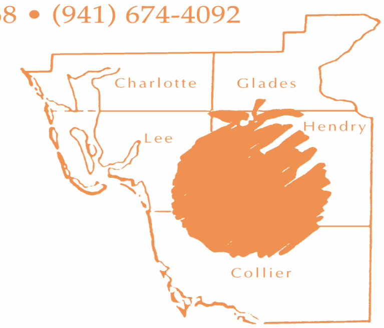
UNIVERSITY OF FLORIDA
EXTENSION
Institute of Food and Agricultural Sciences
Hendry County Extension • P.O. Box 68 • LaBelle, Florida 33975-0068 • (941) 674-4092

Flatwoods Citrus



Vol. 5, No. 4 April 2002

Dr. Mongi Zekri, Multi-County Citrus Agent

UPCOMING EVENTS

All seminars and workshops are held at the Immokalee IFAS Center.

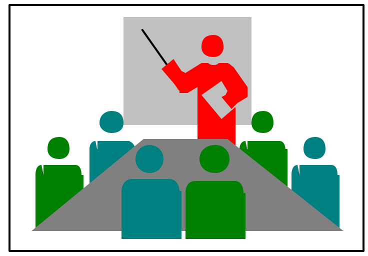
Tuesday, April 16, 2002, 10:00 AM – 12:00 Noon
Grove replanting and resetting strategies and Diaprepes and canker update
Speaker: Jack Neitzke, Ron Muraro and Drs. Fritz Roka & Robin Stuart
Sponsor: Shelby Hinrichs, Nufarm Agriculture USA, Inc.
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Following the seminar, we are planning a free lunch (Compliments of Nufarm Agriculture USA, Inc.) for only who call Sheila at 863 674 4092 no later than Friday, 12 April.

Wednesday, April 10, 2002 & Monday, April 22, 2002
Master Gardener Training in Lee County
Speaker: Dr. Mongi Zekri
Coordinator: Stephen Brown, Lee County Extension Office

If you want to print a color copy of the Flatwoods Citrus Newsletter, get to the Florida Citrus Resources Site at http://www.fcprac.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

Thursday, April 18 & 25, 2002
Master Gardener Training in Charlotte County
Speaker: Dr. Mongi Zekri
Coordinator: Ralph Mitchell, Lee County Extension Office



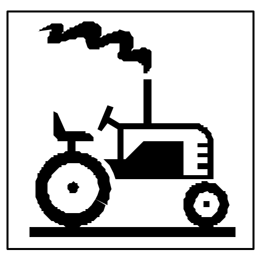
Tuesday, May 21, 2002, 8:30 AM –12:00 Noon
Greasy spot and other fungal diseases
Speaker: Drs. Pete Timmer and Pam Roberts
Sponsor: Larry McCauley, Griffin LLC
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors

Aquatic Weed Control Short Course

Earn up to 28 CEUs
May 19-24, 2002
Fort Lauderdale Research & Education Center
For more information, contact
Dr. Vernon Vandiver
Phone: 954 577 6316
Fax: 954 475 4125
E-mail: vvv@ufl.edu
www.conference.ifas.ufl.edu/aw

Florida Agricultural Conference & Trade Show (FACTS)

Date: May 22-23, 2002,
Location: Lakeland Center, Lakeland
For more information, call 407 678 5337



Saturday, June 1, 2002, 7:45 AM – 2:45 PM

Farm Safety Day

Coordinator: Dr. Mongi Zekri
2 CEUs for Pesticide License Renewal

Tuesday, June 18, 2002, 8:30 AM –12:00 Noon
Update on new citrus cultivars and rootstocks
Speakers: Drs. Jude Grosser, Fred Gmitter, and Kim Bowman
Sponsor: Les Stephens, Duda Citrus Nursery
2 CEUs for Certified Crop Advisors

Wednesday, August 21 & Thursday, August 22, 2002

Citrus Expo in Fort Myers

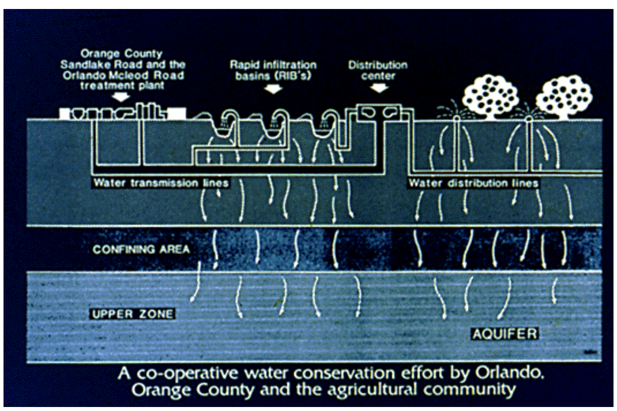
For more information, call Bob Rouse at 941 658 3400 or Mongi Zekri at 863 674 4092.

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 E-mail: maz@gnv.ifas.ufl.edu

WATER CONSERV II

As our demand for water increases due to the large influx of people in the state, the supply continues to decrease for several reasons including drought conditions and saltwater intrusion. Since there will not be enough water for agricultural irrigation by depending on groundwater alone, alternative sources of water have to be developed to ensue surging demand does not exceed supplies. Treating and expanding the use of municipal wastewater to conserve our water supplies can be an environmentally sound, a very viable alternative, a dependable and an abundant source of water.

Jointly owned by the City of Orlando and Orange County, Water Conserv II is the largest water reuse project of its kind in the world. It is also the first reuse project in Florida permitted by the Florida DEP to irrigate crops produced for human consumption with reclaimed water.



