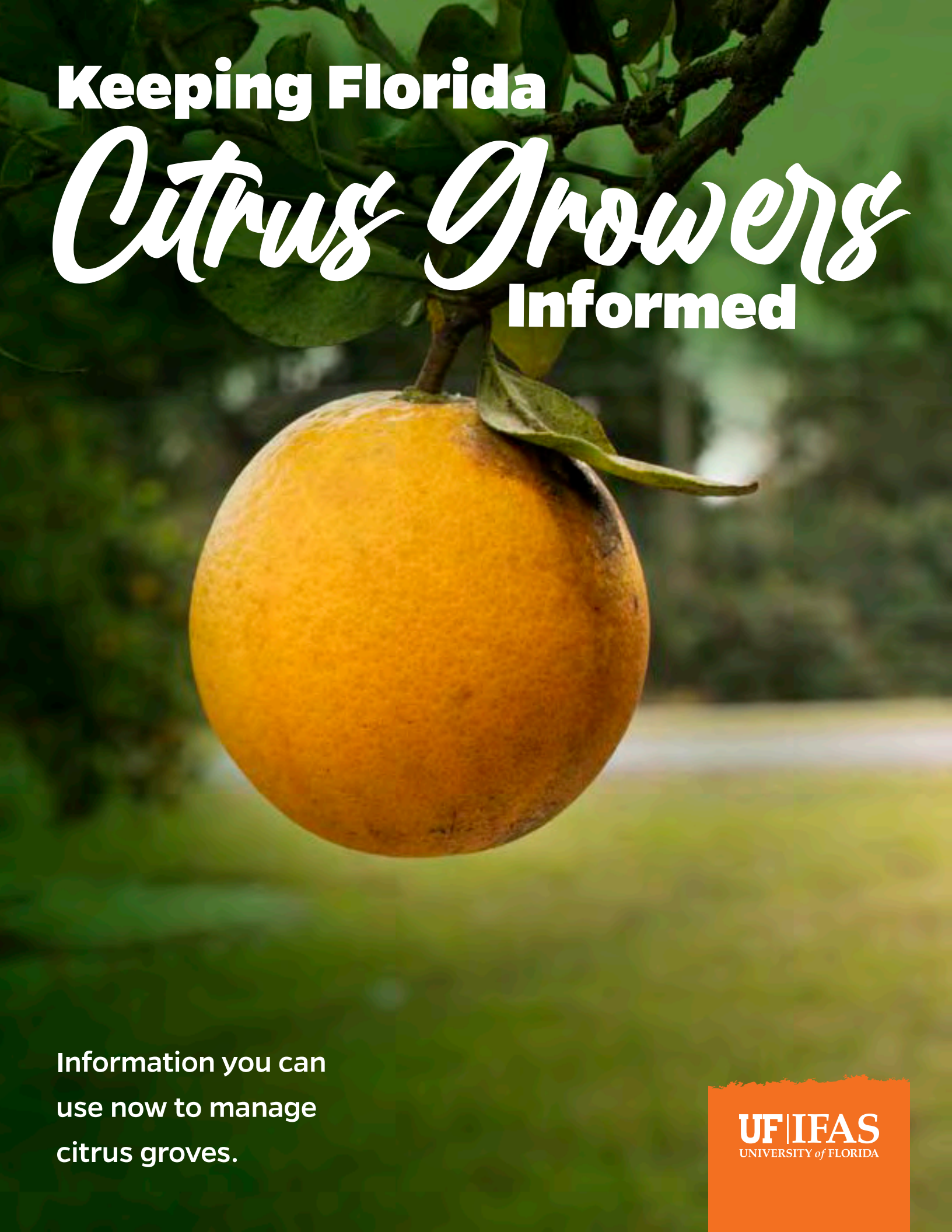


Keeping Florida Citrus Growers Informed

Information you can use now to manage citrus groves.

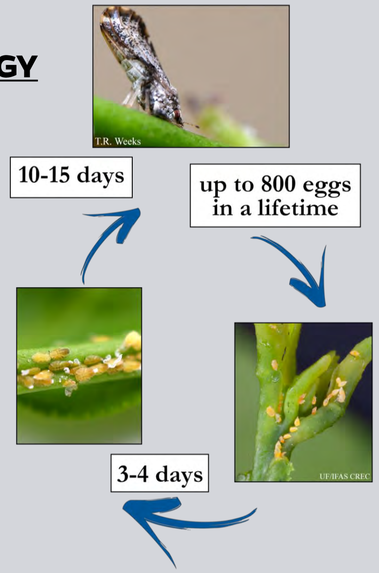
UF | IFAS
UNIVERSITY of FLORIDA

This publication contains brief descriptions of applied research outcomes that citrus growers may find useful in managing their groves. It contains the results of numerous research projects led by citrus researchers located at UF/IFAS research centers in Gainesville, the Citrus Research and Education Center in Lake Alfred, Southwest Florida Research and Education Center in Immokalee and the Indian River Research and Education Center in Fort Pierce. This research advances our knowledge about growing citrus in Florida including fighting HLB, improved grove management, and better nutrition recommendations. Please contact the faculty listed with each poster for additional information. More resources are available on-line at **citrusresearch.ifas.ufl.edu**.

ASIAN CITRUS PSYLLID MANAGEMENT

1 ASIAN CITRUS PSYLLID (ACP) BIOLOGY

- Pest of citrus and vector for citrus greening (Huanglongbing, HLB) disease
- Most active in spring through fall
- Adults feed on flush, mature leaves, and non-citrus plants
- Require flush to reproduce



2 MANAGEMENT

Chemical

- Recommended contact and systemic insecticides can be found in the Florida Citrus Production Guide
- Insecticide resistance has been documented in local populations, susceptibility can be restored by rotating insecticide Mode of Action (MOA)

Biological Controls

- Natural enemies measurably reduce ACP populations in unsprayed areas; however, 3-4 insecticide sprays/year can reduce the impact of natural enemies

Cultural Controls

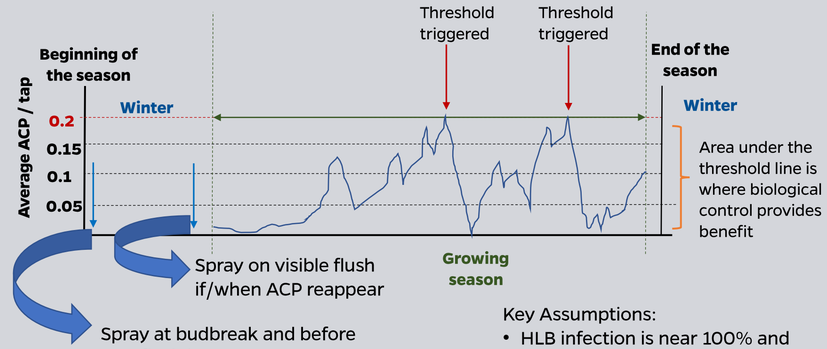
- ACP can be prevented from accessing newly planted trees through use of IPCs
- Metallized reflective mulch and red kaolin can reduce ACP infestation and subsequent infection with HLB

Funding: CRDF Citrus Research and Development Foundation, Inc. USDA HLB Multi Agency Coordination Group

3 TIMING MANAGEMENT TO PEAK ACTIVITY

- Psyllid populations can be managed by targeting flush
- Dormant season sprays made in the winter provide reduction in the early spring ACP breeding populations and therefore are critical for effectiveness of season-long ACP management
- Timing sprays to peak flush periods will reduce survival of eggs and nymphs

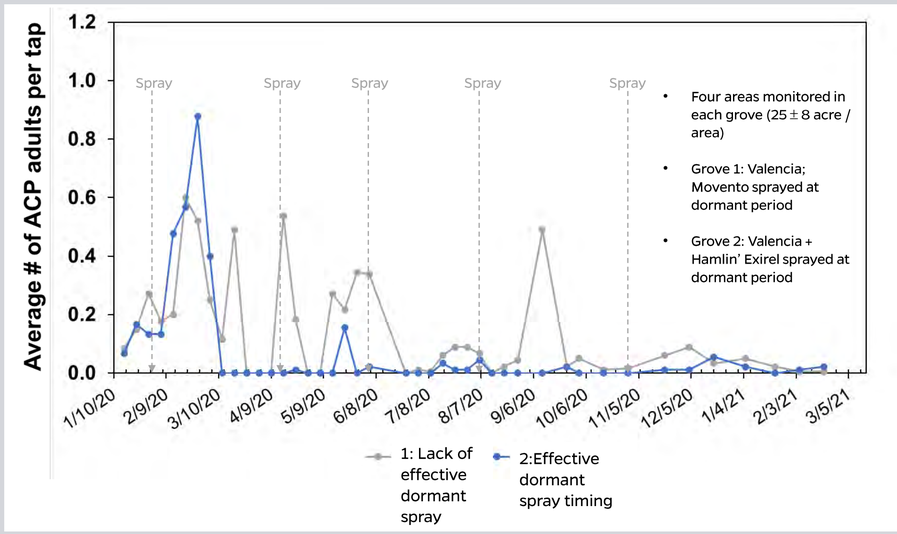
Hypothetical example of implementing an Economic Injury Level at 0.2 ACP/ tap



Key Assumptions:

- HLB infection is near 100% and stopping spread is not a goal
- Keeping ACP below the chosen threshold boosts yield via improved tree health

4 PUTTING THEORY INTO PRACTICE



- Starting out with low ACP population with effective dormant spray is essential for implementing an EIL

For more information, please contact Lauren Diepenbrock, ldiepenbrock@ufl.edu, Lukasz Stelinski, stelinski@ufl.edu, or Jawwad Qureshi, jawwadq@ufl.edu

MANAGEMENT OF CITRUS LEAFMINER

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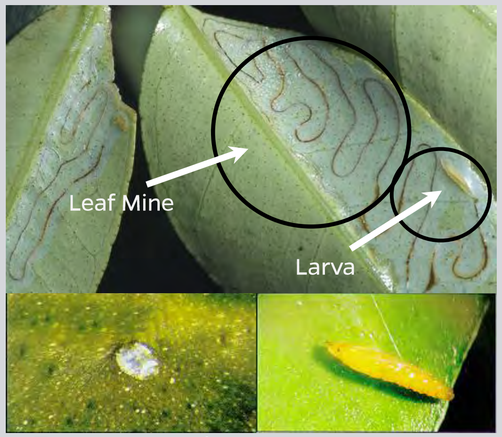
1 CITRUS LEAFMINER FIELD IDENTIFICATION

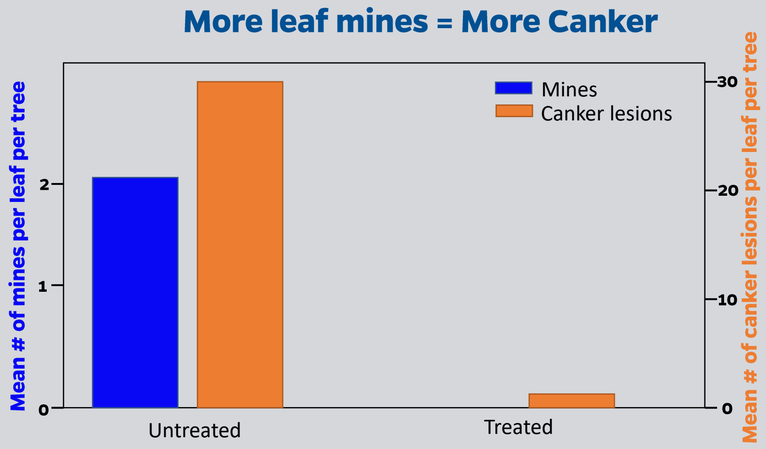


Transparent and ovoid-shaped egg

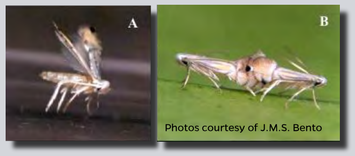
Pupa

2 DAMAGE AND RELATIONSHIP WITH CANKER

- Damage heaviest during flush
- Direct damage greatest to young trees
- Reduced photosynthesis, tree growth
- Mines provide entry for pathogens



