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. 6, No. 2 February 2003

Dr. Mongi Zekri, Multi-County Citrus Agent

UPCOMING EVENTS

Seminars at the Hendry County Extension Office, LaBelle

Tuesday, February 4, 2003, 10:00 AM – 12:00 Noon
Strategies for efficient application of pesticides
Speaker: Dr. Masoud Salyani
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: Michael Harowitz, FarmSaver.com
Following the seminar, we are planning a free lunch (Compliments of FarmSaver.com) for only who call 863 674 4092 no later than Monday, 3 February.

Tuesday, February 18, 2003, 10:00 AM – 12:00 Noon
Update on herbicide program options
Speakers: Dwight Meeker, Mike Prescott and Dr. Steve Futch
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: Donna Muir-Strickland, Monsanto
Following the seminar, we are planning a free lunch (Compliments of Monsanto) for only who call 863 674 4092 no later than Monday, 17 February.

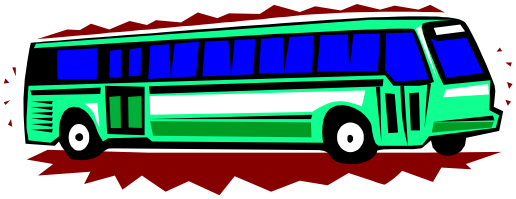
If you want to print a color copy of the Flatwoods Citrus Newsletter, get to the Florida Citrus Resources Site at http://www.fcprac.ifas.ufl.edu/
You can also find all you need and all links to the University of Florida Citrus Extension and the Florida Citrus Industry

Tuesday, March 18, 2003, 10:00 AM – 12:00 Noon
Irrigation scheduling, maintenance, plugging problems and solutions
Speakers: Drs. Larry Parsons, Brian Boman, Tom Obreza and Sanjay Shukla
1 CEU for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: John Coley, Citrus Maintenance & Service, Inc.

Tuesday, April 15, 2003, 10:00 AM – 12:00 Noon
Citrus leafminer and citrus psyllid management for resets and non-bearing trees
Speaker: Dr. Phil Stansly
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: Jay Hallaron, Uniroyal Chemical/Crompton Corporation

Tuesday, May 20, 2003, 10:00 AM –12:00 Noon
Greasy spot and possible contaminants from pesticides and fertilizers
Speaker: Cathleen Osgood and Drs. Tom Obreza, Pete Timmer and Pam Roberts
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: Bobbitt Jenkins, BASF Corporation

COLLIER COUNTY EXTENSION AG TOURS



Dates: Wednesday 19 March and Friday 21 March 2003
For more information, call the Collier County Extension Office at 239 353 4244.

Indian River Citrus Seminar at Ft. Pierce

(See details in enclosed brochure)

Florida Agricultural Conference & Trade Show (FACTS)

Date: April 29-30, 2003, Location: Lakeland Center, Lakeland

FARM SAFETY DAY
Saturday, June 7, 2003
Immokalee IFAS Center

Citrus Expo in Fort Myers

Wednesday, August 27 & Thursday, August 28, 2003

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 863 674 4092.

RESULTS OF THE DIAPREPES SURVEY CONDUCTED IN NOVEMBER 2002

1. Do you have Diaprepes in any of your groves? Yes **36%** No **42%** Do not know **11%** N/A **11%**
2. Do you believe we have all the needed options to effectively combat Diaprepes?
   Yes **18%** No **64%** Do not know **18%**

3. Which areas or information in combating Diaprepes is deficient, lacking or not provided adequately?

15% Cultural control
17% Survey and monitoring
12% Sanitation
23% Biopesticides or Biological control
25% New Management Techniques
8% Others (Please list them)

4. Is the available information to combat Diaprepes current, efficient, and useful?
   Yes **33%** No **29%** Do not know **38%**

5. Are the current strategies

Economical?	Yes **13%**	No **51%**	Do not know **36%**
Not difficult to implement?	Yes **13%**	No **51%**	Do not know **36%**
Effective?	Yes **11%**	No **33%**	Do not know **56%**

6. Are you aware of the Diaprepes website at **http://www.lal.ufl.edu/diaprepes/diaprepesemergence.htm** Yes **56%** No **44%**