The average daily reclaimed water volume to the distribution center is 30-35 million gallons. Sixty percent of the volume is sent to commercial and agricultural customers, and the other 40 percent goes into the water table via the Rapid Infiltration Basins (RIBs). The RIB network contains seven sites with 74 RIBs over a total of 2 thousand acres. Each RIB has one to five cells for a total of 149. They have the capacity to handle about 22 million gallons daily. Both the distribution network and RIB site network are monitored and controlled from a central computerized control system.

Benefits of WATER CONSERV II

More than 15 years ago, as an incentive to sign on, growers were offered reclaimed water at no cost for 20 years at pressures suitable for microsprinkler irrigation. By providing agricultural customers with reclaimed water at pressures suitable for microsprinkler irrigation, costs for the installation, operation and maintenance of a pump system can be eliminated. For citrus growers, this means a savings of about $130/acre per year. Agricultural customers also benefit from enhanced freeze protection capabilities. The project is able to supply enough water to each customer to protect his crops. Citrus growers have also realized increased crop yields and tree growth. The increases are not only due to the reclaimed water itself, but also to the availability of water in the soil for the tree to absorb. Since the water is free, growers are maintaining higher soil water content levels.

Conserv II has eliminated discharge of wastewater effluent to surface waters and replenishes the Floridan aquifer through the discharge of reclaimed water to the RIBs. It also reduces the demand on the aquifer by eliminating the need for well water for irrigation.

Special Thanks to the following 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 E-mail: maz@gnv.ifas.ufl.edu

WASTEWATER

How wastewater affects us?

The water we use never really goes away. In fact, there will never be any more or any less water on Earth than there is right now, which means that all of the wastewater generated by our communities each day from homes, farms, businesses, and factories eventually returns to the environment to be used again. So, when wastewater receives inadequate treatment, the overall quality of the world's water supply suffers.

Are there any regulations for wastewater treatment?

Wastewater treatment is a relatively recent practice. Prior to the twentieth century, human and other wastes were just dumped or conveyed to the nearest body of water without treatment. As a result, groundwater and drinking water sources were regularly contaminated with sewage. In 1972, the U.S. Congress adopted the Clean Water Act to protect the waters of the nation. Through this act, the U.S. Environmental Protection Agency and corresponding state agencies were given the responsibility to regulate activities that threaten the quality of the nation's water resources. In the Federal Clean Water Act, Congress adopted a comprehensive water policy for the nation and set as a national goal the elimination of pollutant discharges to the navigable waters of the U.S. by 1985. To reach these goals, the U.S. Congress established a regulatory framework. Each state, through a designated regulatory agency, issues discharge permits and enforces the discharge limits. Today, community leaders are responsible for ensuring that state standards for wastewater treatment and water quality are met consistently to protect public health and the environment.

What is wastewater?

Wastewater is sewage, stormwater, and water that has been used for various purposes around the community. Wastewater is over 99% water with a very small portion of dissolved and suspended solid material. Untreated wastewater also contains pathogens, other microorganisms, nutrients, minerals, and metals. Unless properly treated, wastewater can harm public health and the environment. Most communities generate wastewater from both residential and nonresidential sources.

a. <u>Residential wastewater</u>

Although the word sewage usually brings toilets to mind, it is actually used to describe all types of wastewater generated from every house. However, there are two types of domestic sewage: blackwater or wastewater from toilets, and graywater, which is wastewater from all sources except toilets. Blackwater and graywater have different characteristics, but both contain pollutants and disease-causing agents that require treatment.

b. <u>Nonresidential wastewater</u>

Nonresidential wastewater in small communities is generated by such diverse sources as offices, businesses, department stores, restaurants, schools, hospitals, farms, manufacturers, and other commercial, industrial, and institutional entities. Stormwater is also a nonresidential source, which carries trash and other pollutants from streets, as well as pesticides and fertilizers from yards and fields.

What's in wastewater?

Wastewater is mostly water by weight. Other materials make up only a very small portion of wastewater, but can be present in large enough quantities to endanger public health and the environment. Because practically anything that can be flushed down a toilet, drain, or sewer can be found in wastewater, even household sewage can contain many potential pollutants.

a. Organisms and pathogens

Many different types of organisms live in wastewater and some are essential contributors to its treatment. Different kinds of bacteria, protozoa, and worms work to break down certain carbon-based (organic) pollutants in wastewater by consuming them. Through this process, organisms turn wastes into carbon dioxide, water, or new cell growth. Bacteria and other microorganisms are particularly plentiful in wastewater and accomplish most of the treatment. Most wastewater treatment systems are designed to rely in large part on biological processes. However, many disease-causing viruses, parasites, and bacteria are also present in wastewater.

b. Organic Matter

Organic materials in wastewater originate from plants, animals, or synthetic organic compounds. Many organics are proteins, carbohydrates, or fats and are biodegradable. However, even biodegradable materials can cause pollution and can be devastating to receiving waters. These organic materials can be dangerous to lakes, streams, and oceans because microorganisms use dissolved oxygen in the water to break down the wastes. This can reduce or deplete the supply of oxygen in the water needed by aquatic life, resulting in fish kills, odors, and overall degradation of water quality. The amount of oxygen that microorganisms need to break down wastes in wastewater is called biochemical oxygen demand (BOD) and is one of the measurements used to assess the overall wastewater strength. Furthermore, certain synthetic organics such as pesticides and herbicides can also be found in wastewater. They are disposed of improperly in drains or carried in stormwater and are toxic to humans, fish, and aquatic plants.

c. Nutrients

Wastewater often contains relatively large amounts of nitrogen and phosphorus in the form of nitrate and phosphate, which promote plant growth. Nitrogen can range from 10 to 40 ppm and phosphorus can range from 5 to 20 ppm in untreated sewage. Organisms only require small amounts of nutrients in biological treatment. Excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water. Again, deprived of oxygen, fish and other aquatic life die, emitting bad odors. Nutrients from wastewater have been linked to ocean "red tides" that poison fish and cause illness in humans.