3 CLM PHEROMONE



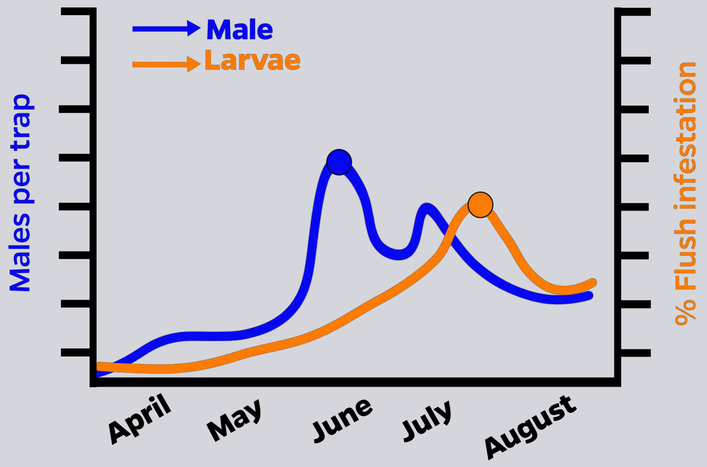
=

Rubber septum releases pheromone just like live female

Insert rubber septum into sticky trap. Males fly to and are caught in trap

4 RELATIONSHIP BETWEEN ADULT FLIGHT AND LEAF INFESTATION

Peak larval infestation of leaf flush occurs 3-4 weeks after peak male capture in traps

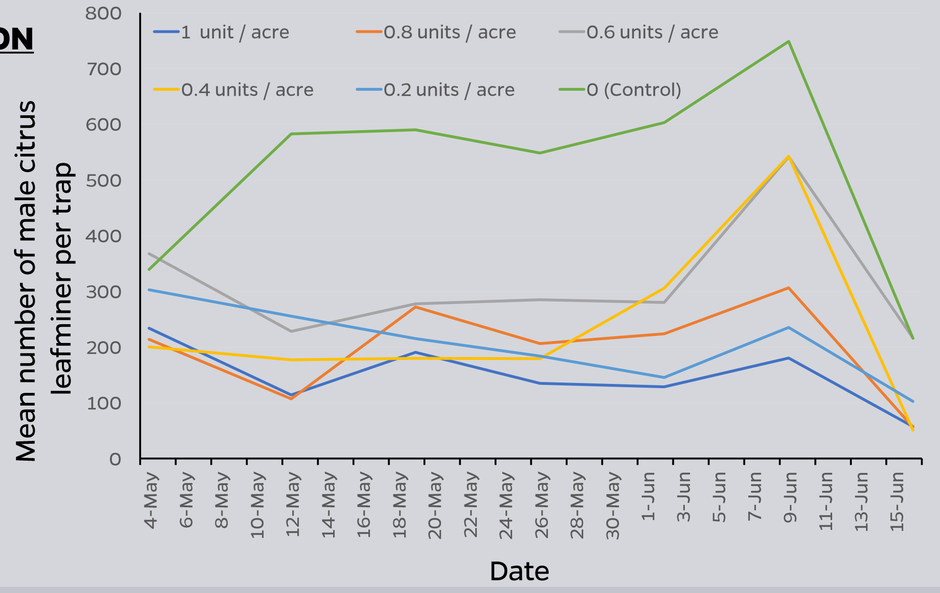


5 PUFFERS FOR MATING DISRUPTION

New technology evaluated in 2021 for management with mating disruption:

- Deployed at low unit density/acre
- Fully automated “Puffers” spray pheromone and remain active season long (April – October)
- Set it and forget it approach

Representative image of an Isomate “Puffer” unit deployed in Walnut



Funding: UF IFAS UNIVERSITY of FLORIDA · CITRUS INITIATIVE FUNDED BY THE FLORIDA LEGISLATURE · CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Lukasz Stelinski, stelinski@ufl.edu

LEBBECK MEALYBUG

1

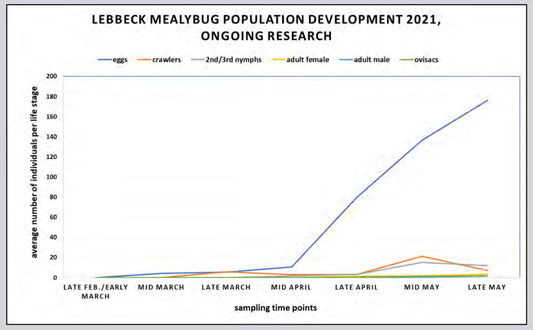
GENERAL INFORMATION

- Scientific name: *Nipaecoccus viridis* (Newstead)
- Many common names including hibiscus mealybug and spherical mealybug
- Wide host range
- Thrives in high humidity and high temperatures, capable of overwintering in cooler climates
- Hard to detect at low populations, crawlers are very small and blend in with bark
- Gregarious, all ages prefer to congregate together tightly and feed in large numbers where juveniles are often protected by the wax of the female ovisacs
- Feed in both open and cryptic locations: under calyx junction, in tree wounds, leaves, etc.
- Feeding can cause damage to fruit, stems, and leaves and can kill young trees at high populations
- Feeding damage can cause fruit to drop before physiological fruit drop
- Impacts of feeding depend on when in fruit development infestation occurred and how heavy the mealybug population is

2

LIFE CYCLE & POPULATION DEVELOPMENT

- Varies by host and temperature
- Development time varies from 14-21 days
- Unmated females produce approximately 400 eggs in a lifetime
- Mated females produce approximately 1000 eggs in a lifetime



Population monitoring is underway in 8 commercial groves in central Florida. In all sites, populations increase concurrent with the start of fruit set. Fruit damaged at this point of development are likely to be lost or severely damaged from mealybug feeding

3

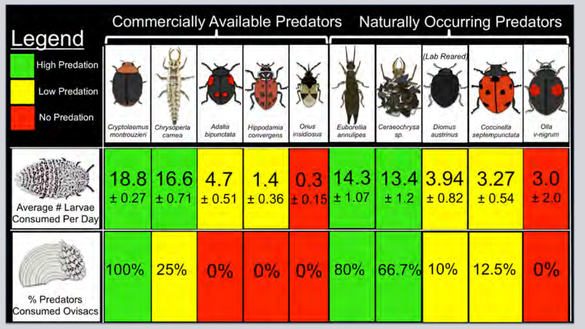
Damage to fruit

Damage to leaves & stems

4

ONGOING RESEARCH MANAGEMENT

- Early season management is key for protecting developing fruit
- Predatory insects and spiders are important to control lebbeck mealybug



Potential predators collected from groves and purchased commercially were screened for potential use against lebbeck mealybug. Several predators from this suite show promise for use as biological controls in an integrated management program

Funding:

UF IFAS UNIVERSITY of FLORIDA

CITRUS INITIATIVE FUNDED BY THE FLORIDA LEGISLATURE

CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Lauren Diepenbrock, ldiepenbrock@ufl.edu

PHYSICAL BARRIERS TO INSECT PESTS CONFER ADDITIONAL STRESS TOLERANCE

1

BENEFITS

- Healthy trees tolerate pests and pathogens better than do trees previously damaged by disease, herbivory or resource deficiency/toxicity.
- Barriers protect newly planted trees, which are less tolerant of pests and diseases than mature trees.

2

LANDSCAPE FABRIC TO PREVENT WEEVIL ENTRY INTO SOIL

This flatwoods site was severely damaged by *Diaprepes* root weevil and replanted on landscape fabric in 2020.

Results

- No need for tree resets to date
- Additional weevil control unnecessary
- Herbicides unnecessary, even if middles are allowed to grow (supporting beneficial arthropods)
- Fabric increases water use efficiency and stimulates tree growth, even in the absence of pests

IPCs PREVENT WEEVILS FROM FEEDING AND LAYING EGGS IN CANOPY

3

This flatwoods site was also severely damaged by weevils prior to replanting in 2019.

Results:

- IPCs prevent HLB and they prevent adult weevils from feeding and laying eggs in the tree canopy
- The individual tree photos were each taken at a distance of 6 feet, note that the tree height of covered trees is nearly twice that of bare trees.
- Note the irregular growth in uncovered tree rows compared to rows with IPCs
- Will covered trees tolerate weevil damage better than uncovered trees following IPC removal?

4

IPCs PREVENT PSYLLIDS FROM CAUSING HLB IN YOUNG TREES

The site above is infested with sting nematode (*Belonolaimus longicaudatus*) and all uncovered trees have HLB. The grove was planted in fall 2017; some heavily damaged roots were removed and replanted in summer 2019.

An upcoming research project will determine if:

- Sting nematodes reduce tree growth as much on covered as on uncovered trees
- Nematode management increases growth of covered trees more than that of uncovered trees
- Covered trees tolerate nematodes better when the covers are removed (due to better health and larger size)
- Covered trees respond to nematode management better following removal of the covers

Funding:

For more information, please contact Larry Duncan, lwduncan@ufl.edu

FRUIT AGE AFFECTS SUSCEPTIBILITY

1 CRITICAL STAGE OF FRUIT SUSCEPTIBILITY

- Fruit stage at the time of inoculation determines the period between infection and appearance of first symptoms
- Fruit symptom severity depends on the time and fruit stage when the pathogen infects the fruit
- If needed to prioritized fungicide application timings, applications should be targeted to younger fruit to reduce fruit drop inducing severe lesions

GREEN FRUIT SIZE AT INOCULATION	FRUIT DIAMETER (INCH)
Small (expanding fruit)	$< 1\frac{2}{5}$
Medium (expanding fruit)	$1\frac{2}{5} >$ Fruit $\leq 1\frac{4}{5}$
Large (fully expanded fruit)	$> 1\frac{4}{5}$

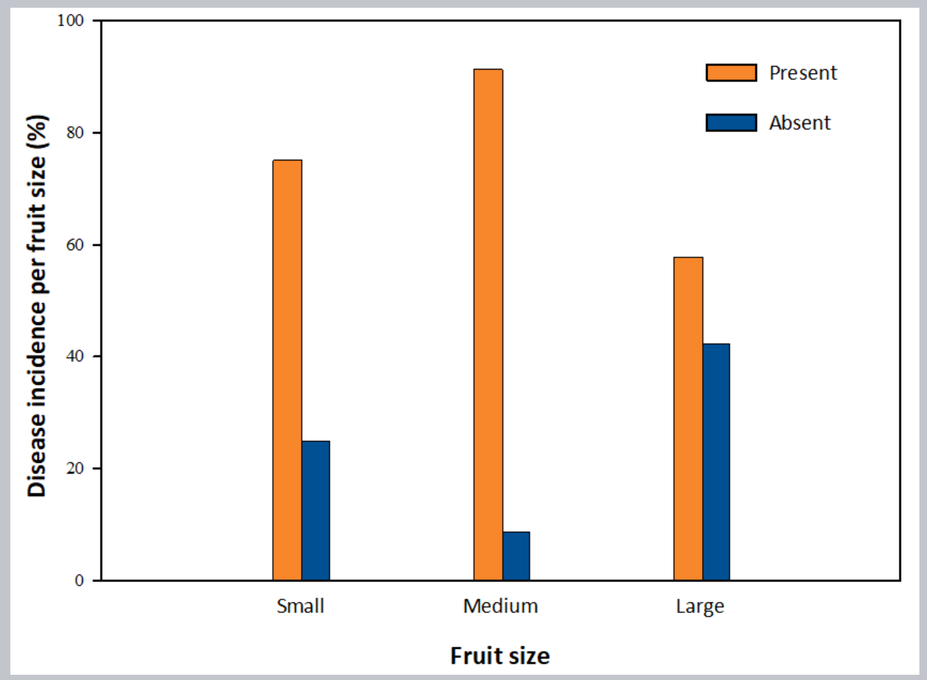
2 GREENHOUSE TRIAL 2019-2020

- To determine critical fruit stage for susceptibility to asexual spore infection
- Observed 97 fruit (72 inoculated) from 24 Meyer lemon trees
- Fruit size ranged in diameter from 3/4 to 2 3/4 inch when inoculated

Highlights

- First symptoms were observed after 5 months post-inoculation on green fruit with inoculated diameters between 1 3/5 to 2 1/5 inch
- Symptoms were more severe on fruit inoculated at the early developmental stages compared to the late stages of maturity
- If optimal environmental conditions are present, fruit are susceptible to infection regardless of their development stage
- Ideally, fruit should be protected by fungicides for most of their maturation process

3 CITRUS BLACK SPOT PRESENCE AND ABSENCE



4 CITRUS BLACK SPOT SYMPTOMS FROM INOCULATIONS

Funding: CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Megan Dewdney, mmdewdney@ufl.edu or Jeffrey Rollins, rollinsj@ufl.edu

CITRUS BLACK SPOT SPREAD

1 WHERE IS CITRUS BLACK SPOT CURRENTLY

- The disease is mainly located in southwest Florida in Collier, Hendry, Lee, Charlotte, and Glades Counties
- There was one site on the Polk and Highlands County border that has since been removed from citrus production
- Citrus black spot has mostly affected active groves, but one homeowner site was identified
- Hurricane Irma passed through the black spot affected regions in 2017
- The disease has spread north and west most recently, roughly following the path of Irma
- Generally, disease will start in isolated parts of the grove, but will intensify if disease management is not undertaken
- Once identified the area will become subject to quarantine rules (DA-2012-09-federalorder.pdf (fdacs.gov))

