Challenges Growing Citrus in a Citrus Greening World

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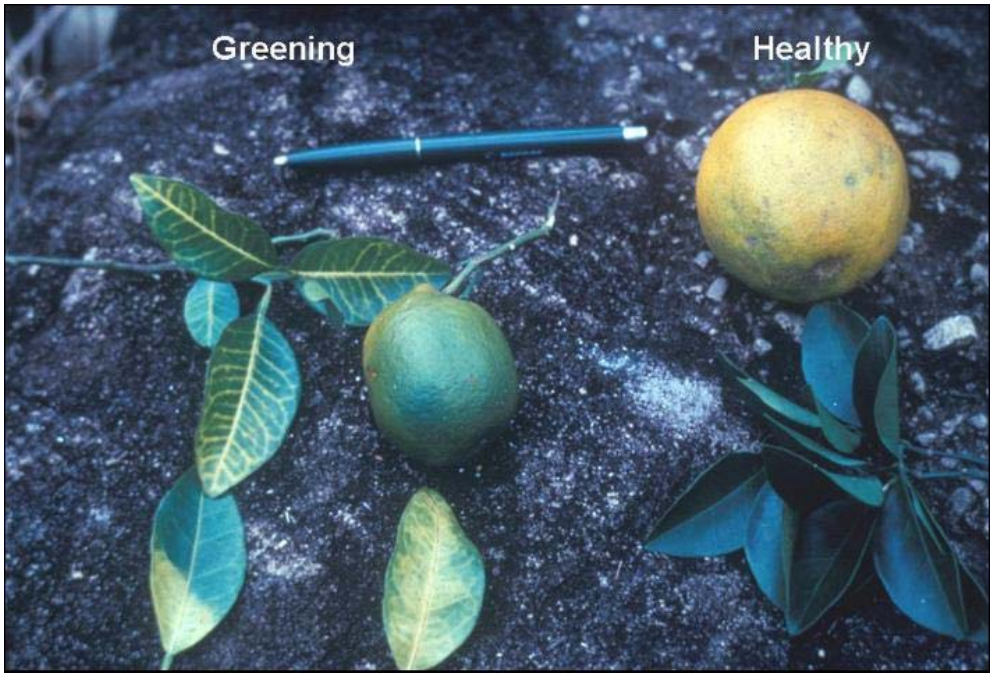
HLB

- Citrus Greening is known as HLB in other parts of the world.
- HLB stands for Huanglongbing, or “Yellow Dragon”.
- HLB has seriously affected citrus production in Asia, Africa, the Indian subcontinent and the Arabian Peninsula



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HLB

- In 2004 it was detected in Brazil
- In 2005 it was detected in South Florida
- Wherever the disease has appeared, citrus production has been compromised with the loss of millions of trees.

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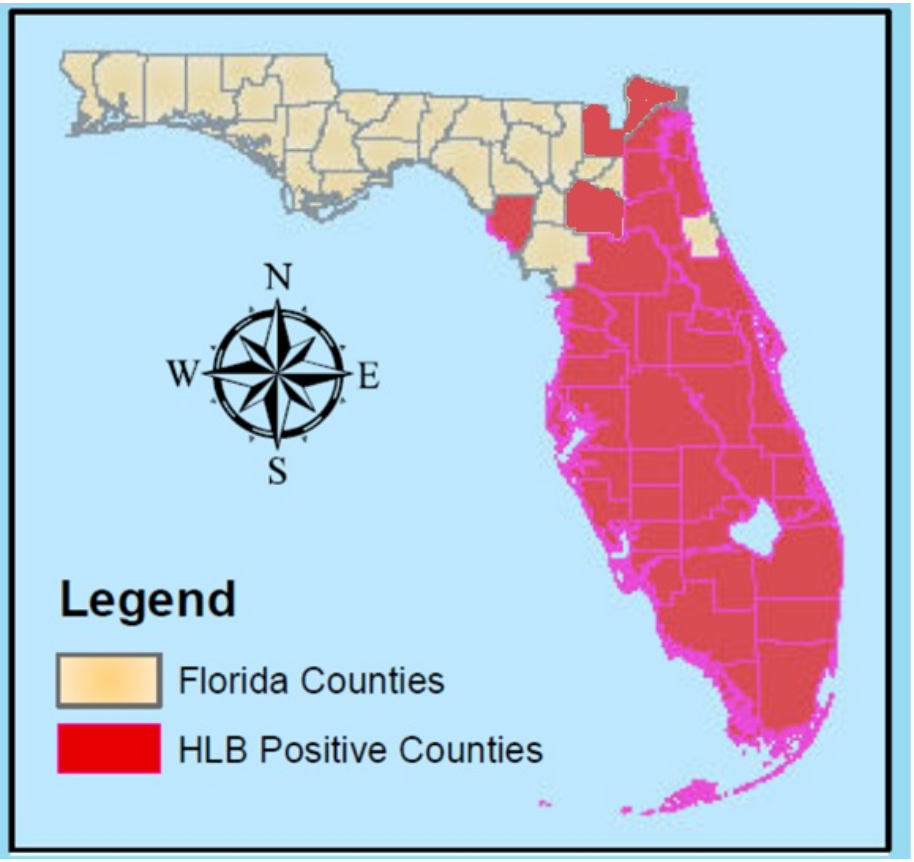
Citrus Greening



