ifas.ufl.edu

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Fax: 941 657 5558

SAFE HANDLING AND USE OF PESTICIDES FOR COMMERCIAL CITRUS GROVE OPERATORS

*When handling pesticides or any other chemical, READ THE LABEL before buying, opening the container, applying, and disposal.
*RESTRICTED USE PESTICIDES must be applied by licensed applicators or by someone working under their direct supervision.
*To obtain a pesticide license, call your extension office.

Employee Training and Supervision

With the adoption of the Worker Protection Standard For Agricultural Pesticides (WPS) by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Agriculture and Consumer Services (FDACS), agricultural workers (farm workers) and pesticide handlers must receive pesticide safety training. The WPS requires the agricultural employer to provide several additional protections for agricultural workers and pesticide handlers. These protections include: information about pesticide applications made for the facility, emergency assistance from medical facilities in case of a pesticide-related illness or accident, and an accessible decontamination site that includes clean water, soap and single-use towels. The WPS applies to all pesticides used in the production of agricultural crops.

A Pesticide Handler is defined by the WPS as one who is employed by an agricultural establishment and is doing tasks such as mixing, loading, or applying pesticides, cleaning or repairing application equipment that contains pesticide residues. Pesticide handlers must receive training covering the following information:

-Format and meaning of information on pesticide labels.
-Hazards of pesticides resulting from toxicity and exposure, including acute, chronic, and delayed effects.
-Routes through which pesticides enter the body.
-Signs and symptoms of pesticide poisoning.
-Emergency first aid for injuries or poisoning.
-How to obtain emergency medical care.
-Routine and emergency decontamination procedures, including emergency eye flushing techniques.
-Need for and appropriate use of personal protective equipment (PPE).
-Prevention, recognition, and first aid treatment of heat-related illness.
-Safety requirements for handling, transporting, storing and disposing of pesticides, including general procedures for spill cleanup.
-Environmental concerns such as drift, runoff, and wildlife hazards.
-Warnings about taking home pesticides or pesticide containers.
-An explanation of WPS requirements that handler employees must follow for the protection of handlers and others.

Video programs covering these training requirements for agricultural workers and pesticide handlers are available in English and Spanish from IFAS Publications at the University of Florida or at county extension offices.

Direct Supervision

A Licensed Applicator may provide direct supervision to unlicensed individuals who are mixing, loading or applying pesticides. Only licensed applicators may apply pesticide products with label directions that require use only by a certified applicator.

Personal Protective Equipment (PPE)

Follow the label directions for use of personal protective equipment (PPE) during mixing, loading and application of pesticides and when repairing contaminated equipment.

Handling and Applying Pesticides

When using pesticides, read the label carefully and follow all directions exactly; pay special attention to warnings and precautions. Applying a pesticide in a manner not consistent with its labeling is a violation of the law. Avoid inhaling pesticide sprays, fogs, mists, or dusts. Never eat, smoke, or drink while handling pesticides. Avoid working alone when applying pesticides. Avoid entering pesticide drift or runoff areas. Do not apply pesticides when drift will be a problem to humans, pets, livestock, bees and other beneficial insects, wildlife, water, and other crops. Make sure all workers and other people are out of the area where pesticides are being applied. Only trained and equipped handlers should be in the area during the application.

Keep application equipment clean and in good shape.

Keep grove workers out of groves during restricted entry intervals.

Storage of Pesticides

Store pesticides in the original container with the label in sight and legible. If the label is destroyed or damaged, request replacement labels from the pesticide dealer immediately. Keep containers tightly closed. Inspect containers regularly for tears, splits, breaks, leaks, rust, or corrosion. If container is damaged, put on protective clothing and immediately take one of the following actions: Use contents completely on label-approved site, transfer to another container that held the same pesticide, or put into another container that can be tightly closed and put the label on the new container.

Do not store pesticides with food, animal feed, seeds, or farm animals. Do not store personal protective equipment (PPE) with pesticides. Store volatile pesticides separately from other types of pesticides. Keep containers away from windows, sunlight or any source of heat. Control the temperature to prevent freezing or overheating. Some pesticides are affected by temperature extremes. Check the label for storage temperatures.