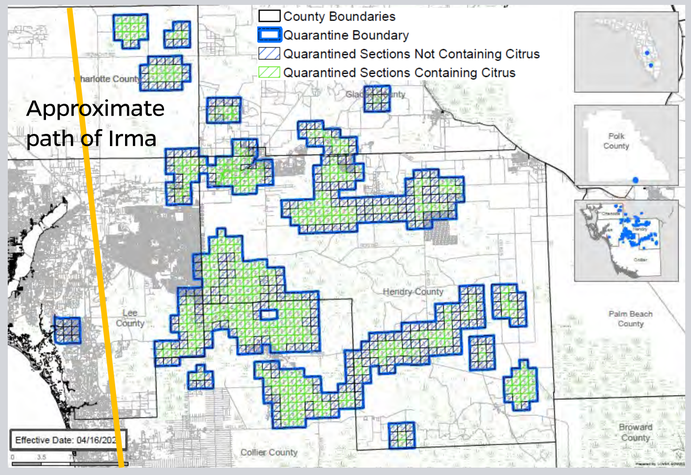
2 FRUIT SYMPTOMS TO LOOK FOR WHEN SCOUTING

- Scout after color break if your grove is in the southwest citrus growing region
- Some years, symptoms are more severe than others and not all fruit symptoms are likely to be present on each tree or even each grove
- Hard spot is the most unique symptom with small, round lesions (under 1/5 inch in diameter) with brick red to chocolate brown margins. The center is necrotic tan color often with fungal structures like pinprick dots
- Cracked spot is a raised chocolate brown to black area with cracks that can turn into hard spot over time. Can be isolated lesions or large areas with diffuse background
- Early virulent spot are small brick red depressed lesions than can become hard spot or virulent spot. Virulent spots are large areas of leathery rind with a brown color. Structures are usually present

3

March 1, 2017 (shortly before Irma)

April 16, 2021 (most current)



Maps of quarantine areas are produced by the Citrus Health Response Program (CHRP), a joint program between FDACS and the USDA.

4 FRUIT SYMPTOMS

The fruit symptoms were seen in groves in 2021. From the top clockwise: virulent spot, early virulent spot, early virulent spot and hard spot, hard spot, cracked spot, severe cracked spot.

Funding:

For more information, please contact Megan Dewdney, mmdewdney@ufl.edu

FUNGICIDAL MANAGEMENT

1 CURRENT FUNGICIDE RECOMMENDATIONS

- Monthly applications with a fungicide program
- Start applications at beginning of May or if April is wet, start in April
- Rotate modes of action (FRAC codes) to manage resistance
- Use at least 125 gal/acre

PRODUCT	FRAC CODE	RATE
Copper products	M 01	Use label rate
Abound	11	9.0 – 15.5 fl oz
Amistar Top	11 + 3	15.4 fl oz
Gem 500 SC	11	1.9 – 3.8 fl oz
Headline SC	11	12 – 15 fl oz
Pristine	11 + 7	16-18.5 oz

2 FIELD TRIAL 2019-2020

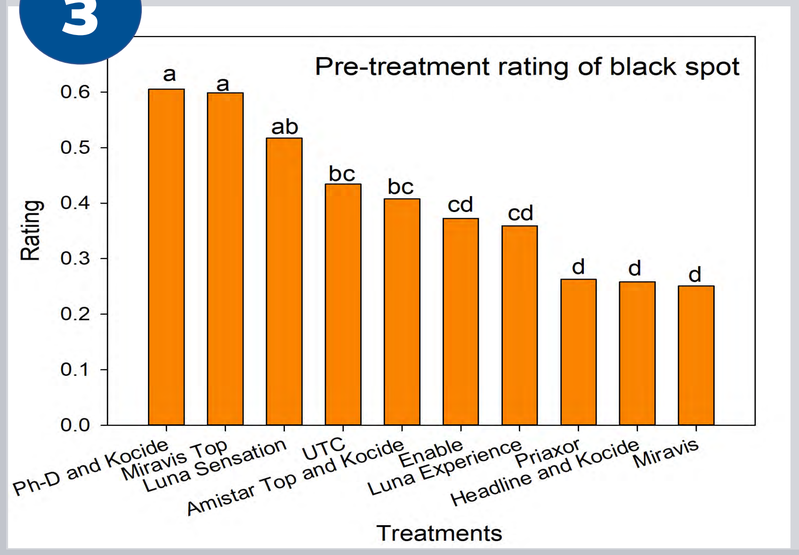
- Purpose to find new modes of action to use for CBS management as management currently relies heavily on the strobilurins (FRAC 11)
- Located in 20+ year-old Valencia grove with history of CBS
- Used monthly applications from mid-May to early September (5 applications)

Highlights

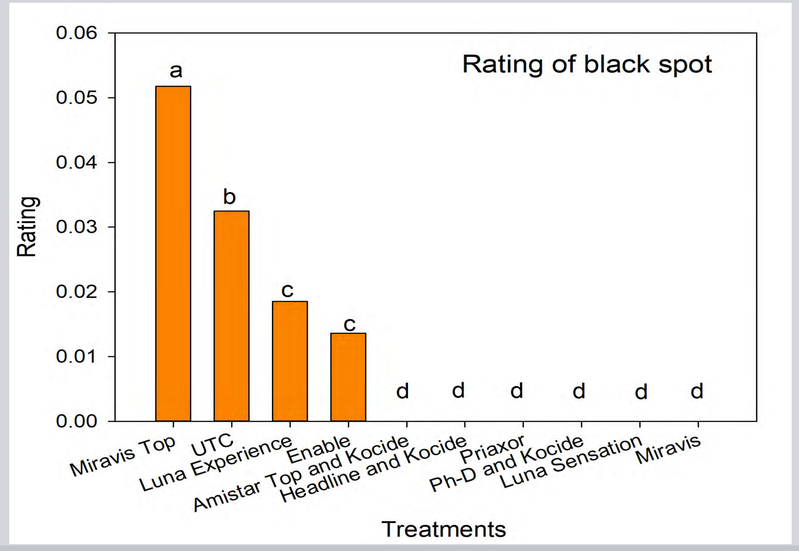
- More disease in pre-treatment ratings than post-treatment ratings, likely because of weather in the 2019-2020 season
- Some products look very promising but too soon to change recommendations
- Light disease pressure may make products look better than otherwise would
- Another trial currently under way for 2021-2022 season
- Will hopefully change recommendations based on results from 2021-2022 trial

3

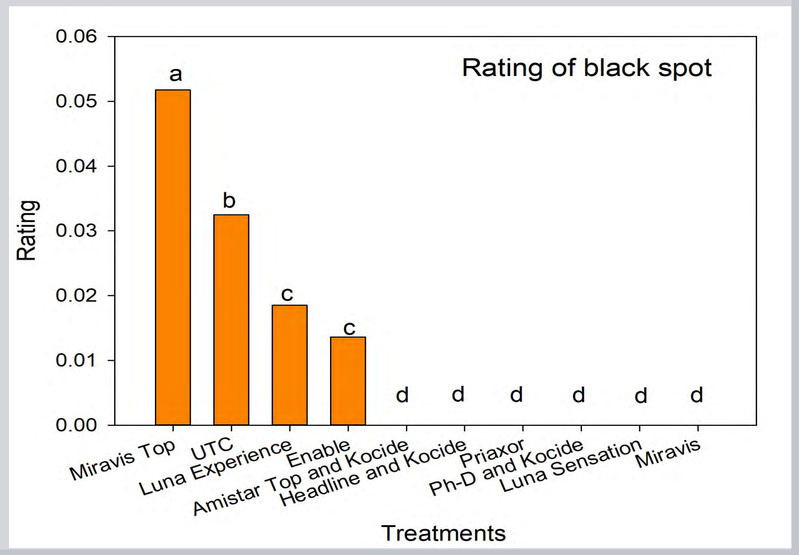
PRE-TREATMENT RATINGS



POST-TREATMENT RATINGS



FRUIT DROP RATINGS



TREATMENT PER ACRE

1. Miravis (14.9 fl oz); 2. Miravis Top (15.0 fl oz.); 3. Enable (8 fl oz); 4. Amistar Top rotated with Kocide 3000 (15.4 fl oz or 3.5 lb); 5. Luna Sensation (4 fl oz); 6. Luna Experience (8 fl oz); 7. Ph-D rotated with Kocide 3000 (6.2 oz or 3.5 lb); 8. Priaxor (11 fl oz); 9. Headline rotated with Kocide 3000 (15.0 fl oz or 3.5 lb); 10. Untreated control (UTC)

Funding: CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Megan Dewdney, mmdewdney@ufl.edu or Ozgur Batuman, obatuman@ufl.edu

LEAF LITTER MANAGEMENT

1 WHY LEAF LITTER MANAGEMENT MATTERS

- Very few leaf symptoms of citrus black spot are usually visible, but the leaves are infected
- Leaf litter is a source of spores that cause citrus black spot infections
- Spores are formed in specialized structures in the leaves as they decompose
- The spores are splashed from the litter into the canopy by rain and wind
- Some growers have reported enhanced fungicide control from spreading compost under their trees

PRODUCT	RATE PER ACRE
Control	Untreated control
Soil-set	1.3 fl oz
Urea	40 lb

2 FIELD TRIAL 2014-2017

- Purpose to improve fungicide application efficacy without increasing number
- In 20+ year-old Valencia grove with history of CBS
- One application of soil amendment in late March to early April with herbicide boom at 50 gal/acre in 10-foot strip on either side of tree
- Grower conducted normal fungicide program of 3 to 4 applications

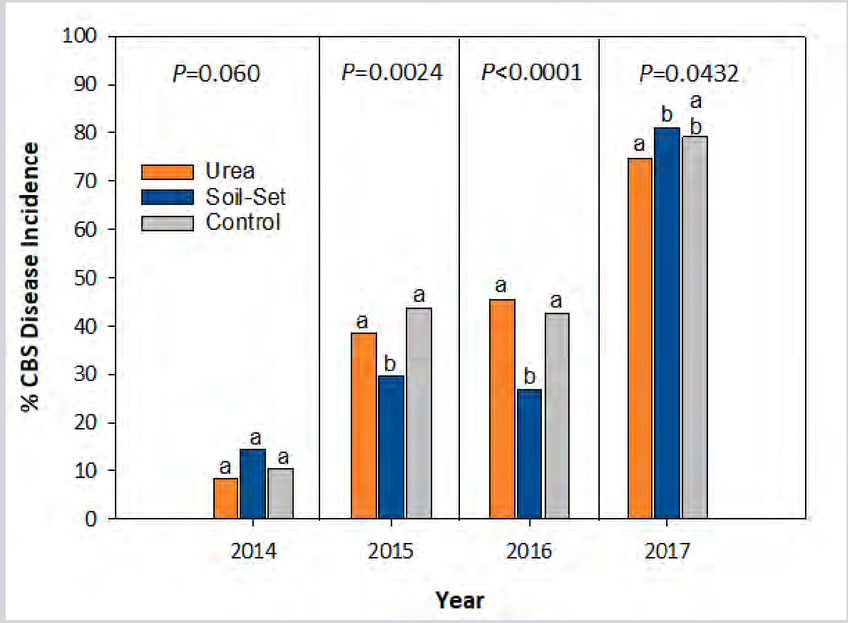
Highlights

- Soil-set reduced the frequency of fruit infections two of three treated seasons
- Fruit severity was reduced each treated season by Soil-set
- In fruit destined for processing, reducing severity will reduce the proportion of fruit that drop from citrus black spot
- Soil-set did not slow the intensification of the disease in the grove

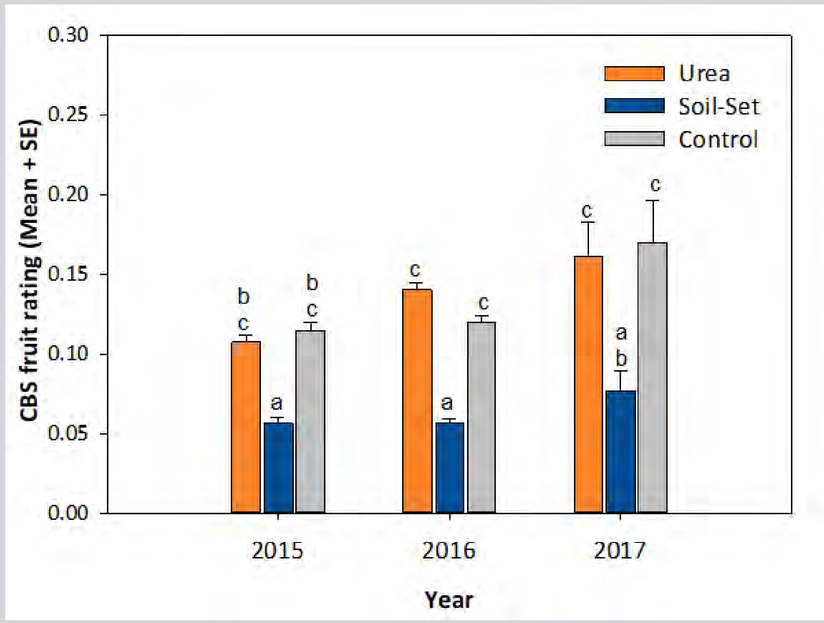
FIGURE NOTES

There was no treatment in 2014 but there was an indication of the level of disease before starting the experiment