7. Are you aware of the information on many citrus topics including Pest Control, which includes information on Diaprepes at **http://flcitrus.ifas.ufl.edu/citrustopicsframes.htm**
   Yes **62%** No **38%**

8. Have you been kept up to date with the Diaprepes situation through IFAS Extension ?
   Yes **84%** No **5%** N/A **11%**

9. What needs to be done in Research and Extension to minimize the impact of Diaprepes on citrus production? **More research; Develop satisfactory eradication; Address Diaprepes as you would canker; Look at ideas of physical barriers such as development of ground cloth materials to serve as barriers for weevil larvae, refer to Dr. Childers idea; Basic, simple ways to eliminate this pest is needed by all growers; More work on biological control; Biocontrol; Need more information and research on controlling Diaprepes in heavy soils; Find new and better products to control this menace; Keep working on monitoring and control; Tolerant rootstocks; Political action to restore chlorinated hydrocarbons.**

10. What educational materials or programs need to be developed30% Fact sheets?
    15% Yearly reports **25%** Seminars **28%** Workshops **2%** Others

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Susan S. Thayer

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Wayne Simmons

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1600 Hwy 29 South
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Fax: 863 675 6963

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PESTICIDE SPRAY COVERAGE FOR CITRUS

Obtaining the proper distribution of a spray or coverage is essential for efficient management of citrus pests. Sprayer air deflectors, nozzle orientation and number of nozzles should be adjusted to match the size and shape of the canopy in order to minimize spray wastage. Recommended coverage varies from pest to pest. For example, an outside coverage spray is sufficient for aphids, citrus leafminers, and citrus psyllid that are found mostly on the periphery of the tree, whereas rust mites, greasy spot, and relatively immobile pests such as scales will need a more thorough coverage. Obtaining the proper coverage can be difficult because of the dense canopy of citrus trees and involves a balance of varying droplet size, amount of spray, and ground speed.

Aircraft applications typically use 20 to 5 gallons of water per acre. Low volume ground applications generally use 100 to 20 gallons of water per acre. To be effective and avoid phytotoxicity with oils and other chemicals, low-volume applications must be delivered in small droplets. Small droplet size can be obtained by providing high air velocities at the discharge outlet or by utilizing high spray pressure. Low-volume applications use between 75 and 100% of the amount of pesticide that would be applied per acre as a dilute spray. In order to achieve proper coverage, apply low-volume treatments only when it is relatively calm. It is not recommended to apply low-volume applications if wind speeds exceed 5 mph. In addition, extra precautions must be taken to protect handlers and applicators because of the high concentrations of chemicals used in low-volume applications.

Outside coverage applications use 50 to 150 gallons of water per acre to achieve thorough distribution of the spray to the outside or peripheral parts of the tree only. Larger trees and/or high-density plantings require the higher gallonage per acre. Relatively small trees can be sprayed with the same concentration of agrichemical, but using few nozzles. This should provide spray deposition approximately comparable to that of mature trees, with lower spray volume and active ingredient per acre. Because the spray distribution requirements are less stringent with outside coverage, ground speeds may increase up to 3 mph and the amount of spray/acre decreases, thus reducing the cost per acre.

<u>Tips to Help Minimize Pesticide Spray Drift</u>

Pesticide spray drift is the movement of pesticides away from the target area. Whether you do your own spraying or you contract somebody to do it for you, it is important to pay close attention to drift and to understand the serious problems it can cause. Pesticide spray drift is expensive, dangerous and illegal. It can result in increased insurance premiums, wasted product, increased production costs, claims, costly legal fees, and fines from government inspectors. The single most important step a grower can take to avoid pesticide drift is to make sure all ground and aerial applicators are skilled, careful, and fully trained.

Environmental conditions contributing to drift

Environmental conditions are one of the factors contributing to pesticide spray drift. Wind speed and direction, relative humidity, temperature and atmospheric stability affect drift. High wind speeds can carry pesticide particles out of the target area. High temperature and low relative humidity decrease particle size and increase drift potential. Spraying when it is too windy or when the wind is blowing toward a sensitive off-target area can cause serious problems. This is where having a skilled, well-trained applicator and monitoring conditions come into play. Be sure to check the wind speed and direction to ensure they are within the recommendations on the pesticide label. It is important that wind direction always be checked, even at very low wind speeds. A buffer should always be left between the spray application and sensitive off-target areas to allow for some drift downwind into the buffer.