Keep an up-to-date inventory of the pesticides you have in the storage area. Mark each container with the date of purchase and use older materials first. Organophosphate pesticides should be used within one year of purchase. All other classes should be used within two years. Do not store large quantities of pesticides for long periods of time. Purchase only as much as you will need for a season or year at most.

Transportation of Pesticides

Pesticides should always be transported in a vehicle or trailer designed for this purpose. Side walls and the rear gate should be at least as high as material transported. Never transport pesticides on the catwalk of a sprayer or water tank, the floor of an open "goat," or a flatbed truck with no sidewalls, or in the passenger compartment of a vehicle.

Disposal of Pesticides

Pesticides should never be purchased in excess of need. Any excess material that has been tank mixed should be applied to the crop per label instructions. Triple rinse or pressure rinse empty pesticide containers and add the rinsate to the spray tank. The best way to "dispose" of EXCESS PRODUCT is to find someone who can use it, if the product is still legal to use. Check with the supplier or manufacturer to determine if they will take it back. You may be able to dispose of small quantities of excess product during hazardous waste collection programs sponsored by local solid waste management agencies.

Overexposure

If a worker becomes ill due to overexposure to pesticides, take the individual to the emergency room of the nearest hospital. Do not let the individual go to the hospital alone. Take a label of the pesticide(s) with the individual.

Spills

If liquids spill in the storage room, cover the entire spill with absorbent materials such as vermiculite, fine sand, clay, sawdust, or absorbent pillows or pads. When cleaning up spills wear a protective apron, footwear, gloves, eye protection and a respirator. Keep adding absorbent material until the spilled liquid is soaked up and removed. Sweep up the absorbent material containing the pesticide and place it into a heavy-duty plastic drum or bag. Apply this material as a pesticide to a site for which the pesticide is approved as directed by the label. If this method is impractical, see disposal section for hazardous waste disposal.

CITRUS NUTRITION ON CALCAREOUS SOILS

Calcium carbonate ($CaCO_3$) can occur naturally in soils or can be added through irrigation with water from the aquifer. Calcareous soils are alkaline (have pH values greater than 7) because of the presence of $CaCO_3$. The pH of these soils range from 7.6 to 8.3 regardless of $CaCO_3$ concentration, unless a significant quantity of sodium (Na) is present. Special nutritional management is required to grow citrus successfully on calcareous soils. However, planting citrus trees on these soils may not be economically feasible. The presence of $CaCO_3$ affects the availability of almost all nutrients.

LIME ROCK

NITROGEN (N)

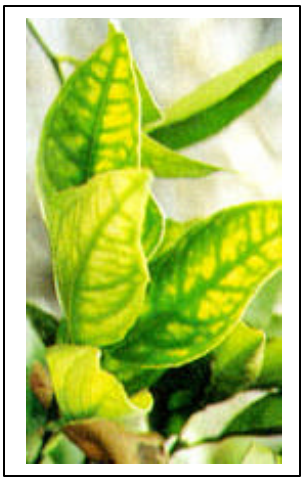
Nitrification, which is the conversion of ammonium (NH_4^+) to nitrate (NO_3^-) by soil bacteria, is most rapid in soils with pH values between 7 and 8. Ammonia volatilization is the loss of N to the atmosphere through conversion of the ammonium ion to ammonia gas (NH_3). Volatilization of ammoniacal-N fertilizer is significant when the soil surface pH is greater than 7. Nitrogen loss through ammonia volatilization on calcareous soils is a concern when ammoniacal N is applied on the soil surface and remains there without moving it into the soil. When applying dry fertilizer containing urea or ammoniacal N, the fertilizer should be moved into the root zone through irrigation or mechanical incorporation if rainfall is not imminent. Applying a portion of the required N fertilizer foliarly (urea, potassium nitrate, calcium nitrate) will improve the N status. Applying N with irrigation water (fertigation) and scheduling irrigation to maintain the N in the root zone is a sound method to prevent large N leaching losses.