3 CITRUS BLACK SPOT FRUIT INCIDENCE



4 CITRUS BLACK SPOT FRUIT SEVERITY



Funding: CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Megan Dewdney, mmdewdney@ufl.edu

FERTILIZATION METHODS

1 SOIL APPLIED

- The plant uptakes nutrients via the roots when they are in a solution (water/irrigation)
- During the water uptake by the plant, the dissolved mineral nutrients get taken up by the plant and distributed throughout the tree canopy

Granular

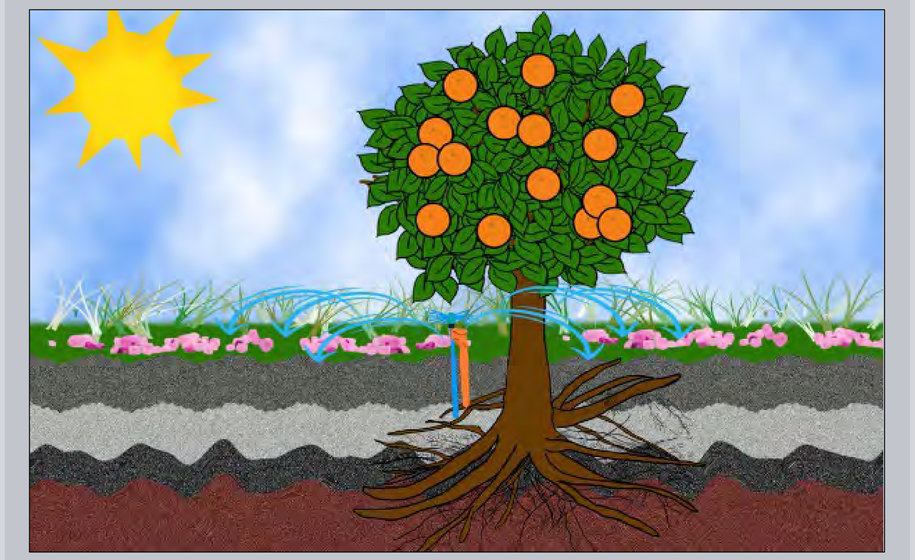
- Traditional soil applied fertilizer
- Advantages
  - Fertilizer is inexpensive
  - Readily available to plant
- Disadvantages
  - Subject to leaching
  - Multiple applications increase labor and costs

Controlled Release Fertilizer

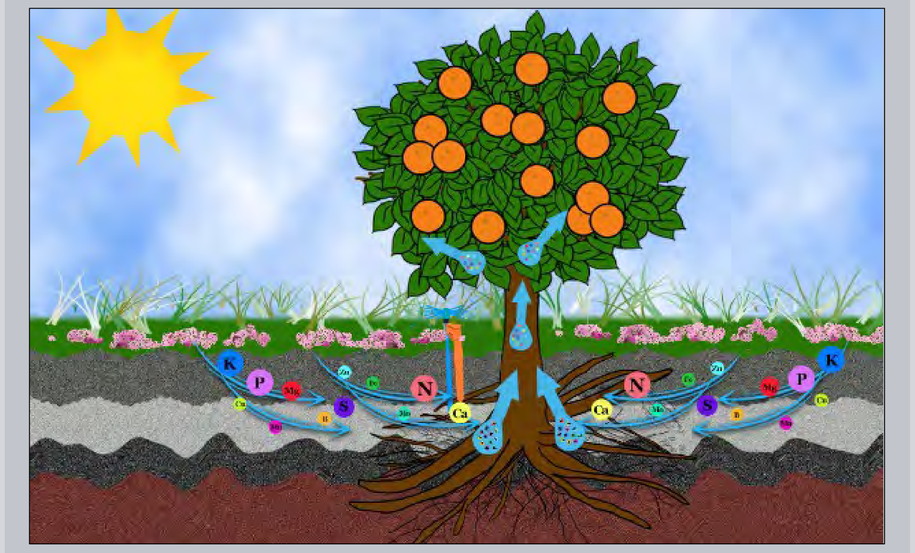
- Granules release small amounts of fertilizer over time
- Advantages
  - Slowly released; therefore, a constant supply of nutrients
  - Fewer applications, reduced rate
- Disadvantages
  - Expensive

Fertigation

- Liquid fertilizer applied through irrigation system
- Advantages
  - Relatively inexpensive
  - Flexibility in application
  - Small doses, constant supply, reduced rates
- Disadvantages
  - High maintenance (cleaning/flushing)
  - Not suitable for all nutrients



Water helps dissolve fertilizer into the ground
Graphic Design: K.M. Snyder and T.R. Weeks, UF/IFAS



Fertilizer is absorbed by the roots and moved throughout the tree
Graphic Design: K.M. Snyder and T.R. Weeks, UF/IFAS

2 FOLIAR APPLIED

- Yield can increase 10%-25% with supplemental foliar feeding versus conventional soil fertilization only
- Best used as a supplemental and not a substitute for soil-applied nutrition
- Best time to apply is morning or evening
  - Right temperature (temperatures above 80°F can cause burn)
  - Minimal wind to ensure full coverage
  - Leaf stomates are open to increase uptake
- Best to apply when crop demand is high and tree needs additional help (vegetative growth, flowering, fruit set, and fruit growth)
- Quickest method to correct a deficiency, although, if a deficiency is observed, potential yield lost has already occurred

Advantages

- Quickest method
- Assist trees during times of high demand or other hindering conditions (wet or dry conditions, cold weather, etc.)

Disadvantages

- Cannot use a foliar nutrition program alone, must be coupled with a soil nutrition program
- Causes leaf burn when not applied at the correct time

Funding: UF IFAS UNIVERSITY of FLORIDA

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu, Davie Kadyampakeni, dkadyampakeni@ufl.edu, Kelly Morgan, conserv@ufl.edu

CITRUS BEST MANAGEMENT PRACTICES

1 Agricultural best management practices (BMPs) are practical measures that producers can take to reduce the amount of fertilizer, animal waste, and other pollutants entering our water resources. BMPs are designed to improve water quality while maintaining agricultural production.

2 NUTRIENT MANAGEMENT

- Choosing appropriate sources and formulations of fertilizer based on nutritional needs of the plants
- Using soil and tissue tests and UF/IFAS recommended fertilizer rates
- Calibrating and adjusting fertilizer application equipment
- Using split applications for soluble fertilizers
- Keeping records of nutrient application and location

3 IRRIGATION MANAGEMENT

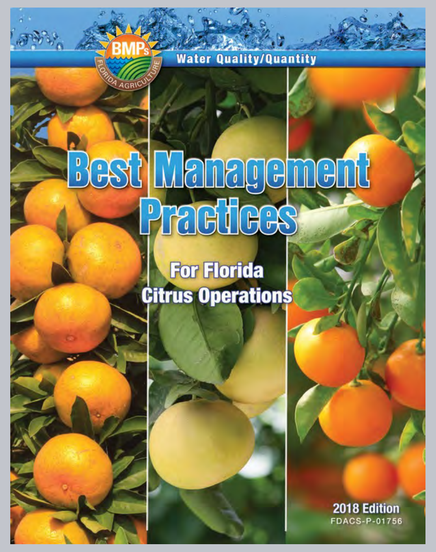
- Using tools such as soil moisture sensors, water table observation wells, crop water use information, or weather data, to make good irrigation decisions
- Monitoring and maintaining irrigation systems and utilizing a Mobile Irrigation Lab if available
- Using the FAWN application irrigation and frost/freeze tools or other applicable weather monitoring tool when irrigating for frost/freeze protection

4 WATER RESOURCES PROTECTION

- Installing and maintaining appropriate vegetated buffers
- Using backflow-prevention devices at the wellhead
- Maintaining vegetative cover in row middles
- Managing water velocities near drainage structures to prevent sediment from entering the drainage system
- Restricting pesticides applications to within the citrus tree canopy drip line
- Stabilizing bare soil areas with grass or vegetation after soil bedding to minimize erosion

5 REASONS TO ENROLL IN THE FDACS BMP PROGRAM

- Some BMPs can help increase production efficiency and reduce costs while helping to protect the environment
- Enrollment provides producers access to technical assistance with BMP implementation
- Producers become eligible for cost-share, when available, for certain practices
- Implementing verified FDACS-adopted BMPs provides a presumption of compliance with state water quality standards for the pollutants addressed by the BMPs
- Producers who implement FDACS-adopted BMPs might satisfy some water management district permitting requirements. Check with your district
- In areas with adopted basin management action plans (BMAPs), and some other designated areas, producers who implement BMPs avoid having to conduct costly water quality monitoring
- BMP participation demonstrates agriculture's commitment to water resource protection and helps maintain support for this alternative approach



Information obtained from www.fdacs.gov

Funding:

FERTILIZER APPLICATION RATES

1 FERTILIZER APPLICATIONS

- Fertilizer applications should begin in February and end the first week of October
- Dry and foliar nutritionals should be divided into at least 4-5 applications, but do not need to be evenly divided
- For example, more nitrogen is needed in the spring than in early fall
- For HLB-affected trees, up to 20% yield increase has been observed with:
  - A combination of Ca (65 lbs/ac) and Mg (70 lbs/ac) increased yields
- Micronutrients applied 3x the IFAS recommendations increased the yield

Small, frequent doses of <u>all nutrients</u> are beneficial for both the environment and tree health. It reduces leaching and allows trees a constant supply

2 HOW TO CALCULATE NITROGEN (N)

To determine the rate of N, you need the following information:

- Base N rate (yearly amount of N)
- Average yield (number of boxes/acre from grove)

Formula: Base N rate + {[(Average yield – 200 boxes/acre)/100] x 15 lb/acre}

Grower provides

Predetermined values based on healthy tree standards

<u>Example:</u>

Grower provided: Base N rate = 180

Grower provided: Average yield = 250

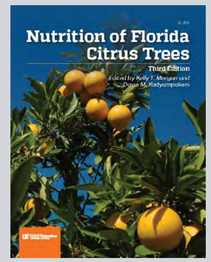
Step 1: Fill in the formula. 180 + {[(250-200)/100] x 15}

Step 2: Calculate parenthesis and brackets. 250-200=50; 50/100=0.5

Step 3. Calculate remaining brackets. 0.5 x 15 = 7.5

Step 4. Add the last two numbers. 180 + 7.5 = 187.5

187.5 = total pounds N per acre per year



For more information on fertilizer calculations, see Nutrition of Florida Citrus Trees, 3rd Edition

3 DETERMINING PHOSPHORUS (P) NEEDS

Scenario #1		
‘Hamlin’ grove, Bearing age, Ridge soil		
P Leaf Analysis	0.11 (low)	<u>Recommendation</u> P is sufficient and no P application is needed at this time. Monitor for any nutrient deficiency symptoms. Continue nutrient analysis and monitor for any continual declines in P.
P Soil Analysis	205 (very high/sufficient)	
pH	6.8 (high)	

Scenario #2		
‘Valencia’ grove, Bearing age, Ridge soil		
P Leaf Analysis	0.12 (optimum)	<u>Recommendation</u> P is sufficient and no P application is needed at this time. Continue to monitor for any changes.
P Soil Analysis	245 (very high/sufficient)	
pH	7.0 (high)	

Scenario #3		
‘Valencia’ grove, Bearing age, Flatwoods soil		
P Leaf Analysis	0.17 (high)	<u>Recommendation</u> Low pH decreases the ability of P used by the plant. Recommended; not apply P and raise pH levels. Once pH levels are optimum, tree can absorb P instead of storing it. Monitoring both pH and P levels on a regular basis.
P Soil Analysis	28.5 (less than sufficient)	
pH	5.05 (low)	

<u>Funding:</u> UF IFAS UNIVERSITY of FLORIDA

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu, Davie Kadyampakeni, dkadyampakeni@ufl.edu, Kelly Morgan, conserv@ufl.edu