Importance of the right droplet size

In the past, trees were drenched with high volumes and coarse droplets at 250–500 gallons per acre, resulting in trees dripping with excess pesticide. The belief that too much is better than too little is wrong. Dripping trees lead to environmental pollution such as soil contamination, and an excessive number of tank loads per acre results in poor time management and extra expense. Lower volumes must be used, which may result in smaller droplets, although there is a limit to droplet size because of concerns about drift. Droplets need to be small enough to cover the area, but not too small that the drift potential increases. When given a choice, always choose larger drops within the range that will give complete control as specified on the pesticide label. Droplets that are too small can be avoided by choosing appropriate nozzle types and/or orifice (opening) size, by adding recommended adjuvants to increase viscosity, by running sprayers at the lowest recommended pressure, and by avoiding high temperature conditions that can cause droplets to evaporate in mid-air, thus becoming smaller and prone to drift.

Importance of proper sprayer design and height

It is important that the height of sprayers is adjusted properly. The greater the distance between spray nozzles and target foliage, the greater the opportunity for air movement to carry droplets away. Wind speeds are higher with increasing height above the ground, so any increase in height causes an even greater increase in drift distance. In some cases, the pesticide label may give recommended heights. Otherwise, spray as close as possible to reduce drift but far enough away to still get proper coverage. Sprayers can be fitted with ultrasonic or laser canopy sensors. The sensors also detect the shape of a tree and adjust the spray pattern accordingly. The advantages include reduced drift, ground deposition, and reduced pesticide use. Herbicide drift from weed control practices should not be ignored. Shielded herbicide sprayers should be used to prevent drift from damaging citrus trees.

Importance of sprayer calibration and timing

Applying the correct product to the correct target at the correct time with the correct equipment is the key to good spraying. Correct calibration will ensure that all the nozzles are discharging the correct amount of liquid at the correct distance and angle to the target and at the correct forward speed. Operators must set the air deflectors correctly to confine airflow, spray and disturbance to the tree canopy. Choose the correct size sprayer with good backup support to ensure that spraying is done in a timely manner. Far too often, growers are racing around the clock in an attempt to apply pesticides. Planning in advance is the key to good management. Continuing development of spray application techniques will improve the efficiency of spraying. Investment in modern technology must be maintained if the grower is to remain competitive.

Importance of written records

Be sure to keep accurate, written records to remember exactly what was done the last time you or your applicator sprayed. Some items that are useful to include may or may not be required by law: the date (of the pesticide spray), accurate start and end times, weather conditions (temperature, humidity, wind speed and direction), materials and amounts applied (including adjuvants), and target pests. Also, be sure to keep maintenance records (including the dates of calibration, and nozzle and tip replacement) on all sprays.

MANAGEMENT STRATEGIES TO REDUCE DRIFT

1. Train the operator to use the sprayer correctly in your grove under your conditions.
2. Don't dismiss the importance of well-trained, skilled pesticide applicators.
3. Plan in advance the spraying operation.
4. Read and follow the pesticide label thoroughly.
5. Select the correct nozzle for the target. Adjust the position of the nozzles to achieve proper coverage.
6. Check that air deflectors are set properly to confine disturbance to the target.
7. Calibrate the sprayer with water to ensure that everything is working correctly.
8. Consider spray additives to reduce drift.
9. Only spray when weather conditions are ideal; avoid spraying on days when conditions are favorable for atmospheric inversion or wind drift and keep monitoring environmental conditions.
10. Ensure the spray is not drifting on non-target areas and watch for changes in wind speed and direction.
11. Run sprayers at the lowest recommended pressure and ensure an accurate gauge is used.
12. Maintain a constant speed and pressure.
13. Keep accurate written records.

GUIDELINES FOR FERTILIZER PROGRAMS

Fertilizer management should include calibration and adjustment of fertilizer spreaders, booms, pumps, or irrigation systems to accurately deliver fertilizer rates and place fertilizers within the tree rootzone. To improve fertilizer efficiency, soil and leaf analysis data should be studied, evaluated, and taken into consideration when generating a fertilizer program and selecting a fertilizer formulation. Fertilizer application should be split into 3 to 4 applications per year with a complete balanced fertilizer. For mature trees, the highest nutrient requirement extends from late winter through early summer. This coincides with flowering, heavy spring flush, fruit set, and fruit development and expansion. For best fresh fruit quality, nutritional requirements, particularly nitrogen (N), should decrease late in the summer and fall. Based on tree demands, 2/3 to 3/4 of the yearly fertilizer amount should be applied between February and June. In warm areas such as southwest Florida where tree growth can continue certain years during the winter, fertilizer applications should also be made in the fall to satisfy vegetative growth demand. However, fall fertilizer applications may sometimes delay fruit color development.