d. Solids

Solid materials in wastewater consist of organic and/or inorganic materials and organisms. They must be significantly reduced by treatment or they can increase the BOD when discharged to receiving waters and provide places for microorganisms to escape disinfection. Certain substances, such as sand, grit, and heavy organic and inorganic materials settle out from the rest of the wastewater stream during the preliminary stages of treatment. On the bottom of settling tanks and ponds, organic material makes up a biologically active layer of sludge that aids in treatment. Suspended solids materials that resist settling may remain suspended in wastewater. Suspended solids in wastewater must be treated, or they will reduce the effectiveness of disinfection systems. Dissolved small particles of certain wastewater materials can dissolve like salt in water. Some dissolved materials are consumed by microorganisms in wastewater, but others, such as heavy metals, are difficult to remove by conventional treatment.

How to dispose of household hazardous wastes?

Many household products are potentially hazardous to people and the environment and never should be flushed down drains, toilets, or storm sewers. Some examples of hazardous household materials include motor oil, transmission fluid, antifreeze, paint, paint thinner, varnish, polish, wax, solvents, pesticides, rat poison, oven cleaner, and battery fluid. Many of these materials can be recycled or safely disposed of at community recycling centers.

Will reducing wastewater save money?

Reducing wastewater by conserving water is a good idea for a number of reasons. Not only does it lower monthly water bills, but it also can reduce the money that homeowners and communities spend for wastewater treatment. Water conservation also directly benefits homeowners with onsite systems. Simply by reducing water use, homeowners can extend the life of their systems for many years, prevent system failures, and minimize maintenance costs, potentially saving hundreds of dollars.

How is treatment achieved?

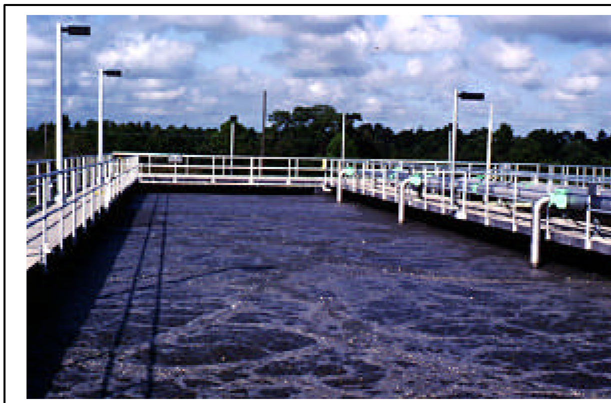
Sewage treatment is a multi-stage process to renovate wastewater before it reenters a body of water, is applied to the land, or is reused for other purposes. The goal is to reduce or remove organic matter, solids, nutrients, disease-causing organisms and other pollutants from wastewater to minimize the risks to public health and negative impact on the environment.

1. Preliminary Treatment

Preliminary treatment to screen out, grind up, or separate debris is the first step in wastewater treatment. Sticks, large food particles, sand, rocks, bottles, cans, toys, etc., are removed at this stage to protect the pumping and other equipment in the treatment plant. Treatment equipment such as bar screens, garbage disposal, and grit chambers are used as the wastewater first enters a treatment plant. The collected debris is usually disposed of in a landfill.

2. Primary Treatment

Primary treatment is the second step in treatment and separates suspended solids and greases from wastewater. Wastewater is held in a quiet tank for several hours allowing the particles to settle to the bottom and the greases to float to the top. The solids drawn off the bottom and skimmed off the top receive further treatment as sludge. The clarified wastewater flows on to the next stage of wastewater treatment. Clarifiers and septic tanks are usually used to provide primary treatment.



3. Secondary Treatment

Secondary treatment is a biological treatment process to remove dissolved organic matter from wastewater. Sewage microorganisms are cultivated and added to the wastewater. The microorganisms absorb organic matter from sewage as their food supply. Three approaches are used to accomplish secondary treatment: fixed film, suspended film, and lagoon systems.

a. Fixed Film Systems grow microorganisms on substrates such as rocks, sand or plastic. The wastewater is spread over the substrate, allowing the wastewater to flow past the film of microorganisms fixed to the substrate. As organic matter and nutrients are absorbed from the wastewater, the film of microorganisms grows and thickens. Trickling filters, rotating biological contactors, and sand filters are examples of fixed film systems.

b. Suspended Film Systems stir and suspend microorganisms in wastewater. As the microorganisms absorb organic matter and nutrients from the wastewater they grow in size and number. After the microorganisms have been suspended in the wastewater for several hours, they are settled out as sludge. Some of the sludge is pumped back into the incoming wastewater to provide "seed" microorganisms. The remainder is wasted and sent on to a sludge treatment process. Activated sludge, extended aeration, oxidation ditch, and sequential batch reactor systems are all examples of suspended film systems.

c. Lagoon Systems are shallow basins, which hold the wastewater for several months to allow for the natural degradation of sewage. These systems take advantage of natural aeration and microorganisms in the wastewater to renovate sewage.

4. Final Treatment

Final treatment focuses on removal of disease-causing organisms from wastewater. Treated wastewater can be disinfected by adding chlorine or by using ultraviolet light. High levels of chlorine may be harmful to aquatic life in receiving streams. Treatment systems often add a chlorine-neutralizing chemical to the treated wastewater before stream discharge.

5. Advanced Treatment

Advanced treatment is necessary in some treatment systems to remove nutrients from wastewater. Chemicals are sometimes added during the treatment process to help settle out or strip out phosphorus or nitrogen. Some examples of nutrient removal systems include coagulant addition for phosphorus removal and air stripping for ammonia removal.