IRRIGATION MANAGEMENT

1

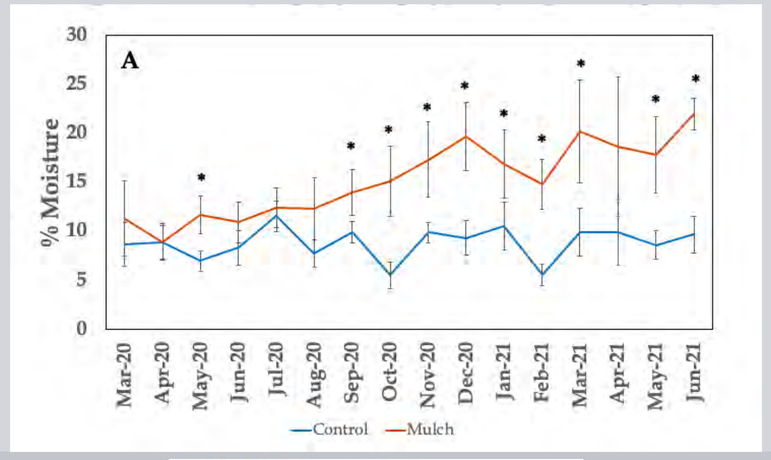
HLB and IRRIGATION

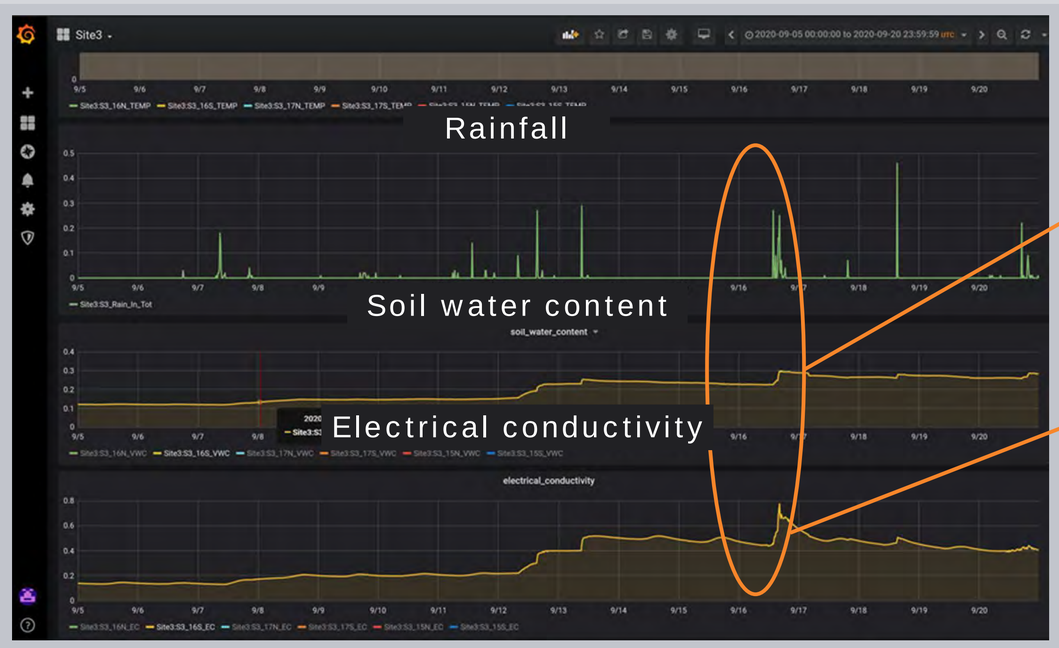
- HLB-affected trees have smaller and weaker root systems than healthy trees; therefore, water uptake is limited
- Schedule small, frequent irrigation applications for HLB-affected trees, but use the same total amount of water as a healthy tree
- Canopy size, root growth, and yield are improved with daily irrigation once or twice a day
- Drip irrigation/fertigation with reflective mulch appears to enhance canopy size and tree growth tissue nutrient content

2

OAK MULCH

- Results showed that plots treated with oak mulch had increased soil phosphorus and soil potassium compared to control plots at certain times of year
- No differences were observed in leaf phosphorus and potassium between oak mulched plots and control plots
- Soil moisture levels were consistently higher in mulched plots compared to control plot
- No significant differences were observed in leaf Ct value between treatments
- **These findings indicate that oak mulch increases soil nutrients and moisture but does not actively suppress HLB**





3

AFTER AN IRRIGATION EVENT

Soil moisture data tells you how much water is available for the trees

AFTER A FERTIGATION EVENT

Electrical conductivity (EC) data tells you where the nutrients are For sandy soils we can see spikes in EC after 1 hour

4

CONSIDERATIONS

- Some probes provide volumetric ion content (VIC) readings. These readings show more clearly the movement of fertilizers
- For controlled release fertilizers the spike in EC or VIC readings can be registered after two days or more
- To register good fertilizer management practices, it is necessary to compare the values from the upper to the lower sensor. If the upper sensor shows a spike and the lower sensor is flat, this means good fertilizer management

Funding: SARE Southern Sustainable Agriculture Research and Education

Funding: UF IFAS UNIVERSITY of FLORIDA; USDA National Institute of Food and Agriculture U.S. DEPARTMENT OF AGRICULTURE

For more information, please contact Davie Kadyampakeni, dkadyampakeni@ufl.edu, Lorenzo Rossi, l.rossi@ufl.edu, Sandra Guzman, sandra.guzmangut@ufl.edu

SOIL pH

1 pH AND NUTRIENT INTERACTIONS

- Soil pH affects nutrient availability of plant nutrients
- At high soil pH micronutrients availability reduces, whereas at low pH calcium and magnesium can be lost from the soil.
- Tables show multiple examples of the soil pH and calcium and magnesium content of same grove over the period of two years.
- Most Florida soil are acidic in their native state. Years of irrigation with alkaline water has raised the soil pH to over 7.0 at many places.
- HLB-affected trees decline at faster rate under high soil pH condition (Figure 2 and 3).
- Soil pH for HLB-affected trees should be maintained at 5.8-6.5.
- High soil pH can reduce the availability of soil-applied micronutrients as well as cause abiotic stress.
- High soil pH increases oxidative stress in the roots and plant.
- Oxidative stress is linked with pre-harvest fruit drop. Groves with well-maintained soil-pH drops fewer fruit than groves at high soil-pH.

Grove 1			
Year	**pH**	**Ca**	**Mg**
2021	5.7	889	132
2019	6.6	1140	186

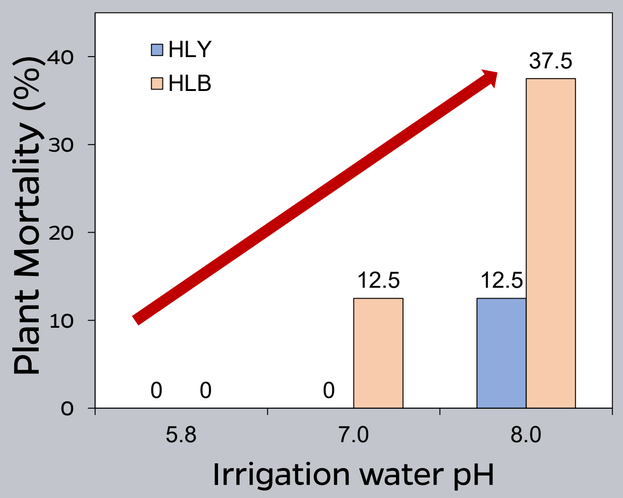
Grove 2			
Year	**pH**	**Ca**	**Mg**
2021	6.7	1786	351
2019	5.4	611	132

Grove 3			
Year	**pH**	**Ca**	**Mg**
2021	6.9	1450	180
2019	7.7	3704	363

Grove 4			
Year	**pH**	**Ca**	**Mg**
2021	6.2	1025	241
2019	4.8	364	51

When adjusting pH, Ca and Mg are sensitive to pH changes than other nutrients. Red highlights extreme changes in pH resulting in extreme changes in Ca and Mg. A pH between 5.8 and 6.5 is ideal for all nutrients and allows a well-balanced nutrient uptake.

Funding: UF IFAS UNIVERSITY of FLORIDA · CITRUS INITIATIVE FUNDED BY THE FLORIDA LEGISLATURE · USDA National Institute of Food and Agriculture U.S. DEPARTMENT OF AGRICULTURE



At high pH, HLB plants have significantly higher mortality than healthy plants

At high pH, HLB undergo significant root loss, whereas at low pH, the feeder root growth is higher in HLB plants

2 ADJUSTING SOIL pH

- The pH should be maintained between 5.8-6.5.
- The soil pH adjustment is a continuous process
  - When making big changes, ideally monitor at least every 6 months
- How to measure soil pH: send soil to testing lab (most accurate method) or use soil pH meters
- If soil pH is low, use dolomite to bring it up
  - 1 ton per acre will raise one point of pH
  - It can take up to 6-8 months to see change
  - Since dolomite supplies calcium and magnesium, the fertilizer should be adjusted
- If soil pH is high, consider elemental Sulphur or thiosulfate or ammonium fertilizer for long term effect.
  - Irrigation water acidification for short term effect

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu, Davie Kadyampakeni, dkadyampakeni@ufl.edu, Kelly Morgan, conserv@ufl.edu

PLANT GROWTH REGULATORS (PGR)

1 PGR DEFINED

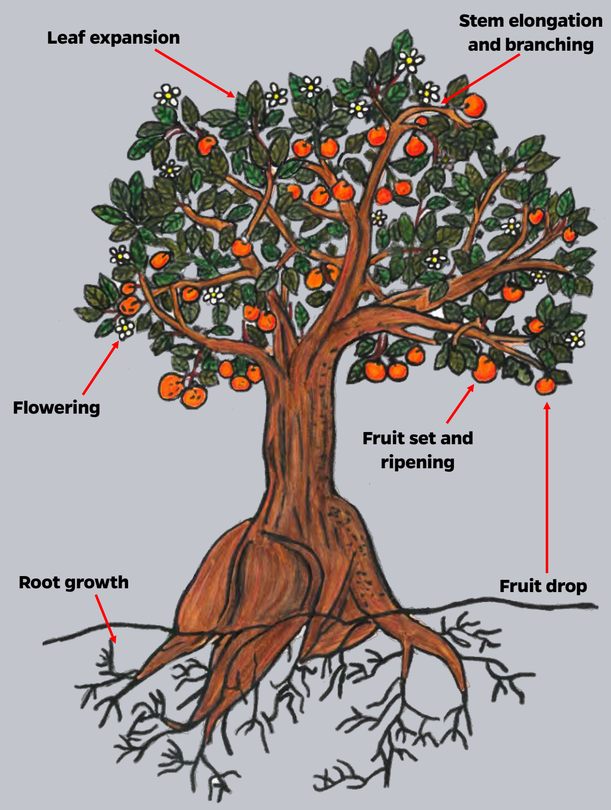
- Defined by Florida Department of Agriculture Consumer Services (FDACS)
- Any substance or mixture of substances intended, through physiological action, for accelerating or retarding the rate of growth or maturation or for otherwise altering the behavior of ornamental or crop plants or the produce thereof, but not including substances intended as plant nutrients, trace elements, nutritional chemicals, plant inoculants, or soil amendments
- Regulated as a pesticide
- Must follow pesticide laws when applying PGRs

3 PGR APPLICATION

- Must be absorbed by the plant tissue
- Uniform spray coverage must be ensured
- Absorption is often affected by weather conditions; warm and humid is favorable for absorption
- A surfactant helps in absorption of PGRs

4 COMMONLY USED PGRs

- In citrus, 2,4-dichlorophenoxyacetic acid (2,4-D) and gibberlellins (gibberellic acid; GA) can reduce premature and preharvest fruit drop in healthy trees
- Naphthalenacetic acid (NAA) can be used for fruit thinning in mandarin varieties



Plant growth regulators impact multiple components of citrus tree growth.

PGRs can have multiple effects on plant depending on the developmental stage and time of application.
For example, auxins can cause chemical thinning of fruit, reduce preharvest fruit drop, and promote next season bloom; therefore, careful consideration is needed when applying PGRs.