IFAS fertilizer guidelines for nonbearing citrus trees

Year in grove	Lb N/tree/year (range)	Lbs Fertilizer/tree/year (range)		Lower limit of application frequency	
		6-6-6	8-8-8	Dry	Fertigation
1	0.15 – 0.30	2.5-5.0	1.9-3.8	6	10
2	0.30 – 0.60	5.0-10.0	3.8-7.5	5	10
3	0.45 – 0.90	7.5-15.0	5.6-11.3	4	10

IFAS fertilizer guidelines for bearing citrus trees (4 years and older)

Oranges	Grapefruit	Other varieties	Lower limit of application frequency	
Lbs N/acre/year (range)			Dry	Fertigation
120 - 200	120 - 160	120 - 200	3	10

◄Nitrogen and potassium rates up to 240 lbs/acre may be considered for orange groves producing over 700 boxes/acre and up to 180 lbs/acre for grapefruit groves producing over 800 boxes/acre.

◄Young trees planted on previously uncropped soils should receive fertilizer containing the following ratio of elements: nitrogen-1, phosphorus-1, potassium-1, magnesium-1/5, manganese-1/20, copper-1/40, and boron-1/300.

◄On previously cropped soils, the proportion of phosphorus (P) in the blend should be reduced or even omitted if the leaf and soil-test results indicate high levels. However, a declining trend in extractable soil P accompanied with leaf P concentration below the optimum range justifies a P fertilizer application.

◄For mature citrus trees on non-calcareous soils, nitrogen and potassium fertilizer applications with a 1:1 ratio of N to K_2O are recommended. However, if leaf and soil testing reveals high levels of Ca might be limiting K uptake, the K_2O rate should be increased by 25% to have an N:K_2O ratio of 1:1.25.

◄Visual symptomology, soil and plant analysis, field experience, production history and economics should all be considered to generate an efficient fertilizer management program.

Nutritional balance: Nutrient supply is closely and directly correlated with yield increases and total production. Both correct amounts and correct ratio of applied nutrients are critical to nutrient management and sustainability. Imbalance allows mining of the most deficient nutrients in the soil. If an element is below the critical level, yield production will fall even though the other elements are kept in good supply.

Nutrient balance is often confined to N, P, and K because of their need in relatively large amounts by crops. Indeed, they are most often the limiting factors in crop production. However, nutrient balance goes beyond N, P, and K and will not be achieved without adequate supply of the other nutrients. A balance of adequate levels of nutrients is a key component to profitability. Plant nutrients interact positively when properly balanced. For example, in the case of N fertilization, a shortage of another nutrient could have unused N in the soil, reduce N use efficiency and returns on investment, and increase the potential for nitrate leaching.

Balanced nutrition should be a high priority management objective for every grower. Plants require a balanced nutrition program formulated to provide specific needs for maintenance and for expected production performance. Properly nourished trees grow stronger, produce more consistently, have better disease resistance, and are more tolerant to stresses. Fertilizer represents a relatively small percentage of the total cost of crop production, but it has a large effect on potential profitability. Again, plant and soil analysis, visual symptomology, experimental research, field experience, production history, and economics should all be integrated together to formulate efficient fertilizer programs, and nutrient balance is the key to success.

Magnesium (Mg):

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.

Magnesium is a part of the chlorophyll molecule. It is involved in photosynthesis and carbohydrate metabolism and synthesis of nucleic acids. Magnesium is related to the movement of carbohydrates from the leaves to other parts of the trees and also stimulates P uptake and transport. Magnesium deficiency has been a major problem on practically all citrus soils in Florida.

Trees with inadequate Mg supply may 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.