PHOSPHORUS (P)

When P fertilizer is added to a calcareous soil, it undergoes a series of chemical reactions with Ca. These reactions decrease P solubility through a process called P fixation. Consequently, the long-term availability of P to plants is controlled by the application rate of soluble P and the dissolution of fixed P. Applied P is available to replenish the soil solution for only a relatively short time before it converts to less soluble forms of P. Phosphorus fertilizer should be applied each year in newly planted groves until the groves begin to bear fruit. As the trees approach maturity, P applications can be limited to once every few years. Diagnostic information from leaf and soil testing can help determine whether P fertilization is necessary.

MAGNESIUM (Mg) AND POTASSIUM (K)

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 about 25% to have a N:K_2O ratio of 1:1.25.



ZINC (Zn) AND MANGANESE (Mn)

At alkaline (high) pH values, Zn and Mn form precipitous compounds with low water solubility, decreasing significantly their availability to plants. On alkaline soils, soil applications of Zn and Mn fertilizers are ineffective. The least expensive way to correct effectively Zn and Mn deficiencies is through foliar sprays. Preliminary research data indicate little difference in magnitude of foliar uptake, regardless of the form of carrier or chelate applied.

IRON (Fe)

Iron is considerably less soluble than Zn or Mn in high pH soils. Thus, inorganic Fe contributes relatively little to the Fe nutrition of plants on calcareous soils. Citrus rootstocks vary widely in their ability to overcome Fe deficiency. The easiest way to avoid lime-induced Fe chlorosis in citrus trees to be planted on calcareous soils is to use tolerant rootstocks. Existing Fe chlorosis can be corrected through soil application of Fe chelates. Foliar application of iron compounds has not proven satisfactory on citrus trees because of poor translocation within the leaf. Furthermore, foliar sprays of Fe have the possibility to cause fruit and leaf burn.

Effective pH Range of Various Fe

Iron Chelates	Effective pH Range
Fe-EDTA	4 to 6.5
Fe-HEDTA	4 to 6.5
Fe-DTPA	4 to 7.5
Fe-EDDHA (Sequestrene 138 Fe)	4 to 9.0

SULFUR PRODUCTS USED AS SOIL AMENDMENTS

Soil acidulents can improve nutrient availability in calcareous soils by decreasing the soil pH. Soils with visible lime rock or shell in the root zone would require repeated applications of a high rate of acidulent. Examples of S-containing acidulents include elemental sulfur (S) and sulfuric acid (H_2SO_4). These compounds act to neutralize $CaCO_3$ with acid. Ammonium sulfate [$(NH_4)_2SO_4$] acidifies the soil by converting NH_4^+ to NO_3^- during nitrification. The sulfate ion (SO_4^{2-}) alone possesses no acidifying power.

VISIBLE SHELLS

Elemental S is the most effective soil acidulent. Although not an acidic material itself, finely ground elemental S is converted quickly to sulfuric acid in the soil through microbial action. Sulfuric acid reacts more quickly than any other material, but it is hazardous to work with and can damage plants if too much is applied at one time. Dilute concentrations of sulfuric acid can be applied safely with irrigation water and used to prevent Ca and Mg precipitates from forming in microirrigation lines. Repeated applications of sulfuric acid with irrigation water will tend to lower soil pH within the wetted pattern of the emitter.

The soil within the wetted pattern of a microirrigation emitter often becomes alkaline when the water contains bicarbonate, while the surrounding soil may be neutral or acidic. To lower the soil pH in this situation, acid or acidifying fertilizer must be applied to the wetted pattern only.

$CaCO_3$ Neutralizing Power of Several S Sources

Sulfur Source	Amount Needed to Neutralize 1,000 lbs $CaCO_3$
Elemental Sulfur	320 lbs
Concentrated sulfuric acid (66° Baume)	68 gallons
Ammonium sulfate 21-0-0-24S	900 lbs

SUMMARY

1. Calcareous soils are alkaline because they contain $CaCO_3$.

2. The availability of N, P, K, Mg, Mn, Zn, and Fe to fruit trees including citrus decreases when soil $CaCO_3$ concentration increases to more than 3% by weight. These soils generally have a pH value in the range of 7.6 to 8.3.