Funding: UF IFAS UNIVERSITY of FLORIDA

2 PGR FACTS

- Known as growth regulators or plant hormones
- Chemicals used to alter the growth of a plant or plant part
- Can be growth inhibitors, promoters, or retardants
- Play major role in abscission, dormancy, fruit ripening, fruit set, leaf expansion, stem elongation, root growth, germination, etc.
- Efficacy and effect of PGRs depends on rate, spray volume, and the developmental stage of plant or fruit
- Can work at very low concentration
- If applying two or more PGRs at a time, ratio of PGRs is very critical for efficacy

5 PGR RESEARCH

- Current research suggests that 2,4-D and GA are not effective in reducing HLB induced preharvest fruit drop. Further research is needed
- A new class of plant hormones, Brassinosteroids (HBr), has shown improvement of HLB-affected tree health in greenhouse studies
- Field trials on HBr are underway to evaluate their efficacy under Florida field conditions
- GA has been shown to be effective in reducing off season flowering and synchronizing spring bloom in HLB-affected trees when applied in late fall. This can be an effective tool to manipulate flowering if PFD is a concern

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu

SELECTING A PGR AND READING THE LABEL

CLASS	ASSOCIATED FUNCTION(S)	PRACTICAL USES
Auxins	Shoot elongation	Fruitlet thinning, increased rooting and flower formation; sprout inhibitor
Gibberellins	Stimulate cell division and elongation	Increase shoot length, fruit size, and fruit set
Cytokinins	Stimulate cell division	Prolong storage life of flowers and vegetables and stimulate bud initiation and root growth
Ethylene	Ripening, abscission, and senescence	Induce ripening and loosens fruit
Abscisic acid	Seed maturation, dormancy	Regulate plant stress
Jasmonates	Plant defense	Wound response
Salicylic acid	Systemic Acquired Response (SAR)	Defense against pathogenic invaders
Brassinosteroids	Developmental processes	Regulate germination and other developmental processes
Strigolactones	Suppresses branching and promotes rhizosphere interaction	Suppress branching, promote secondary growth, and promotes root hair growth

ACTIVE INGREDIENTS ON CHEMICAL LABEL

Auxins
1-naphthalenacetic acid (NAA)
2,4-Dichlorophenoxyacetic acid (2,4-D)
3-indoleacetaldehyde acid (IAld)
3-indoleacetic (IAA)
3-indolepyruvic (IPA)
indolebutanoic acid (IBA)

Gibberellins
GA_4GA_7
GA_3

Cytokinins
CPPU
Kinetin

Ethylene
Ethephon
Ethylene

Jasmonates
Methyl jasmonate (MeJA)
Linolenic acid (LA)

Salicylic acid
Methyl salicylate

SAMPLE PGR LABELS SHOWING ACTIVE INGREDIENT

ACTIVE INGREDIENT:
1-Naphthaleneacetic Acid, Potassium Salt* 6.25%
INERT INGREDIENTS: 93.75%
Total 100.00%

ACTIVE INGREDIENTS: By Wt
3-Indolebutyric acid (IBA) 0.85%
Cytokinin, as Kinetin 0.15%
OTHER INGREDIENTS: 99.00%
TOTAL 100.00%

Active Ingredient: Gibberellic Acid (A_3) 20%
Other Ingredients: 80%
Total: 100%

ACTIVE INGREDIENTS
*Cytokinin, as Kinetin 0.090%
*Gibberellic Acid 0.030%
*Indole Butyric Acid 0.045%
OTHER INGREDIENTS 99.835%
TOTAL 100.000%

FOLLOW ALL LABEL PRECAUTIONS

ACTIVE INGREDIENT:
Isopropyl Ester of 2,4-Dichlorophenoxyacetic Acid* 45.0%
INERT INGREDIENTS: 55.0%
TOTAL: 100.0%
*2,4-Dichlorophenoxyacetic Acid Equivalent 38% = 3.36 lbs. 2,4-D acid equivalent per gallon
Contains petroleum distillates

USE PRECAUTIONS
- ALCO CITRUS FIX is a plant growth regulator for use on citrus only. Do not use as a herbicide!
- Do not use on citrus trees less than 6 years old.
- Do not apply during a flush of leaf growth.
- Do not apply within 7 days of harvest.
- Do not allow drift to susceptible plants, which include but are not limited to, cotton, grapes, roses, beans, peas, alfalfa, lettuce, ornamentals and broadleaf plants. This product may injure cotton, beans, peas, grapes, ornamentals, etc. (coarse sprays are less likely to drift).
- Do not use equipment that has been used to spray ALCO CITRUS FIX to spray 2,4-D sensitive plants. Always use caution in disposing of spray solutions as they can cause extreme injury or kill sensitive plants. (See Storage and Disposal section.)
- Before using spray equipment for any other purpose, thoroughly clean same with hot soap suds followed by soaking and washing with ammonia or baking soda.

Funding: UF IFAS UNIVERSITY of FLORIDA

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu

GIBBERELLIC ACID (GA)

1 RECENT GA WORK ON HLB-AFFECTED TREES

- Current findings suggests that GA can improve productivity of HLB-affected trees by improving source to sink ratio. The effect of GA is 'holistic', in addition to reduction of fruit drop
- GA increases vegetative growth (Figure1).
- When applied in late fall, it delays and decreases flowering; GA causes 50% reduction flowering with suppression of early flowering wave
- Resulting flower are leafy blooms; leafy blooms have tendency of better fruit set and growth
- According to four-year average, GA treated trees produced 228 lbs of fruit per tree versus 175 lbs of fruit per tree. This can be extrapolated as 370 boxes per acre with GA treatment as compared to 292 boxes per acre in untreated control. (Figure 2)

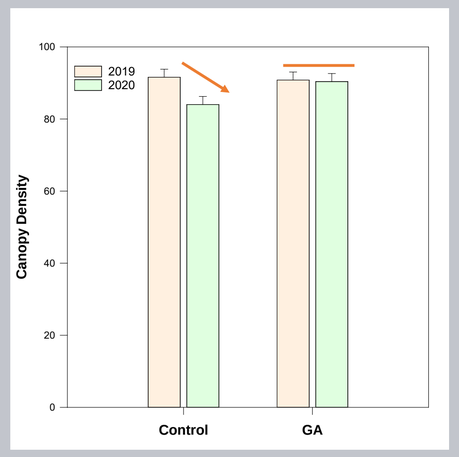


Figure 1. GA-treated trees maintained canopy density while untreated trees decreased in canopy

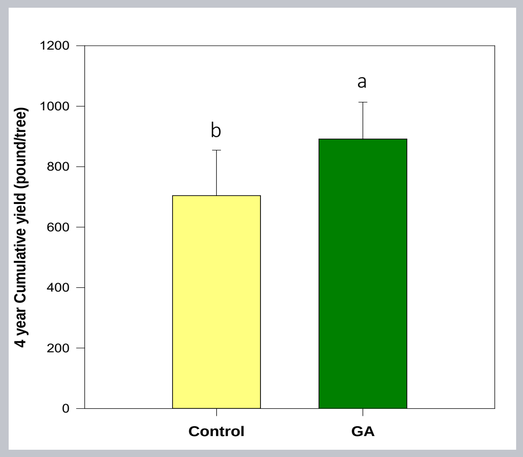


Figure 2. GA-treated trees produced 23% more pounds of fruit per a tree than the control

2 CURRENT RESEARCH AND PRELIMINARY

- In a current study, GA was applied from September-January, 10 fl oz per application in Valencia
- Attention should be paid as the fruit remained green in GA treatment, making it unsuitable if the goal of production is fresh market
- Preliminary work suggests that fewer GA application (two applications in November-December at 10 fl oz per application) might be sufficient
- More work on timing and rate is in progress

3 LABEL USE CHART

Variety	Response	Time of Application	Growth Regulator and Formulation	Product Rate or Volume per Acre
Grapefruit	Delay of rind aging process and peel color development at maturity	August–November. Late sprays can result in re-greening.	Gibberellic acid, GA_3 (ProGibb 4%, ProGibb 40%, ProGibb LV Plus)[2]	16–48 gram a.i.[3]
Tangerine-hybrids				20–40 gram a.i.
Navel oranges				16–48 gram a.i.
All round orange				20–60 gram a.i.
Navel oranges Ambersweet orange Sweet orange	Improvement of fruit set and yield; can result in small size and leaf drop.	December–late January	Gibberellic acid, GA_3 (ProGibb 4%, ProGibb 40%, ProGibb LV Plus)[2]	15–25 gram a.i.
Tangerines Mandarins Grapefruit		Full bloom		8–30 gram a.i.
Processing oranges (late varieties)	To increase juice extraction yield	Color break	Gibberellic acid, GA_3 (ProGibb 4%, ProGibb 40%, ProGibb LV Plus)[2]	20 gram a.i.

Funding:

UF IFAS UNIVERSITY of FLORIDA

CITRUS INITIATIVE
FUNDED BY THE FLORIDA LEGISLATURE

CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Tripti Vashisth, tvashisth@ufl.edu

IPC GENERAL INFORMATION

1 PURPOSE

- Psyllid exclusion is the most effective strategy to keep citrus trees free from HLB
- IPCs are a novel strategy based on psyllid exclusion of individual trees using a protective mesh bag
- This strategy is currently being adopted by many growers
- IPCs can be installed on solid blocks of trees or in resets
- IPCs are especially valuable for planting reset trees in gaps left by dead or removed trees in mature groves where HLB incidence is typically higher, and the risk of infection is therefore greatest
- IPCs should be placed immediately during planting to prevent any exposure of trees to the psyllids.

2 IPC INSTALLATION

Place pole next to tree

Fully cover tree with IPC mesh

Tie closed IPC mesh at base of tree

3 RESEARCH FINDINGS

- IPCs effectively exclude psyllids.
- IPCs maintain trees free from HLB.
- IPCs also reduce canker incidence.
- IPCs do not exclude all pests, and armyworms, black scales and mites are often present. This means that regular scouting and insecticide application may still be necessary.
- Fruits produced under IPCs have better internal quality and significantly more soluble solids (Brix) than fruit from HLB-affected trees.

Funding

CRDF Citrus Research and Development Foundation, Inc.

For more information, please contact Fernando Alferez, alferez@ufl.edu

IPC PEST MANAGEMENT

1 INSECTS AND MITES COMMONLY FOUND IN IPCs

Mites

Citrus red mite

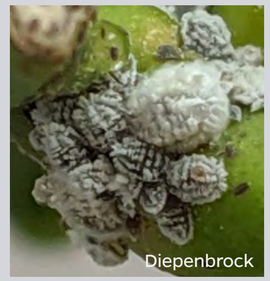
Two spotted spider mite

Scales

Black scale

Soft green scale

Mealybugs



Lebbeck mealybugs

Long-tailed mealybugs

Caterpillars

Southern armyworm

Leafroller

2

PEST ENTRY INTO IPCs

- IPCs are not a closed system
- Very small pests can enter through the IPC mesh on wind
- Caterpillars likely enter IPCs as hatchlings from eggs laid on the IPC
- Ants have been seen moving small pests like mealybugs between IPCs, establishing new infestations
- Some pests can crawl up trunk and establish in canopy

Graphic by: T.R. Weeks

Funding: USDA HLB Multi Agency Coordination Group

3

IPC MANAGEMENT

- Scouting is ideal but not time efficient
- IPCs as a sole means of pest management is not sufficient to protect trees from pests other than ACP
- Reactive management may not prevent irreversible damage to trees
- Prophylactic soil drenches should prevent most pests from building up damaging populations
- Topical insecticide applications may be necessary to control pests that establish in bags
- Airblast sprayers may not provide sufficient penetration into bags, speed and spray particle size will need to be adjusted
- Handgun sprays can penetrate bags but are time consuming
- Opening bags to spray allows good coverage but is labor intensive

For more information, please contact Lauren Diepenbrock, ldiepenbrock@ufl.edu

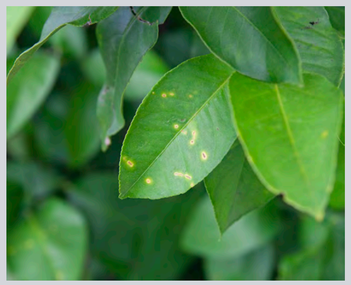
IPC DISEASE MANAGEMENT

1 DISEASES COMMONLY FOUND IN IPCs

GREASY SPOT


Fungus *Zasmidium citri-griseum*

CITRUS CANKER

Bacterium *Xanthomonas citri* subsp. *citri*

SOOTY MOLD


Fungus *Capnodium citri*

2 DISEASE ENTRY INTO IPCs

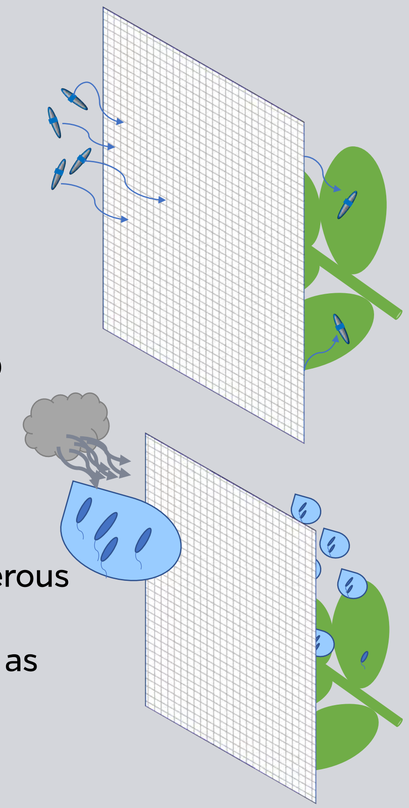
- Disease causing agents are generally microscopic
- Can pass through mesh easily