Alternate bearing is common in seedy cultivars growing under Mg-deficient conditions. The loss of wood as a result of defoliation reduces the fruit-bearing wood for the following year. Magnesium deficiency can result in a great reduction not only in fruit yield but also in fruit quality. It has been shown that fruit from Mg-deficiency trees is low in soluble solids and acids. Magnesium deficiency like other deficiencies makes trees more susceptible to cold injury than normal trees.

In Florida, Mg deficiency is caused primarily by low levels of Mg in the soil. It is particularly severe on acid light sandy soil from which Mg readily leaches. 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 above 6.0 will furnish Mg at the same time. Salinity, high potash fertilizers, and manures have been shown to induce or aggravate Mg deficiency. Magnesium deficiency can also be attributed to calcareous soils relatively low in Mg or to unbalanced conditions in the soil due to excessive K or Ca.

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 heavy summer flush leaves when they are about fully expanded. One foliar spray application of Mg is not always effective in correcting the deficiency when the amount of Mg needed is greater than that absorbed by the leaves.

Boron (B)

Boron is particularly necessary where active cell division is taking place. Boron plays an important role in flowering, pollen-tube growth, fruiting processes, nitrogen (N) metabolism, and hormone activity. Florida sandy soils are low in B, and a deficiency of this element in citrus

occasionally occurs under field conditions. The deficiency may be aggravated by severe drought conditions, cool weather, heavy lime applications, or irrigation with alkaline water. Boron is very mobile in the soil profile of sandy soils and readily leaches by rainfall or excess irrigation.

The chief fruit symptoms include premature shedding of young fruits. The first visual symptoms of B deficiency are generally the death of the terminal growing point of the main stem. Further symptoms are a slight thickening of the leaves, a tendency for the leaves to curl downward at right angles to the midrib, and sometimes chlorosis. Associated with this is a premature shedding of leaves starting in the tops of the trees and soon leaving the tops almost completely defoliated.

Boron compounds can be applied either foliarly or in the fertilizer. As a maintenance program, apply B in the fertilizer at an annual rate equivalent to 1/300 of the N rate. In Florida, foliar spray applications have been found much safer and more efficient than soil application. Soil applications frequently fail to give satisfactory results during dry falls and springs and may result in toxicity problems if made during the summer rainy season. Boron solubility in the soil is reduced at soil pHs below 5 and above 7. Foliar spray may be applied during the dormant period through post bloom, but preferably during early flower development. Treating at this growth stage is important because boron does not move very readily from other parts of the tree to the buds. Applying boron at this time will assist in flower initiation and pollen production, satisfy the needs for pollen tube growth, and enhance fruit set. For maintenance spray application, 0.25 lb/acre of B (1.25 lbs of soluble borate containing 20% B) may be used. Boron levels in the leaf tissue should not drop below 40 ppm or exceed 120 ppm (dry wt basis). Where deficiency symptoms are present, double the amount suggested. Use care not to apply more than the recommended amount because it is easy to go from deficiency to excess.

Phosphorus (P)

Phosphorus levels are inherently low in many flatwood soils. The average fruit crop removes about 20 lbs P_2O_5 per acre. Trees having low to deficient level of P will have stunted roots and exhibit limited flower development with reduced fruit set and fruit yield. The fruit will also have a high acidity in proportion to total soluble solids. Thus, fruit maturity will be delayed.

The cause of P deficiency is either a lack of P in the soil or a lack of available P. Phosphorus deficiency may occur in areas of high rainfall due to leaching and erosion. Under very acid soil conditions, P can become quickly unavailable. Phosphorus availability is also reduced in calcareous soils. Phosphorus deficiency can be corrected by applying superphosphate or any readily available source of P after confirmation of P deficiency by leaf and soil analysis. The phosphorus source in triple superphosphates and in single, normal or ordinary superphosphate is exactly the same (Calcium Phosphate). The major difference between the two is that ordinary superphosphate contains gypsum (Calcium Sulfate) and therefore supplies sulfur to crops, but concentrated (triple) superphosphates do not. When fertilizer programs call for dry material, superphosphates are recommended because they are inexpensive and appropriate for application to soil of any pH, especially alkaline soils.

SUMMARY OF CITRUS TREE PRUNING

A pruning program should begin before any heavy cutting is necessary and should be conducted every year so that desired tree size and shape can be maintained at low cost and with minimum loss of canopy and maximum consistency in fruit production.