How are sludges generated?

Sludges are generated through the sewage treatment process. Primary sludges, materials that settle out during primary treatment, often have a strong odor and require treatment prior to disposal. Secondary sludges are the extra microorganisms from the biological treatment processes. The goals of sludge treatment are to stabilize the sludge and reduce odors, remove some of the water and reduce volume, decompose some of the organic matter and reduce volume, kill disease-causing organisms and disinfect the sludge. Untreated sludges are about 97% water. Settling the sludge and decanting off the separated liquid removes some of the water and reduces the sludge volume. Settling can result in a sludge with about 92 to 95% water. More water can be removed from sludge by using sand drying beds, vacuum filters, filter presses, and centrifuges resulting in sludges with between 50 to 80% water. This dried sludge is called a sludge cake. Aerobic and anaerobic digestions are used to decompose organic matter to reduce volume. Digestion also stabilizes the sludge to reduce odors. Caustic chemicals can be added to the sludge or it may be heat treated to kill disease-causing organisms. Following treatment, liquid and cake sludges are usually spread on fields, returning organic matter and nutrients to the soil.

How to test and monitor wastewater?

Wastewater treatment processes require careful management to ensure the protection of the water body or the land that receives the discharge. Trained and certified treatment plant personnel measure and monitor the incoming sewage, the treatment process, and the final effluent. System operators, designers, and regulatory agencies use tests to evaluate the strength of the wastewater and the amount of treatment required, the quality of effluent at different stages of treatment, and the quality of receiving waters at the point of discharge. Tests also determine whether treatment is in compliance with state, local, and federal regulations. Operators and health officials often are trained to collect samples and perform some or all of the wastewater tests. An option that sometimes is more economical for small systems is to send samples away to a lab for testing. The BOD test is important for evaluating both how much treatment wastewater is likely to require and the potential impact that it can have on receiving waters. Estimating the amount of suspended solids in wastewater helps to complete an overall picture of how much secondary treatment is likely to be required. It also indicates wastewater clarity and is important for assessing the potential impact of wastewater on the environment. Coliform tests are useful for determining whether wastewater has been adequately treated and whether water quality is suitable for drinking, recreation or irrigation.

TREATED MUNICIPAL WASTEWATER FOR CITRUS IRRIGATION

Since water is no longer abundant and restrictions on the use of available groundwater for irrigation are becoming more severe and since disposal of sewage wastewater is also a problem of increasing importance, both the need to conserve water and to safely and economically dispose of wastewater make the use of treated wastewater in agriculture a very feasible option. Furthermore, wastewater reuse may reduce fertilizer rates and provide a low cost source of irrigation water. However, depending upon their sources and treatments, sewage wastewaters may contain high concentrations of salts, heavy metals, bacteria, and viruses.

Treated municipal wastewater has been successfully used for the irrigation of various crops. During the last two decades, several projects involving the reuse of municipal wastewater for citrus irrigation have been initiated and evaluated in Florida. The largest and longest established one is the Conserv II/Southwest Orange County Water Reclamation Project. This project, which started in 1986, currently provides over 30 million gallons per day of reclaimed water from the Orlando, Florida area to agricultural sites including 4,300 acres of citrus trees.

Because considerable interest and concern about the use of reclaimed wastewater on crops intended for human consumption exists, research has been conducted to evaluate the long-term effects of applying treated municipal wastewater on agricultural land with mature citrus trees.

RESEARCH RESULTS

Water Quality: Maximum average concentration limits and chemical analysis and mineral concentrations of Conserv II and well water are presented in Table 1. Maximum average concentration limits are levels set by different groups involved with the project based upon previous work on wastewater. Conserv II water has been a good quality water having very low total dissolved salts (TDS) and heavy metal concentrations. When compared to well water, Conserv II water is higher in all measured chemical parameters with the exception of pH, copper (Cu), and manganese (Mn). For Conserv II water, the mineral concentrations of all elements listed in Table 1 are lower than the maximum allowable concentrations. However, the sodium (Na) and chloride (Cl) concentrations are approaching their respective maximum allowable concentrations. In spite of this, twice these actual concentrations of Na and Cl are not considered harmful to citrus.

Water Nutrient Value: Nutrient values of Conserv II water have to be considered when Conserv II water is applied in relatively high amounts. Although Conserv II water is very low in mineral concentration, it can provide significant amounts of nutrients to the soil as compared to well water (Table 2). Based on soil water content measurements and rainfall, the amounts of irrigation water applied were approximately 35 inches and 20 inches per year for Conserv II and well water, respectively. Based on this approximation, irrigating with Conserv II water can make a difference in nutritional supply, which will be beneficial to citrus trees. Compared with well water, irrigation with Conserv II water can provide an extra 47 lb of nitrogen (N), 31 lb of phosphorus (P), 104 lb of potassium

(K) 183 lb of calcium (Ca), 39 lb of magnesium (Mg), 1 lb of boron (B), and about 0.4 lb of zinc (Zn) and iron (Fe) per acre per year (Table 2). However, not all these amounts were used by citrus trees. Nitrogen and K being soluble are susceptible to leaching losses, while some of the Zn and Fe could be fixed by the soil in insoluble forms.

Leaf Mineral Composition: Since the introduction of Conserv II water into the groves in 1987, consistent trends in foliar P, Mg, Fe, B, Na, and Cl were observed between the two groups. Foliar N, K, and Ca contents were not noticeably higher in Conserv II treatments than in well water treatments although significant amounts of these nutrients were supplied through Conserv II water because the groves in both groups were on a high N fertilizer program. For K and Ca, it could be due to greater growth and larger fruit crops on trees irrigated with Conserv II water relative to the control. The noticeable amount of P added through Conserv II water was significantly reflected in the leaf mineral composition. The amounts of B, Na, and Cl added through Conserv II water were also reflected in leaf mineral status. Although foliar B, Na, and Cl contents from trees irrigated with reclaimed water were twice as high as those from trees irrigated with well water, they were still below the toxicity levels for citrus. There was no consistent trend or significant difference in leaf Cu, Zn, and Mn between Conserv II trees and the controls.