- HLB first was detected in the U.S. near Miami, Florida in August 2005, and to date has been confirmed to have spread to 41 Florida counties.
- The disease is currently found in California, Florida, Georgia, Louisiana, Puerto Rico, South Carolina, Texas and the U.S. Virgin Islands.
- The psyllids have been detected in Alabama, American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, Northern Mariana Islands, Puerto Rico, South Carolina, Texas and the U.S. Virgin Islands.

Citrus Greening

HLB is caused by a phloem-limited bacterium called *Candidatus Liberibacter asiaticus*

- Affects all citrus varieties
- No cure for the disease
- Spread from tree to tree by the **Asian Citrus Psyllid**

Citrus Greening bacterium in citrus tissue

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Asian Citrus Psyllid

- Psyllids fly or are carried by the wind to new plants
- Psyllids feed on an infected tree and then transmit the bacteria to healthy trees

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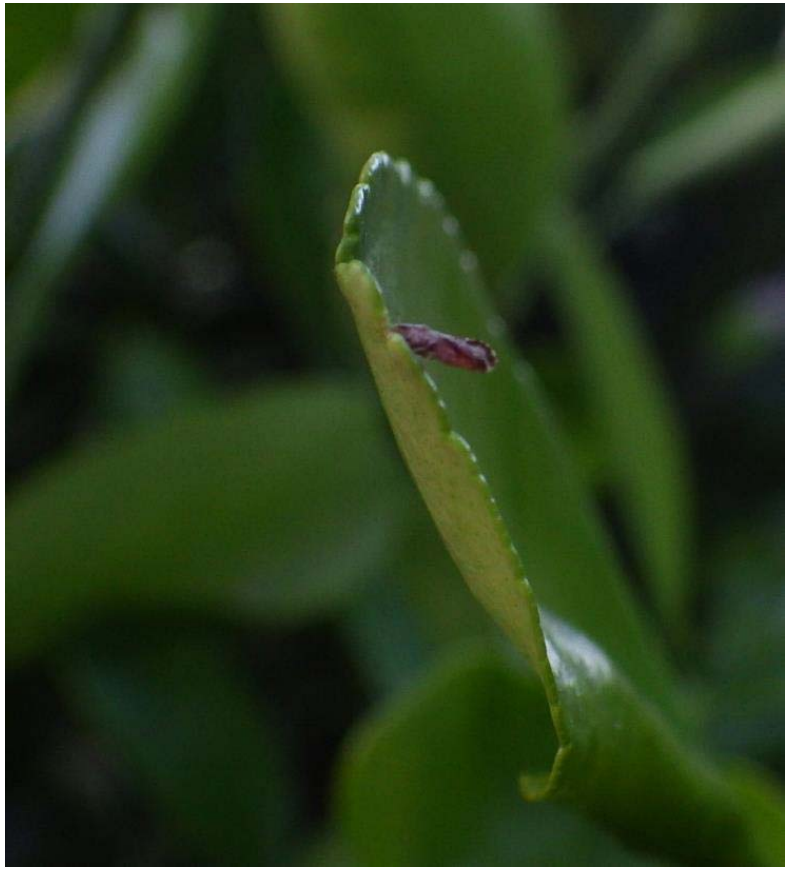
VERY SMALL INSECTS



https://www.youtube.com/watch?v=C3XDRGu_f_A

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HLB

Can infect nearly all citrus species, cultivars and hybrids, as well as some citrus relatives. The HLB bacterium can also multiply in Chinese box orange (*Severinia buxifolia*) and wood apple (*Limonia acidissima*).