Greasy spot

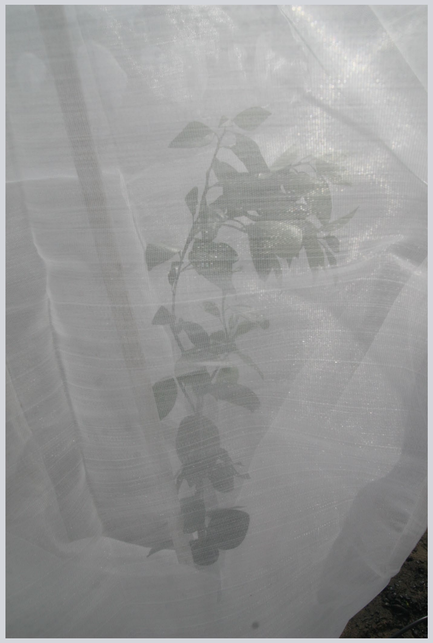
- Wind speed is slowed by mesh, reducing number of spores able to pass through (top graphic)
- Infection conditions still favorable in bags

Citrus Canker

- When rain drops hit the mesh, the drops become smaller and slower but more numerous (bottom graphic)
- Slower speed droplets are not able to force as many bacteria into leaves
- Some bacteria able to move into leaves by themselves



3 IPC MANAGEMENT



- Scouting is best, but if surrounded by older infected trees, canker and greasy spot are likely in IPCs
- Both can still cause defoliation, slowing tree growth
- Greasy spot inoculum may accumulate within the bags
- Copper application in early June and mid-July will help keep the leaves clean from greasy spot
- On young trees, a drench program of Blockade® is effective to reduce canker on leaves within IPCs in combination with copper applications
- As canopy becomes denser, will need to ensure adequate coverage for disease suppression
- More canker will occur on foliage as it starts to touch the mesh and require more management

Funding: USDA HLB Multi Agency Coordination Group

For more information, please contact Megan Dewdney, mmdewdney@ufl.edu

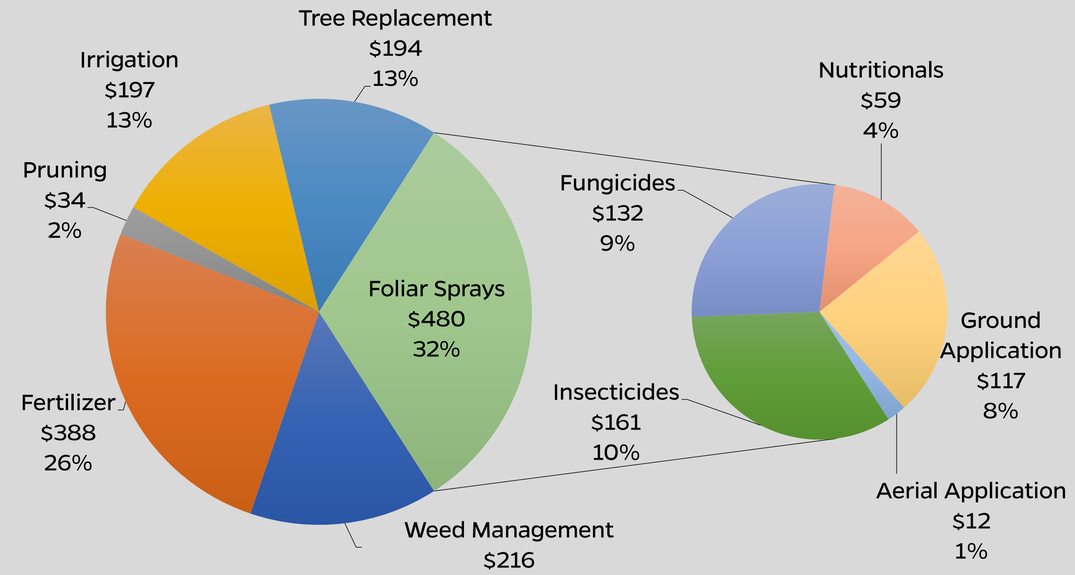
Cost of Production per Acre for Processed Oranges in Southwest Florida, 2020/21

CULTURAL COST OF PRODUCTION PER ACRE	
Costs represent a mature grove (10+ years old) including resets	
	Cost per acre ($)
Weed Management	215.64
Foliar Sprays	479.71
Fertilizer	387.96
Pruning (topping, hedging, chop/mow Brush)	33.58
Irrigation[1]	197.15
Total Cultural Costs of Production without Tree Replacement	**1314.04**
Tree Replacement (6 trees)	193.75
Total Cultural Cost of Production with Tree Replacement	**1507.79**

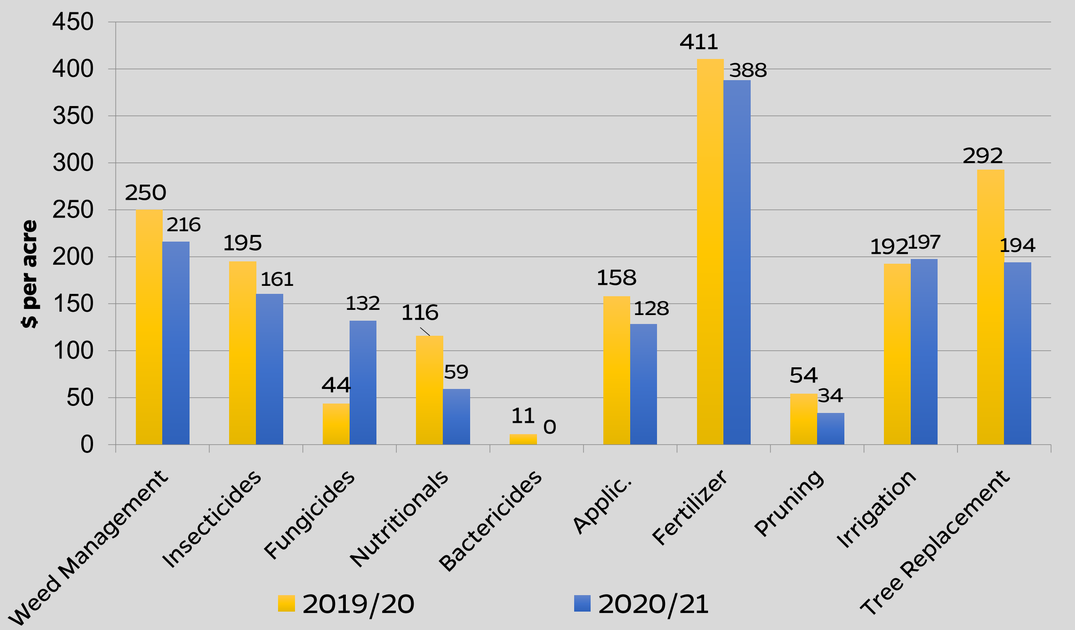
[1]Irrigation System Includes: Maintenance and Repairs to Emitters, Clean Ditches, Ditch and Canal Maintenance, Water Control

TOTAL COST OF PRODUCTION PER ACRE		
Total Cultural Costs		**1507.79**
Other Costs:	Interest on Operating (Cultural) Costs	75.39
	Management Cost	144.00
	Property Tax/Water Management Tax	28.73
	Interest on Average Capital Investment	165.57
Total Other Costs		**413.69**
Total Grower Costs		**1921.48**

Cultural Cost of Production per Acre



Cultural Cost of Production per Acre by Program



For more information, please contact Dr. Ariel Singerman, singerman@ufl.edu

Cost of Production per Acre for Fresh Grapefruit in Indian River, 2020/21

CULTURAL COST OF PRODUCTION PER ACRE

Costs represent a mature grove (10+ years old) including resets

	Cost per acre ($)
Weed Management	258.48
Foliar Sprays	1176.75
Fertilizer	535.50
Pruning (topping, hedging, skirting)	122.50
Irrigation[1] (including fuel)	169.11
Canker Control Costs[2]	25.00
Total Cultural Costs of Production without Tree Replacement	**2334.84**
Tree Replacement (2 trees)	105.58
Total Cultural Cost of Production with Tree Replacement	**2440.42**

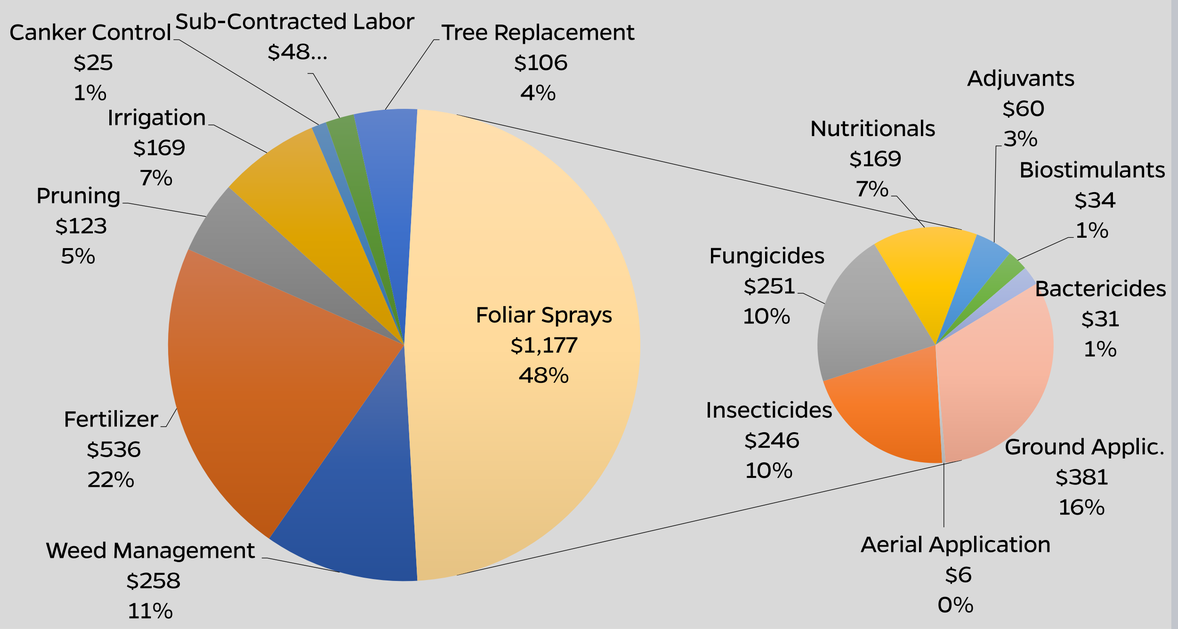
[1]Irrigation System Includes: Maintenance and Repairs to Emitters, Clean Ditches, Ditch and Canal Maintenance, Water Control

[2]Canker Control Includes: Clean Blocks Before Certification and Harvesting; Inspections before "Canker Free" Certifications; Mandatory Citrus Canker Decontamination Costs