Tree Evaluation and Weed Growth Rating: Tree evaluation included canopy appearance, leaf color, bloom, and fruit crop. Overall, the Conserv II blocks had trees with denser canopy, greener leaves, and heavier bloom and fruit crop than the control blocks. Weed growth was 4 times higher in Conserv II blocks than in well water blocks. These relatively higher ratings for tree evaluation and weed growth in Conserv II blocks could be attributed to higher irrigation and higher nutrients from Conserv II water as compared with well water. Higher weed growth and cover in Conserv II blocks could also be attributed to more herbicide leaching caused by heavier irrigation in Conserv II blocks.

CONCLUSIONS

The Conserv II/Southwest Orange County Water Reclamation Project has been a success. The Conserv II water has been of good quality because of its very low salt and heavy metal concentrations. The use of Conserv II water can supply all the needs of P, Mg, and B to citrus trees. Conserv II water can partially supply N and K. The higher Na, Cl, and B levels in Conserv II water as compared with well water are not a problem for citrus because they are maintained below toxicity levels. The increase in fruit weight (fruit size), weed growth, and fruit production, but the reduction in soluble solids in the juice of Conserv II treatment relative to that of well water, were not attributed to the quality of Conserv II water but to heavier irrigation of Conserv II blocks. No detrimental effects were found after fifteen years of continuous heavy applications of reclaimed Conserv II water to citrus trees in central Florida.

TABLE 1. Chemical Analysis of Conserv II and Well Water.

Characteristic	Max. average conc. limits	Well water *Mean + SD*	Conserv II water *Mean + SD*
pH	6.5-8.4	7.9 ± 0.3	7.1 ± 0.2
TDS (ppm)	704	135 ± 25	325 + 25
Element	ppm	ppm	ppm
Total nitrogen	30	7 ± 2	10 ± 3
Nitrate nitrogen	--	5 ± 2	8 ± 2
Phosphorus	10	0.09 ± 0.04	4 ± 2
Potassium	30	1.6 ± 0.6	14 ± 3
Calcium	200	33 ± 6	42 ± 4
Magnesium	25	7 ± 1	9 ± 1
Sodium	70	5 ± 2	62 ± 7
Chloride	100	11 ± 3	69 ± 7
Copper	0.20	0.03 ± 0.02	0.03 ± 0.02
Zinc	1.0	0.02 ± 0.02	0.06 ± 0.02
Manganese	0.20	0.01 ± 0.01	0.01 ± 0.01
Iron	5	0.02 ± 0.02	0.07 ± 0.03
Boron	1.0	0.02 ± 0.01	0.14 ± 0.03

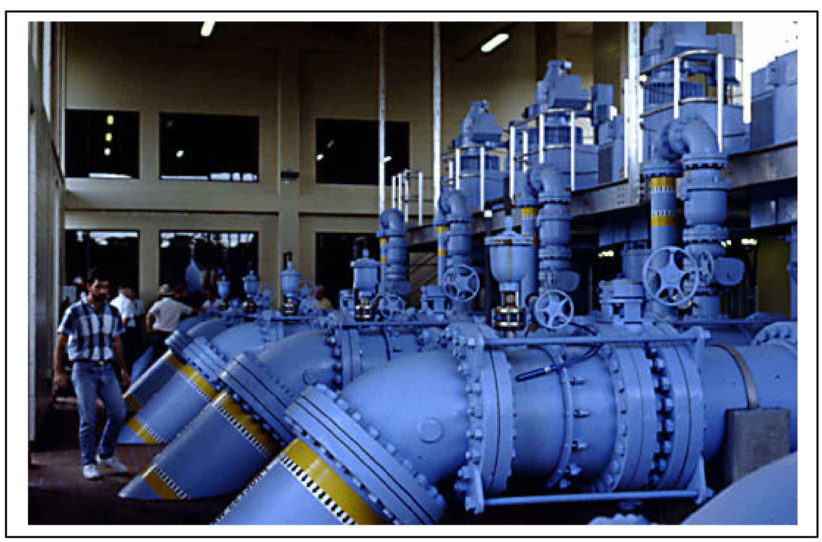
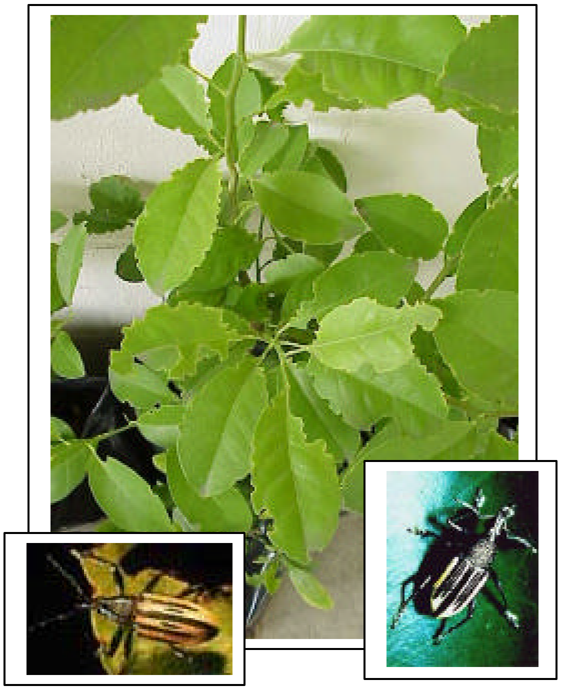


TABLE 2. Estimated Nutrient Values of Conserv II and Well Water Based on Mineral Content from Table 1 and on 35 inches of Irrigation Water Per Year for Conserv II and 20 inches for Well Water.