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What happens to the tree

- In a plant, water moves through the xylem, and sugar and minerals move through the phloem.
- The bacterium colonizes the phloem restricting the flow of nutrients throughout the tree
- Before the symptoms show up in the foliage, the roots are damaged causing even more decline

Photo: UF/IFAS

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Tree Appearance

- Early symptoms of yellowing may appear on a single shoot or branch.
- The yellowing usually spreads throughout the tree over a year, especially on young trees
- Affected trees may show twig dieback, causing the productivity to decline within a few years.

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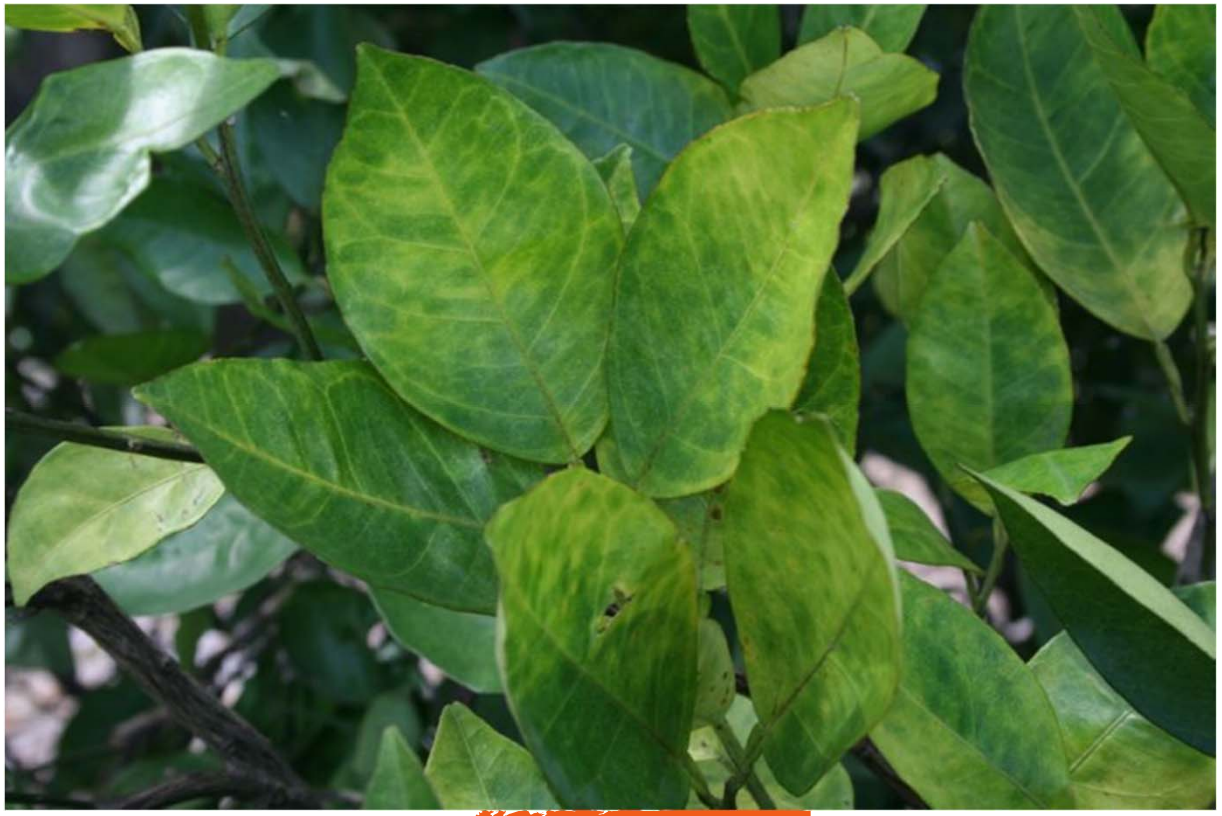
Leaf Symptoms