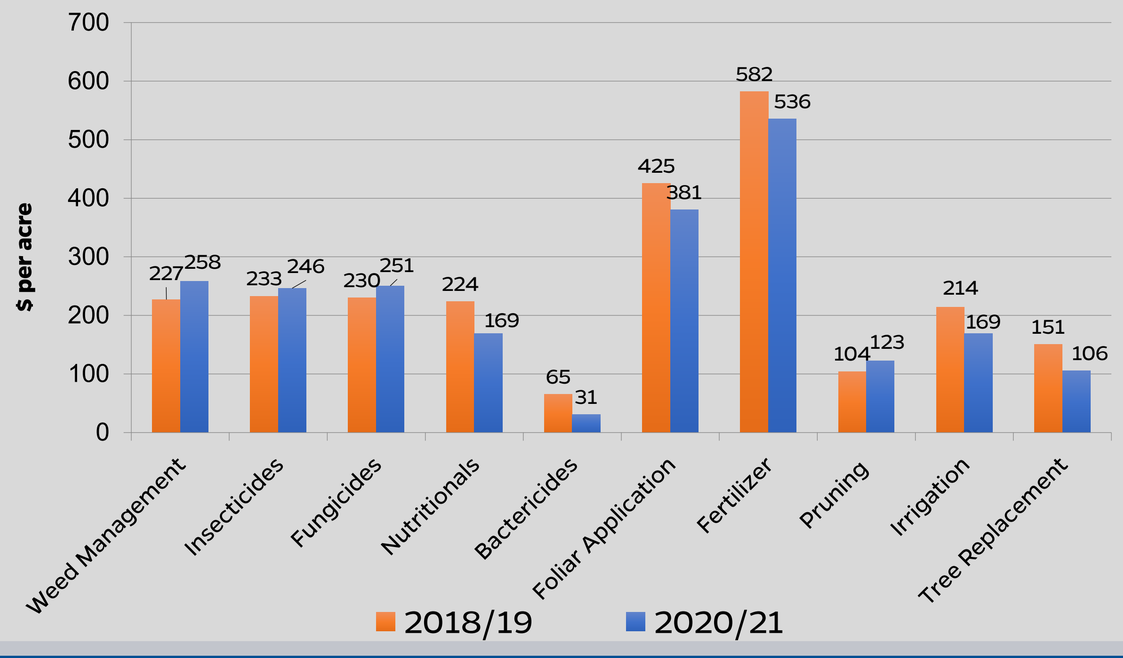
TOTAL COST OF PRODUCTION PER ACRE

Total Cultural Costs		**2440.42**
Other Costs:	Interest on Operating (Cultural) Costs	122.02
	Management Cost	145.00
	Property Tax/Water Management Tax	18.50
	Fly protocol	40.00
	Water Drainage District Assessment	107.00
	Interest on Average Capital Investment	165.57
Total Other Costs		**598.09**
Total Grower Costs		**3038.51**

Cultural Cost of Production per Acre



Cultural Cost of Production per Acre by Program



For more information, please contact Dr. Ariel Singerman, singerman@ufl.edu

UF IFAS Extension UNIVERSITY of FLORIDA

Break-Even Price Analysis

Southwest Florida

Early and Mids (Processed Oranges)	**Yield (boxes per acre)**								
	125	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**
	dollars per acre								
Cost of Production	1921	1921	1921	1921	1921	1921	1921	1921	1921
Pick and Haul	403	483	564	644	725	805	886	966	1047
FDOC assessment	15	18	21	24	27	30	33	36	39
Delivered-in Cost	**2339**	**2422**	**2506**	**2589**	**2673**	**2756**	**2840**	**2923**	**3007**
Break-even Price ($ per box)									
Delivered-in	18.71	16.15	14.32	12.95	11.88	11.03	10.33	9.74	9.25
Break-even Price ($ per pounds solids) assuming 5.15 pound solids per box									
Delivered-in	3.63	3.14	2.78	2.51	2.31	2.14	2.01	1.89	1.80

Valencia (Processed Oranges)	**Yield (boxes per acre)**								
	125	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**
	dollars per acre								
Cost of Production	1921	1921	1921	1921	1921	1921	1921	1921	1921
Pick and Haul	416	500	583	666	749	833	916	999	1082
FDOC assessment	15	18	21	24	27	30	33	36	39
Delivered-in Cost	**2353**	**2439**	**2525**	**2611**	**2698**	**2784**	**2870**	**2956**	**3043**
Break-even Price ($ per box)									
Delivered-in	18.82	16.26	14.43	13.06	11.99	11.14	10.44	9.85	9.36
Break-even Price ($ per pounds solids) assuming 5.66 pound solids per box									
Delivered-in	3.33	2.87	2.55	2.31	2.12	1.97	1.84	1.74	1.65

For more information, please contact Dr. Ariel Singerman, singerman@ufl.edu

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Break-Even Price Analysis

INDIAN RIVER (Fresh Grapefruit)	**Yield (boxes per acre)**								
	175	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**
	dollars per acre								
Cost of Production	3039	3039	3039	3039	3039	3039	3039	3039	3039
Pick and Haul	520	595	669	744	818	892	967	1041	1115
FDOC assessment	12	14	16	18	19	21	23	25	26
Delivered-in Cost	**3571**	**3647**	**3723**	**3800**	**3876**	**3952**	**4028**	**4104**	**4180**
Break-even Price ($ per box) (Assuming: 69% packout, 30% field run, price eliminations $9.52/box and $9.98/box for field run)									
On-tree	29.54	25.02	21.50	18.69	16.39	14.47	12.84	11.45	10.25
Delivered-in	31.89	27.37	23.85	21.04	18.73	16.82	15.19	13.80	12.60

For more information, please contact Dr. Ariel Singerman, singerman@ufl.edu

CITRUS EXOTIC DISEASE: CITRUS LEPROSIS

1 THE PATHOGEN: CITRUS LEPROSIS VIRUS

There are two virus types that cause Leprosis in citrus.
Each virus type contains several viruses.

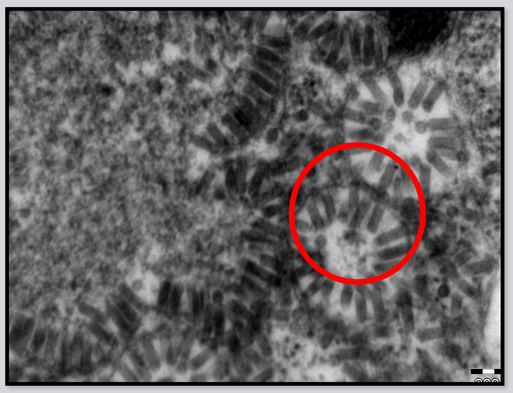
Cilevirus- Cytoplasmic type:
Caused economic losses in Brazil, Argentina, Paraguay, Uruguay, Venezuela, Costa Rica, Mexico, Panamá and Honduras

Virus particles in the cytoplasm

Citrus-affecting cytoplasmic type viruses:

- *Cilevirus*
  - Citrus leprosis virus – C (CiLV-C)
  - Citrus leprosis virus – C2 (CiLV-C2)
- *Higrevirus*
  - Hibiscus green spot virus 2 (HGSV-2)

Rhabdoviridae- nuclear type:
Was present in Florida from 1860s through 1960s.
OFV present in Florida, but NOT in citrus yet.



Virus particles in the nucleus

Citrus-affecting nuclear type viruses:

- *Orchid fleck virus (OFV)*
- *Citrus leprosis virus N (CiLV-N)*
- *Citrus Chlorotic spot virus (CiCSV)*

2 THE DISEASE: CITRUS LEPROSIS

Citrus leprosis primarily affects sweet oranges, but some grapefruit, mandarin, lime, sour orange, clementine, pummelo, kumquat and sweet lime can also be affected. Resistant genotypes include varieties of sour orange, 'Meyer' lemon, 'Royal' grapefruit, mandarins, 'Minneola' tangelo, and 'Temple' tangors.

Early stage, shallow lesions on stem

Early chlorotic leaf lesions

Early chlorotic lesions on fruit

Older lesions, corky and scaly bark

Older leaf lesions with zone pattern

Older lesions gumming cracking, distinct yellow halo

Funding:

For more information, please contact Amit Levy, amitlevy@ufl.edu

CITRUS EXOTIC DISEASE: STEM PITTING

1 THE PATHOGEN: CITRUS TRISTEZA VIRUS (VT isolate)

In addition to the decline of sweet orange or grapefruit trees on sour orange rootstocks, there are other diseases caused by different isolates of citrus tristeza virus (CTV). One important disease is stem pitting caused by the VT isolate.

- Causes severe disease symptoms in Asia, Australia, South Africa, Brazil, and Columbia
- Can be very serious on citrus types and varieties that are grown in Florida
- Currently only mild isolates are found in Florida citrus trees

Virus particles in the cytoplasm

Photo Credit: UF/IFAS

The virus is transmitted by the Asian Citrus Aphid and has the capacity to spread rapidly

- Brown Citrus Aphid present in Florida
- The aphids are capable of periodic outbreaks when conditions are right

2 DISEASE SYMPTOMS

Lime, grapefruit, sweet orange, rough lemon, and Alemow (*Citrus macrophylla*) are highly susceptible to stem pitting. Mandarins are considered tolerant but may show stem pitting under some conditions.

Photo Credit: Donielle Turner

<u>Mild</u>

- Needle-like ingrowth of the bark, causing pits in the stem and branches
- Only a few pits seen; no effect on plant vigor or yield

<u>Severe</u>

- Extensive pitting in the trunk and branches can cause:
  - Bark disruptions
  - Stunting
  - Small and misshapen fruit
  - Chlorotic leaves
  - Yield loss

Photo Credit: Cecile Robertson

Funding: UF IFAS UNIVERSITY of FLORIDA; CITRUS INITIATIVE, FUNDED BY THE FLORIDA LEGISLATURE

For more information, please contact Amit Levy, amitlevy@ufl.edu

Mites

Funding: UF IFAS UNIVERSITY of FLORIDA

1 SIX SPOTTED MITE IDENTIFICATION

- Adults are oval and about 3mm long
- Yellow body color with about 6 blotchy spots on abdomen, some have no distinct spots
- Feed along the midrib or larger veins on the underside of leaves
- Webbing around infested areas
- Occasional pest, most abundant after cold winters

SIX SPOTTED MITE FEEDING DAMAGE

- Primarily feed on mature leaves
- Yellow blistering on mature leaves becomes visible between March and May
- Leaf drop

Photo Credit: Tonya Weeks

2 CITRUS RED MITE IDENTIFICATION

- Females are oval, males have a tapered rear end
- Dark red in color
- Approximately 0.5 mm; male is smaller than female and has long legs
- Found on both leaves and fruit
- Common at low populations year-round, populations highest in March and June

Photo Credit: L. Buss, UF

CITRUS RED MITE FEEDING DAMAGE

- Primarily feed on mature leaves
- On leaves, damage is speckled and may have a silvery appearance
- Leaves and fruit may be pale in color
- Severe populations may cause leaf drop

Photo Credit: D. Rosen, University of California

3 TEXAS CITRUS MITE IDENTIFICATION

- Females (left) are a broad oval shape, males (right) are slender oval shape
- Males have longer legs than females
- Approximately 0.5 mm long
- Often located on upper side of leaf and move from the inner leaf to the outer leaf
- Common at low populations year-round, populations highest in March and June

Photo Credit: University of Arizona

TEXAS CITRUS MITE FEEDING DAMAGE

- Primarily feed on mature leaves
- Leaves will look speckled (stippling)
- High populations may cause leaf and fruit drop
- When leaves drop, the leaf petiole stays intact on tree
- Damage progresses from top of tree, then downward

Photo Credit: University of Texas

For more information, please contact Lauren Diepenbrock, ldiepenbrock@ufl.edu

Mites

1 BROAD MITE IDENTIFICATION

- Oval shaped
- Light yellow to reddish or brownish yellow, may be green
- Females have a stripe, whereas males do not
- Females are 0.2 mm long and males are 0.11 mm long; males move faster
- Feed on unhardened leaves and fruit

Photo Credit: L. Buss, UF

BROAD MITE FEEDING DAMAGE

- Leaf bronzing
- Leaf curling unevenly distributed on leaf, no pattern
- Feeding damage same on various plants (Dogwood pictured)
- Rind damage on developing fruit

Photo Credit: Tennessee State University

2 FLAT MITE IDENTIFICATION

Most common species in Florida citrus:

Brevipalpus yothersi

- Flat, wedged shaped
- Reddish-orange in color
- Females may have a black 'H' marking with green and dark spots
- Approximately 0.2 mm; males are smaller than females
- Can be found on both sides of leaf, stems, and fruit

Brevipalpus californicus

- Oval shaped
- Reddish-orange in color
- Short, stout legs Four legs in the front and 2 on each side
- Approximately 0.2 mm
- Often located on under side of leaf near midvein or other veins, also on fruit and stems

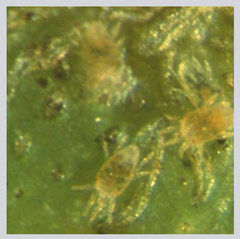


Photo Credit: C. Childers, UF

Photo Credit: R. Lehman, UGA

FLAT MITE FEEDING DAMAGE

- Vectors for citrus leprosis virus
- When populations are very high, leaf damage may occur

3 CITRUS RUST MITE IDENTIFICATION

- Wedge shaped, longer than wide
- Light yellow in color
- 0.15 mm long
- Feed on both fruit and leaves, but prefer fruit
- Often found on outer canopy fruit

Photo Credit: E. Demard, UF

CITRUS RUST MITE FEEDING DAMAGE

- Leaves and fruit have smooth, dark brown spots
- Extreme damage causes bronzing (pictured) on fruit; bronzing also occurs on leaves
- May cause smaller fruit size
- Most often found on outer canopy away from direct sunlight

Photo Credit: J.D. Burrow, UF

Funding:

For more information, please contact Lauren Diepenbrock, ldiepenbrock@ufl.edu

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