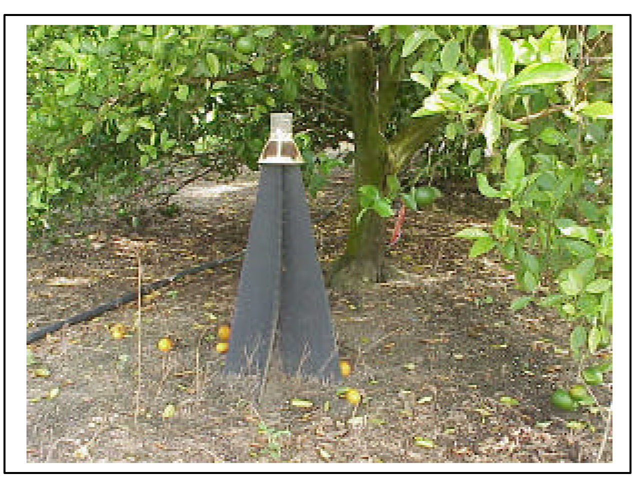
	Nutrient added (lb/acre)		Difference	
Element	Well water	Conserv II	(lb/acre)	(%)
Total nitrogen	32 ∀ 9	79 ∀ 24	47 ∀ 24	60
Nitrate nitrogen	23 ∀ 9	64 ∀ 16	41 ∀ 16	64
Phosphorus	0.4 ∀ 0.2	32∀ 16	31.6 ∀ 16	99
Potassium	7 ∀ 3	111 ∀ 24	104 ∀ 24	94
Calcium	150 ∀ 27	333 ∀ 32	183 ∀ 32	55
Magnesium	32 ∀ 5	71 ∀ 8	39 ∀ 8	55
Sodium	23 ∀ 9	492 ∀ 56	469 ∀ 56	95
Chloride	50 ∀ 14	547 ∀ 56	497 ∀ 56	91
Copper	0.14 ∀ 0.09	0.24 ∀ 0.16	0.10 ∀ 0.16	42
Zinc	0.09 ∀ 0.09	0.48 ∀ 0.16	0.39 ∀ 0.16	81
Manganese	0.05 ∀ 0.05	0.08 ∀ 0.08	0.03 ∀ 0.08	38
Iron	0.09 ∀ 0.09	0.56 ∀ 0.24	0.47 ∀ 0.24	84
Boron	0.09 ∀ 0.09	1.11 ∀ 0.24	1.02 ∀ 0.24	92

Diaprepes

Notching along the margins of the most recent leaf flush is the best way to determine the presence of root weevils.



It is best to look for a sign, such as the pest doing the damage. Weevils are found on the outer portion of the tree in the early morning or late evening hours. Adults generally hide within the tree canopy during the heat of the day. When the adults are disturbed or the tree is shaken, the weevils will fall to the ground faking death. Tedder's traps placed under the tree canopy have been used to capture adults and determine time and intensity of seasonal adult emergence from the soil.