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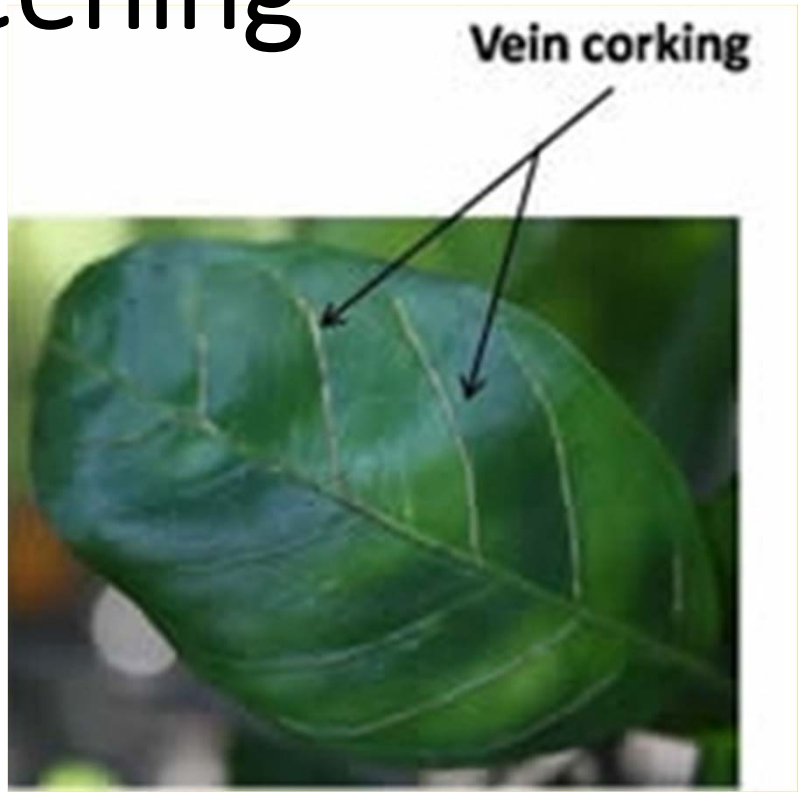
Citrus Greening

- Leaf symptoms include blotchy mottle, yellow veins, vein corking or green islands
- Yellow veins, vein corking or green islands are not diagnostic alone



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Blotchy Mottle on Lemon

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Photo Credit Jamie Burrow, UF/IFAS CREC

Blotchy Mottle on Sweet Orange

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Photo Credit Jamie Burrow, UF/IFAS CREC

Blotchy Mottle on Sweet Orange

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Photo Credit Jamie Burrow, UF/IFAS CREC

Blotchy Mottle on Navel Orange

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Photo Credit: Larry Figart

Blotchy Mottle on Navel Orange

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Photo Credit: Larry Figart

Diagnosing Leaves

- Circle areas on opposite sides of the mid-vein. Are they the same on both sides?
- Nutrient deficiencies are symmetrical and HLB symptoms are asymmetrical