3. To avoid ammonia volatilization, fertilizers containing ammonium-N or urea should be moved into the root zone with rainfall or irrigation, or be incorporated into the soil.

4. Phosphorus fertilizer applied to calcareous soils becomes fixed over time. To maintain continuous P availability, P fertilizer should be applied on a regular basis.

5. Trees planted on calcareous soils require above normal levels of Mg or K fertilizer for satisfactory nutrition. Foliar sprays of magnesium and potassium nitrates are effective where soil applications are not.

6. The least expensive and most effective way to correct Zn and Mn deficiencies of fruit trees on calcareous soils is through foliar application of inorganic or organic chelated forms.

7. The easiest way to avoid lime-induced Fe chlorosis on calcareous soils is to plant trees budded on tolerant rootstocks.

8. The most effective remedy for lime-induced Fe chlorosis on nontolerant rootstocks involves the use of chelated Fe.

9. Sulfur products that act as soil acidulents can potentially improve nutrient availability in calcareous soils.

The use of advertisements and trade names in this newsletter is solely for the purpose of providing specific information and does not imply endorsement of the products named or discrimination against similar unnamed products.

Tentative Schedule for SW Florida seminars and workshops 2001-2002

Coordinator: Dr. Mongi Zekri

To sponsor lunches for seminars call 863 674 4092
or e-mail to maz@gnv.ifas.ufl.edu

Tuesday, September 18, 2001, 10:00 AM – 12:00 Noon
Phytophthora diseases including Brown Rot
Speaker: Dr. Jim Graham
Sponsor: Rachel Martin, Aventis CropScience, Cape Coral
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Weather seminars

- Tuesday, October 16, 2001, 10:00 AM – 12:00 Noon
  Weather 101 – What makes weather and why does it do what it does
- Tuesday, October 23, 2001, 10:00 AM – 12:00 Noon
  Tropical meteorology and severe weather (especially in Florida)
- Tuesday, October 30, 2001, 10:00 AM – 12:00 Noon
  Forecasting – The long range outlooks
- Tuesday, November 13, 2001, 10:00 AM – 12:00 Noon
  Short term forecasts – weather by the seat of your pants

Speaker: Jim Clarke, meteorologist, NBC-WBBH TV, SW Florida
8 CEUs for Certified Crop Advisors

Tuesday, November 20, 2001, 10:00 AM – 12:00 Noon
Scott's controlled release fertilizer, dry application of fertilizers and methods to reduce ammonia volatilization
Speakers: Drs. Tom Obreza and Bob Rouse
2 CEUs for Certified Crop Advisors

Tuesday, December 18, 2001, 10:00 AM – 12:00 Noon
BMPs-What has been done and what to expect?
Speakers: Stan Carter and others
2 CEUs for Certified Crop Advisors

Tuesday, January 15, 2002, 10:00 AM – 12:00 Noon
Thrips, citrus psyllid, and citrus greening
Speakers: Drs. Carl Childers and Pam Roberts
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Tuesday, February 6, 2002, 8:30 AM – 4:00 PM
Workshop on scouting for pests and diseases
Speakers: John Taylor and Drs. Pam Roberts and Mongi Zekri
6 CEUs for Pesticide License Renewal
6 CEUs for Certified Crop Advisors

Tuesday, February 19, 2002, 10:00 AM – 12:00 Noon
Water management and issues related to water regulations
Speakers: Marian Gosa and Drs. Larry Parsons and Sanjay Shukla
2 CEUs for Certified Crop Advisors

Tuesday, March 19, 2002, 10:00 AM – 12:00 Noon
Precision Ag and application technology
Speakers: Neal Horrom, Mike Roberts and others
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Tuesday, April 16, 2002, 10:00 AM – 12:00 Noon
Grove replanting and resetting strategies and Diaprepes and canker update
Speaker: Jack Neitzke and Drs. Fritz Roka and Clay McCoy
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Tuesday, May 21, 2002, 8:30 AM –12:00 Noon
Greasy spot and other fungal diseases
Speaker: Drs. Pete Timmer and Pam Roberts
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Saturday, June 2, 2002, 7:45 AM – 2:45 PM
Farm Safety Day
Coordinator: Dr. Mongi Zekri
2 to 3 CEUs for Pesticide License Renewal