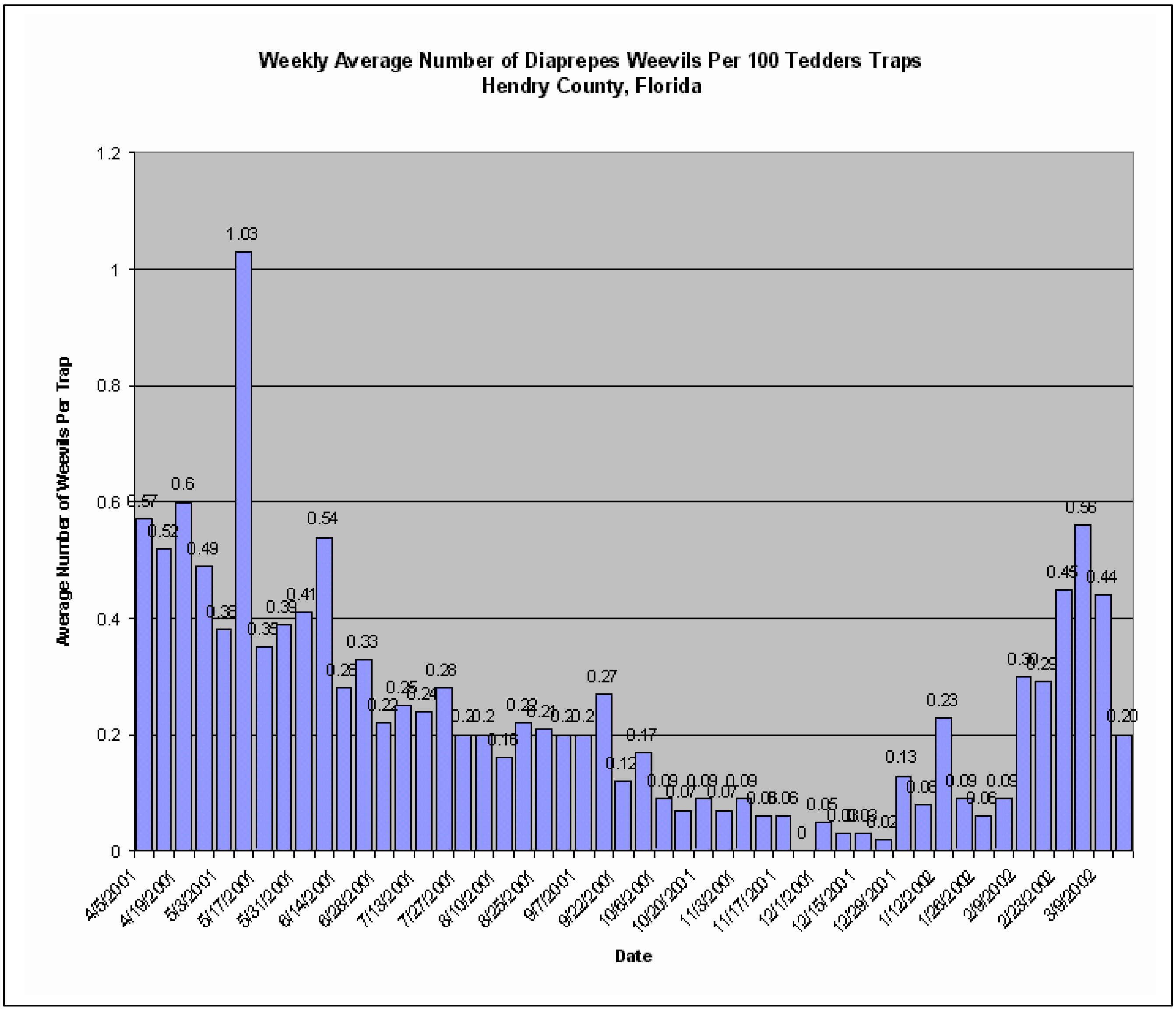


The larvae channel on the outer bark tissue into the cambium layer to the woody portion of the root and often girdle the taproot causing its death and impeding the ability of the tree to take up water and nutrients resulting in plant mortality. In addition, this type of injury provides an avenue for pathogen invasion such as *Phytophthora*. Although adults can emerge year round, their primary emergence period in SW Florida was found to be mid April to mid May. Larval entry into the soil begins about 20 days after adult emergence begins. Two applications of parasitic nematodes at 4 and 12 weeks after adult emergence begins may give satisfactory root protection. In SW Florida, nematode applications are generally recommended with first summer rains. Diaprepes long distance dispersal is through the movement of contaminated soil and nursery plants and trees containing potentially all life stages of the weevil. In addition, soil residues on vehicles and grove equipment may be contaminated with larvae and can move this pest from one grove to another. The use of horticultural oils to separate leaves that have been stuck together to protect eggs may reduce Diaprepes population. When leaves are separated, eggs desiccate or are more subject to parasitism. Oils also prevent females from gluing eggs to leaves. Just after peak trap captures, foliar spays of Guthion, Micromite, or Sevin with one gallon of petroleum oil, or other registered pesticides can effectively control adults. Capture 2EC is also available under Section 18 and can be applied as a soil barrier treatment to control young (neonate) larvae. It should be kept in mind that frequent use of insecticides against adults could affect non-target organisms including biological controls. For more detailed information on this pest and other citrus pests, **GET YOUR COPY OF THE 2002 FLORIDA CITRUS PEST MANAGEMENT GUIDE.**

DIAPREPES ROOT WEEVIL EMERGENCE

The University of Florida and six grower/cooperators are conducting a year-long survey to determine the weekly emergence patterns for Diaprepes root weevils. At each location, 100 Tedder's traps are surveyed weekly to determine the number of weevils collected in the traps. From this data, graphs are being developed to provide growers with average number of weevils per traps as well as total weevils collected during the weekly intervals. From the collected data, growers can get a feel for the emergence patterns over time which have occurred at each of the six locations. With knowledge of emergence patterns, growers can then determine when the best time to apply sprays to reduce Diaprepes injuries. The locations for the surveyed groves are in the following six counties: Lake, Polk, DeSoto, Hendry, Indian River, Dade, and Osceola.

In an effort to provide the growers with the data in a timely manner, the information is posted to a web site maintained at the Citrus Research & Education Center in Lake Alfred at:**<u>www.lal.ufl.edu</u>** Once at the web site, click on the "Extension" Section and then click on "Diaprepes". At this site you can choose the county location which is closest to your grove to estimate the emergence pattern that represents your area. At this web site you can also find other information related to Diaprepes root weevils and its control.



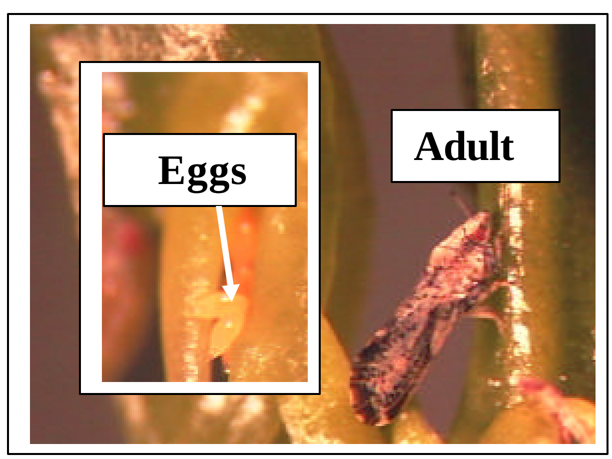
THE CITRUS PSYLLID

The citrus psyllid is a serious pest of citrus. *D. citri* attacks young tender growth (flush), causing leaf distortion and curling. *D. citri* also produce honeydew, which leads to sooty mold infestations, and badly-damaged leaves will die and fall off. Feeding by citrus psylla *(D. citri)* on the young flush of citrus trees causes damage to leaves and shoots because the psyllid has a toxic saliva.

D. citri breeds exclusively on young flush and has a very high reproductive rate. Multiple, overlapping generations can lead to very high populations. Eggs of *D. citri* are laid in late winter and spring on very young leaves in the buds or in leaf axils. The egg stalk is forced into the leaf tissue by the ovipositor of the female. Each female may lay up to 800 eggs during her two-month lifespan. The life cycle takes about 20 days and there may be up to 30 overlapping generations per year. Adults of *D. citri* are about the size of aphids (1/10 inch).