- Severe pruning and training of young, nonbearing trees, tends to delay fruit production and should be avoided.
- Mature trees should be pruned when approaching containment size and before crowding becomes a problem so that only small branches are cut and yield reduction is minimized.
- Crowding results in inadequate light conditions, dieback of small branches in the interior and base of the canopy, loss of foliage and fruit production particularly in the lower portion of the tree.
- Middles between tree rows should have a width of 7 to 8 feet to accommodate grove equipment and provide adequate light to the trees.

- **Hedging** consists of cutting back the sides of trees to prevent crowding.
- Hedging should be done at 10 to 15 degrees from vertical. Hedging at wider angle is better for spray coverage, but may result in severe yield reduction.

- **Topping** should be done before trees have become excessively tall.
- Return from topping is frequently negative due to yield reduction.
- Yield reduction due to light topping is usually not significant if trees still have their lower skirt areas.
- Topping increases light penetration into the trees, stimulates vegetative growth and results in thicker canopies.
- Topping can increase fruit size and packout.
- Retopping should be done just above the old cut.
- Moderate, consistently timed hedging and topping does not reduce yield, but may improve fruit quality.
- The best time to top and hedge early maturing cultivars is after removal of the crop. For Valencia, it is recommended that the first cut is done after harvest and then annually during the winter.

- **Skirting**, which is the pruning to raise tree skirts, has become a more widely accepted practice.
- Skirting facilitates the movement of herbicide booms and other equipment, improves weed control, fertilizer distribution and air circulation under the tree canopy, reduces brown rot and Phytophthora problems, and makes less difficult the inspection of irrigation systems.
- Skirting may be needed for mechanical harvesting.
- Except for the first subsequent season, skirting has minimal effects on yield.

FROM THE 2003 FLORIDA CITRUS PEST MANAGEMENT GUIDE

PESTICIDES MANAGEMENT IN CITRUS PRODUCTION

Pesticides are available to growers for the management of pathogenic fungi, plant parasitic nematodes, weeds and numerous species of insects and mites found on the tree or in the soil. Generally, new pesticides being registered today are much safer to man and the environment. Natural products such as petroleum oils and copper compounds are effective and widely used in citrus pest management to control insects, mites and diseases. Synthetic chemicals and biologicals representative of different classes of pesticides are also available to growers. Workers require protective clothing during mixing, loading, and/or application.

Biological pesticides are generally more environmentally friendly, but often lack residual effect and can be strongly influenced by weather factors. Regular pesticide usage usually improves the appearance of a citrus tree; however, pests suppressed by pesticide treatment often have little, if any, effect on tree growth and yield. Consequently, judicious use of pesticides is highly recommended for Florida citrus.

Many insects and mites found in Florida citrus groves are under biological control. Growers should select pesticides that are least disruptive to natural enemies. All foliar and soil applied pesticides registered for citrus affect natural enemy abundance; however, less toxic products with short residual action, such as petroleum oil, are less disruptive to natural enemies.

Highly toxic pesticides that kill upon contact may be less disruptive than pesticides with moderate contact toxicity and long residual effect. Concern for pesticide resistance suggests a more conservative approach. Products with similar modes of action should be applied only once per season where alternative products are available. Petroleum oils may be an exception in view of their unique mode of action.

Copper is the most widely used fungicide in Florida citrus. Multiple applications of copper annually, year after year, have resulted in soil accumulation of toxic levels of copper. Copper will disrupt the action of certain natural enemies on occasion. Therefore, growers are cautioned to use copper products only for disease control at the recommended rates and frequencies.

Grower use of soil-applied pesticides with high potential for leaching should be avoided when possible or used with caution. Proper timing of application with good irrigation management will reduce the potential for groundwater contamination.

Tank mixing chemicals is an accepted practice that can reduce production costs. Growers should determine the compatibility of each pesticide, growth regulator, nutritional element, and surfactant before tank mixing. The practice of using partial rates of two compounds with similar activity instead of the recommended rate of one is questionable in terms of efficacy and is not recommended.