Nutrient Deficiency

Greening

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Look a likes

A.Greening
B.Manganese
C.Zinc
D.Nitrogen

Fruit Symptoms

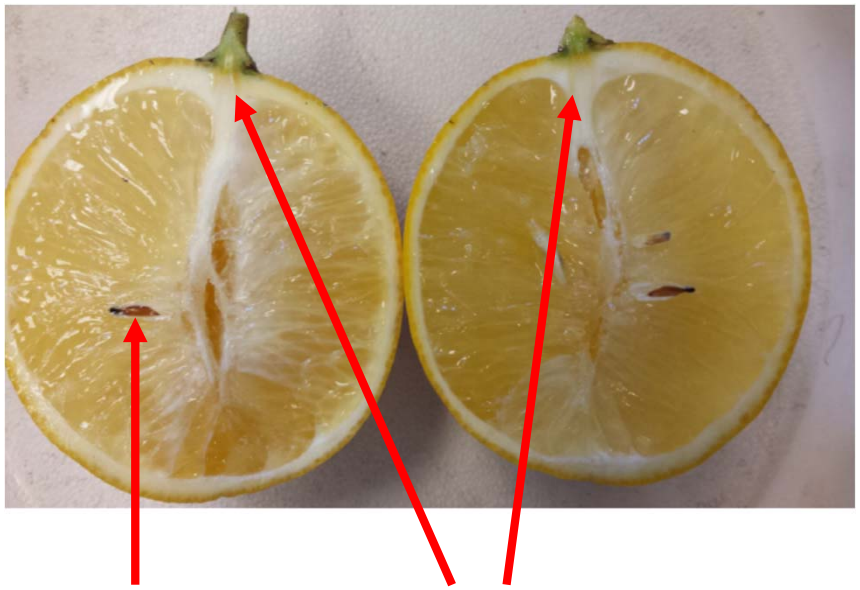
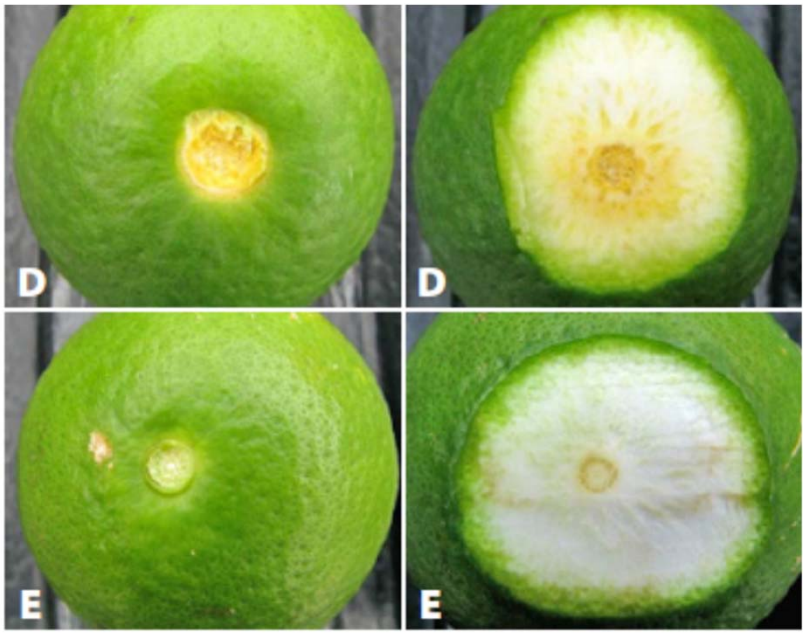


Photo: Brooke Moffis, UF/IFAS Lake Co.

- The fruit may taste salty and bitter (usually a late symptom)
- The internal appearance may have aborted seeds, yellow stain beneath the calyx button and/or a curved central core

Fruit Symptoms



D: Yellow Calix Stain E Healthy Fruit

- Additionally, fruit often have a yellow stain below the calyx (point of stem attachment, D) when compared to healthy fruit (E).

Fruit Symptoms

- Fruit external appearance may be lopsided, misshapen or small green fruit
- The Stylar end (opposite of Stem End) can remain green

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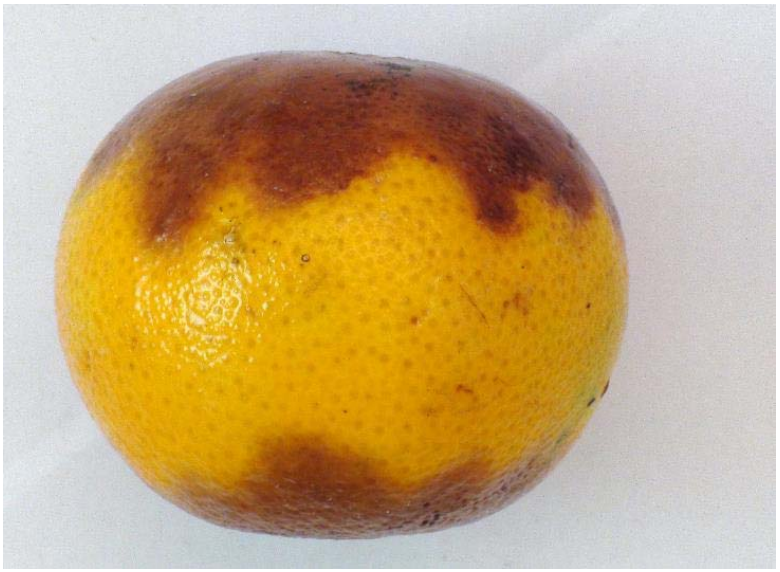
Fruit Symptoms

- Premature Fruit Drop
- Diplodia



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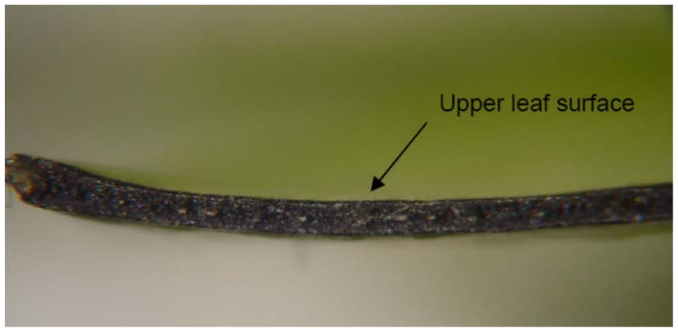
Iodine Test

1. Using a sharp, clean razor blade, cut a section from the selected leaf that includes the symptomatic tissue. Do not cut through the mid-vein, rather cut sections from the leaf blade on either side of the mid-vein.