Tuesday, June 18, 2002, 8:30 AM –12:00 Noon
Update on new citrus cultivars and rootstocks
Speakers: Drs. Bill Castle, Fred Gmitter, and Kim Bowman
2 CEUs for Certified Crop Advisors

Lunch sponsors are needed

To sponsor a lunch for a particular seminar, please call 863 674 4092
or e-mail to maz@gnv.ifas.ufl.edu

Drought and Flooding—Famine or Feast

By Dr. Larry Parsons, Lake Alfred CREC

When it comes to rainfall in Florida, it seems to be either a famine or a feast. The year 2000 was the driest year on record in central Florida. Average rainfall in 2000 in Polk County was about 33 inches (normal rainfall is around 51 inches) and Lake Alfred received only 27.9 inches. The spring of 2001 was also one of record drought and the rainfall deficit from January to May 2001 was 4 to 5 inches in central Florida. Fortunately, the rainy season started in June, but then we had high rainfall in a few days that led to localized flooding. The southern citrus belt received more of the rain. Immokalee got 16.7 inches in July, and 7.65 inches came in a 4-day period. Stuart on the east coast got 13.5 inches in one day! With heavy rainfall like that, flooding is inevitable.

There have been other periods of heavy rainfall. The summers of 1994 and 1995 were particularly wet. The notorious El Nino in the winter of 1997-98 also flooded homes and some groves. The present hurricane season could easily lead to flooding in some areas. Hence, flatwoods growers in particular need to provide adequate drainage because flooding rain events will come sooner or later.

Earlier research showed that flooding damage could potentially occur if water stood for four or more days over the crowns of citrus trees in the summer. Root injury can occur even if water stands a few inches below the soil surface. The lack of oxygen allows anaerobic bacteria to develop rapidly in flooded soils. Toxic sulfides produced by anaerobic sulfur-reducing bacteria can kill roots. Flooding damage can be determined by digging into the soil and smelling root and soil samples. Sour odors or a rotten egg smell (indicating hydrogen sulfide) indicates that feeder roots are dying. Vegetative material buried during bed formation in the flatwoods can provide the energy source for bacteria that reduce sulfates to sulfides. Only small amounts of sulfur (3 ppm) are needed for the bacteria to function well. Flood damage is usually less when the water is moving than when it is stagnant because anaerobic bacteria can't multiply if oxygen is present.

It is ironical that one of the symptoms of excess water is leaf wilting. This occurs because flooding and the lack of oxygen increases the root resistance to water uptake. Deficient aeration decreases water absorption. Nevertheless, transpiration, or the loss of water vapor from the leaves, continues. Hence, in hot summer weather, tree water loss can be greater than water uptake through the roots. Because of that, flooding injury occurs sooner in hot weather than in cool weather. Other symptoms of flooding injury include leaf yellowing, chlorosis, fruit drop, leaf drop, and twig dieback.

In the flatwoods, observation wells are excellent tools for determining the height of the water table. Observation wells can be made with PVC pipe and float indicators that can be easily seen when driving by the well site. Small data loggers and potentiometers are now available that can record hourly changes in the water table level. Components for these recording water tables cost less than $150, and several months of water table data can easily be collected with them and displayed on a computer. For assistance with water table observation well construction and monitoring, contact your local office of the National Resource Conservation Service (formerly SCS).

When roots have been flood damaged, irrigation management becomes more critical. Since the lower roots are usually killed, the goal is to regrow the shallow surviving root system. Light, frequent irrigations are needed until the root zone gets reestablished.

Phytophthora root rot can make flooding damage worse. Certain fungicides can help, but if *Phytophthora* was not a problem before the flooding, excess water will not necessarily create one. Do not make costly soil or foliar fungicidal applications unless soil propagule counts indicate that such treatments are needed. Soil and root conditions should be evaluated after the flooding has subsided and the potential for fungal invasion determined. The fungicides can help if there is a *Phytophthora* problem, but they cannot bring dead roots back to life!

In conclusion, flooding requires that tree management be intensified to minimize the effects of stress on water-damaged trees.