The pH and Total Dissolved Solids (TDS) of the water supply and the finished tank mix should be monitored routinely. Certain nitrate-based nutritionals are known to greatly reduce the pH, affect the performance of other compounds in the tank mix (e.g., solubility of copper), and thereby contribute to fruit burn and fruit drop. For tree canopy sprays (pesticides, nutritionals, and growth regulators), surfactants should be used only if

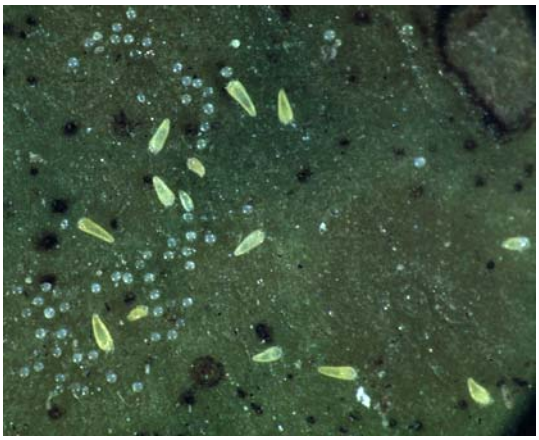
recommended on the label, and adjuvants with strong penetrating properties should be avoided.

Tank mixes should be kept simple as the potential for leaf and fruit burn increases with the number of products in the tank particularly under conditions of water stress, high temperature and low humidity. Care should be taken when using copper fungicides in the summer. They may darken and enhance existing wind scar, melanose, and other blemishes on fruit surface. Hence, economic loss from reduced packouts can be substantial. **The suggested mixing order of various formulations of agricultural chemicals is: water, wettable powders and dry flowables, water-soluble concentrates or solutions, emulsifiable concentrates and oil.** Check with your chemical supplier for information regarding special chemicals and foliar nutritionals.

PESTICIDE RESISTANCE MANAGEMENT

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 pesticides to control insects, mites, and some fungal diseases of citrus 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 to 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, or a decreased penetration of the pesticide through the cuticle. 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.



The key operational factor that will delay the onset of pesticidal resistance, and therefore prolong the effective life of a compound, is to ensure the survival of some susceptible individuals in order to dilute the population impact of resistant individuals. The following operational procedures should be on a grower's checklist to steward sound pesticidal resistance management for acaricides, insecticides, and fungicides:

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. Resistance to Benlate developed in the greasy spot fungus shortly after the product was introduced about 30 years ago and is still widespread. Benlate resistance also occurs in the scab fungus in isolated situations and is stable. No resistance has developed to ferbam or strobilurin fungicides at this time; however, strobilurin fungicides (Abound, Gem, and Headline) have potential for resistance development.

Dicofol resistance in citrus rust mite was detected throughout the citrus industry about 10 years ago, but resistance proved to be unstable and usage of dicofol has continued. Agri-mek tolerance in citrus rust mite is of concern and growers should follow sound resistant management practices when using this product.

To aid in the selection of chemicals by growers wanting to rotate materials within a season or from year to year, the pesticides listed below are grouped by chemical class. 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.

Insecticides and Acaricides:

- Aluminofluoride
  Kryocide (cryolite)
- Carbamates
  Sevin, Temik
- Chlorinated Hydrocarbons
  Kelthane
- Insect Growth Regulators
  Micromite
- Macrocyclic Lactone
  Agri-Mek
- Organo-phosphates
  Ethion, Guthion, Malathion, Lorsban, Supracide, Dimethoate, Orthene
- Organo-tin
  Vendex
- Pyridazinone
  Nexter
- Sulfite Ester
  Comite
- Synthetic Pyrethroids
  Capture, Danitol
- Chloronicotinyl
  Admire

Fungicides:

- Benzimidazoles
  Benlate, Thiabendazole, Topsin
- Dithiocarbamates
  Ferbam
- Strobilurins
  Abound, Gem, Headline

FROM THE PACKINGHOUSE NEWSLETTER

UNIVERSITY OF FLORIDA
Cooperative Extension Service
Institute of Food and Agricultural Sciences

Dr. Mark Ritenour
Indian River REC
2199 South Rock Road
Ft. Pierce, FL 34945-3138
Phone: (772) 468-3922
FAX: (772) 468-5668
Email: mritenour@ifas.ufl.edu

Packinghouse Newsletter No. 197
January 3, 2003

Key Index Words: Blossom-end clearing, packinghouse employee safety, Florida citrus postharvest researchers

All previous and present Packinghouse Newsletters (PHNL) are available on the Internet at the University of Florida's postharvest web site (http://postharvest.ifas.ufl.edu) and can also be accessed through our citrus resources web site (http://flcitrus.ifas.ufl.edu).