D. citri is an efficient vector of greening disease, which is considered the most serious citrus disease in Asia. If this psyllid species arrived in Florida carrying greening disease, the impact on our industry would be very serious.

Generalist predators such as lacewings, syrphid flies, lady beetles, and spiders attack psyllids. These native natural enemies are not expected to suppress the pest populations to a non-economic level. Two parasitoids, *Diaphorencyrtus aligarhensis* and *Tamarixia radiata* of the pest have been imported in Florida and are being released in a classical biological control program. Even during the winter time, the citrus spyllid can survive, reproduce and cause noticeable damage to the spring flush in SW Florida. Many backyard and commercial citrus trees, particularly young trees and resets have been severely damaged by the citrus psyllid. It is recommended for homeowners and growers to use pesticides that can help suppress psyllids, but not disrupt natural enemies of citrus pests. The use of oil is less disruptive and should be used. Based on feedback from citrus growers and production managers, spray oil (at 3-5% concentrations) has been working effectively in suppressing psyllid populations. It is well known that oil has a number of advantages over conventional pesticides because oil is less disruptive to natural enemies, insects do not develop resistance to oil, oil has a low toxicity to vertebrates, and oil breaks down readily in the environment.



PROBLEMS WITH TREES ON SWINGLE

Taken from "Update on Use of Swingle Citrumelo Rootstock" by Drs. Bill Castle and Ed Stover

Swingle's tolerance to blight, Tristeza, citrus nematodes, and Phytophthora foot and root rot, coupled with its reputation for cold-tolerance, made it very popular following the freezes of the 1980s. By 1990, more than 50% of the citrus trees being propagated in Florida were on this rootstock and that is unchanged.

Soil Problems Related to Calcareous Materials

Trees on Swingle are generally not suited to calcareous soils, and are even less suited to such soils than trees on most citrange rootstocks. In a Gulf Coast study, the size of young grapefruit trees on Swingle declined 60% as the total soil $CaCO_3$ increased from none to only 2%, and yields declined sharply with increased soil calcium even when $CaCO_3$ concentrations were below 0.25% (Obreza, 1995 Proceedings of the Fla. State Hort. Society).

Possible Soil Problems Unrelated to Calcareous Materials

Frequently, trees on Swingle citrumelo and Carrizo citrange decline at about 5 to 8 years of age when grown in certain soils. The reasons for this decline are not clear, but a preliminary survey suggests that problem soils are generally those in the Winder and Riviera series. Soils in both series occur in the coastal regions of Florida usually in slough landscape positions, but they also are found in depressional areas. These soils are partly characterized by an argillic (clay) horizon that begins about 20 inches below the soil surface and extends to 40 inches. In depressional areas, the thickness of the sand layers above the clay can be as little as 10 inches.

Blight, Stunting, and Decline Problems

Swingle is basically a blight-tolerant rootstock. Some loss does occur although the cumulative loss is often less than 10% after15 to 20 years. In a very few instances, higher rates of loss have been observed and confirmed with the blight protein test. There are other declines and changes in tree growth that appear to be peculiar to trees on Swingle and may or may not be blight-related; also, these declines are apparently unrelated to soil factors or pathogens (Steve Garnsey, 1998 F.A.C.T.S. Proceedings). For example, there are a few groves on the Ridge and in the Gulf area in which low numbers of trees on Swingle display stunted growth, which was evident before trees were 5 years old. In other instances, the trees are typically Valencia on Swingle, and a high proportion of trees display blight-like symptoms without evidence of stunting. Neither situation is associated with a disturbance at the bud union or other obvious incompatibility symptoms. Tree response is superficially similar to that observed from blight, but the decline characteristics are also not entirely consistent with this disorder. It may be that these trees are budded on off-type seedlings, or on a citrumelo other than Swingle. Previous research showed that trees on Swingle off-type seedlings were stunted. Growers should report new observations of blight-like symptoms in Swingle, so that better recommendations can be developed.

Are There Problems with Valencia on Swingle Citrumelo?

There is increasing concern about low yield among Valencia trees on Swingle. It should first be recognized that Valencia grows more slowly, produces a smaller tree, and is less productive than other round orange cultivars. These Valencia characteristics are even more apparent when the rootstock is Swingle, but the combination of Valencia on Swingle is basically a good choice. Nevertheless, the somewhat slower development of Valencia on Swingle may be interpreted as poor performance in some groves even though differences in growth and yield between trees on Swingle and other rootstocks like Carrizo often do not become apparent, especially in the Flatwoods, until after several years in the grove.

Soil Physical and Chemical Traits

In addition to problems with Swingle on calcareous soils, there is evidence that Swingle often produces very small trees when planted in "sand ponds," which are areas with low-organic matter content, and other impoverished soils with low CEC and water-holding capacity. The inherently less vigorous trees produced on Swingle make this rootstock inappropriate for most poor soils, and more vigorous rootstocks should be considered.

Alternative Rootstocks for Trees on Swingle in the Flatwoods

The primary problem in any grove on relatively poor sites is generally tree vigor. Therefore, in poor sites not troubled with tree decline, select rootstocks that give more vigorous trees than those on Swingle and also provide good yields. Some appropriate choices among established rootstocks are Volkamer lemon and Carrizo citrange, but they have known limitations. Several new rootstocks with consistent Valencia performance in several field trials are Benton citrange, C-32 citrange, and 1584 (trifoliate orange x Milam). In Winder and Riviera soils in depressions, and other places where trees decline on Swingle, consider Kinkoji or Smooth Flat Seville.