Blossom-End Clearing of Grapefruit

Mark A. Ritenour, Indian River REC, Ft. Pierce
Huating Dou, Florida Department of Citrus, Lake Alfred
Ed Etxeberria, Citrus Research and Education Center, Lake Alfred

Symptoms. Blossom-end clearing (BEC) is characterized by the translucent, watersoaked appearance of the fruit peel (most commonly at the blossom end) caused by internal bruising and juice leakage from juice vesicles (Fig. 1). Juice vesicles in the bruised areas usually have a gray tinge compared with unbruised tissue, and BEC-affected fruit develop off flavors. BEC is visible within 24 hours after bruising (often much earlier) and can affect up to 90% of the fruit in some loads. Decay, in particular mold, often develops in areas with BEC symptoms. BEC has also been referred as "wet bottoms," "stylar-end clearing," "water bottom," "waterlog," and "wet wick."

Factors involved in BEC development.

Fruit characteristics: Seedless grapefruit (e.g. 'Ruby Red' or 'Marsh') are most affected by BEC. The disorder is similar in appearance to "stylar end breakdown" or "juice spot" of 'Tahiti' limes. Grapefruit grown along Florida's east coast (Indian River region) are more prone to BEC development than fruit grown in the State's central regions. BEC develops most often in late-season fruit. Depending on the year, greater susceptibility to BEC may begin to appear in January and increase rapidly throughout the remainder of the harvest season. During this time, incidence in fruit from the same grove may increase about 4 fold. Sensitive fruit often exhibit an open core with little spongy tissue and juice vesicles that protrude into the cavity. The fragile vesicle membranes rupture easily and leak juice into the core. The juice eventually runs into the peel at the blossom end of the fruit creating a wet spot. Small fruit may be twice as likely to

develop BEC than large fruit. Thicker-skinned fruit develop less BEC than thin-skinned fruit under the same conditions. The severity of BEC varies widely from year to year and from grove to grove.

Fig. 1. Symptoms of grapefruit Blossom-end Clearing.

Rough Handling: BEC does not occur while fruit are still attached to the tree and does not develop on fruit handled very gently (receiving no drops or appreciable surface impacts). **Rough handling is the primary cause of fruit BEC**. Though fruit handling during harvest (e.g. from dumping fruit into bins) may cause BEC, most BEC develops as a result of rough handling in the packinghouse. Dumping operations are most likely to produce impacts that cause BEC, but other steps in the packing operation (e.g. presizer, sizing, and bagging/packing) can also contribute to BEC. Efforts should be taken to minimize drop heights and other impacts throughout the packing operation. For example, reducing fruit drop heights from 2 feet to 1 foot can reduce the development of BEC by more than half. Refer to Miller et al. (2001) for more information on reducing fruit damage in citrus packinghouses (http://edis.ifas.ufl.edu/AE184).

Temperature & RH: Although damage from rough handling is necessary to cause BEC, other postharvest factors also influence its development. Incidence of BEC greatly increases with higher fruit temperatures; doubling the fruit temperature can more than double the likelihood of BEC development. Thus, harvesting fruit earlier in the morning when fruit temperatures are cooler will reduce the incidence of BEC. Even if fruit were exposed to high temperatures in the grove prior to harvest, cooling the fruit (e.g. even to 70^{o}F) will dramatically reduce the likelihood of developing BEC during packing operations. Such cooling is especially important later in the season when fruit are most likely to develop BEC. Holding fruit at low humidities prior to packing increases fruit susceptibility to BEC compared to holding it at high humidities. For example, fruit held for 2 days at 40% RH before packing developed about twice as much BEC as fruit held for 2 days at 95% RH at the same temperature. It is thought that cultural practices also influence fruit susceptibility to BEC, but there is no data at present.

Recommendations to reduce BEC.

1. Carefully handle grapefruit during all harvesting and packing operations.
2. Groves with a history of BEC should be harvested no later than early March.
3. Harvest fruit earlier in the morning when fruit temperatures are lower. Be cautious, however, that fruit are not so turgid that oil spotting (oleocellosis) results.
4. Allow susceptible fruit harvested under warm conditions to cool overnight (e.g. to 70^{o}F or below) before packing.
5. Always hold fruit under high relative humidities.