2. Immerse the cut section(s) of leaf in the prepared iodine solution for 1.5 - 2 minutes.

3. Remove the sections and rinse with clear water.

4. Examine the cut edge of the section(s) for dark staining using a hand lens or magnifying glass.



www.crec.ifas.ufl.edu/extension/greening/PDF/HS37500.pdf

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Where to send Samples

Mail leaf samples to:

UF Plant Diagnostic Center

2570 Hull Rd, Bldg 1291

Gainesville, FL 32611-0830

https://plantpath.ifas.ufl.edu/extension/plant-diagnostic-center/

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How to collect samples

- If possible, samples should be collected from late July through March
- Leaves from the sampled branch/twig should be fully expanded and hardened.
- Collect 6-8 leaves (including the leaf petiole) from around the tree.
- Samples should be collected from the symptomatic areas/branches of the trees.
- Should be sent so the samples arrive early in the week and not sitting at the lab over the weekend.

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Future Greening Control

- At the present time there is NO Control for HLB
- Some research is being applied to develop an environmentally sage, systematic bactericide that can be applied with conventional spray or drench technology.
- Citrus breeding program to develop an HLB-resistant citrus cultivar.
- Producing Citrus Under Screen (CUPS)
- Develop an effective microbial treatment for citrus plants affected by HLB.
- New methods to control the Asian Citrus Psyllid
- Genetic Modification

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Living With Greening

- Tolerant Varieties such as ‘Sugar Belle’
- Fertilizing more with Slow Release Fertilizers and Micronutrients
- Micronutrient Sprays

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Living With Greening

- Sugar Bell was originally developed in 2009 to compete with the California easy peel fruit
- The mandarin hybrid — a mix of the sweet Clementine and Minneola
- The sweet-tart fruit may be best described as a mandarin with a tangy punch.
- Hard to find unless you want to take a day trip to Palatka

Fertilizing Citrus

- Check pH first, it may be causing nutrient availability problems
- Citrus pH should be from 6-6.5
- Slow Release (SRF) fertilizers are best but may be hard to find
- Read the Label: the sample to the left is 50% slow release nitrogen which is good.

Miracle-Gro® Citrus, Avocado, & Mango Food 6-4-6

GUARANTEED ANALYSIS F1144

Total Nitrogen (N) 6%
1.50% Ammoniacal Nitrogen
3.41% Urea Nitrogen*
1.00% Other Water Soluble Nitrogen*
0.09% Water Insoluble Nitrogen*
Available Phosphate (P_2O_5) 4%
Soluble Potash (K_2O) 6%
Calcium (Ca) 11.5%
Magnesium (Mg) 8%
0.25% Water Soluble Magnesium (Mg)
Iron (Fe) 0.36%
0.0004% Water Soluble Iron (Fe)
Manganese (Mn) 0.13%
0.09% Water Soluble Manganese (Mn)

Derived from: Methyleneureas, Polymer-coated Urea, Urea, Ammonium Phosphate, Potassium Chloride, Dolomitic Limestone, Magnesium Oxide, Magnesium Sulfate, Iron Oxide, Ferrous Sulfate, Manganese Oxide, and Manganese Sulfate.

*3.04% slowly available nitrogen from Methyleneureas and Polymer-coated Urea

Information regarding the contents and levels of metals in this product is available on the Internet at http://www.regulatory-info-sc.com

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How Much Fertilizer

Table 1: Citrus Fertilization Table

Tree Age	*Cups of Fertilizer per Application*			*Applications per year*
	6-6-6	*8-8-8*	*10-10-10*	
1	.5-1.5 cups	.5-1.25 cups		6
2	2-4 cups	1.5-3 cups		5
3	3.5-7 cups	2.75-5.5 cups		4
4	8.5-11.25 cups	6.5-8.25 cups	5.25-6.5 cups	3
5+	12-15.5 cups	9-11.5 cups	7.25-9.25 cups	3

**Year 1 starts at planting.*

Based on the **Nitrogen** Percentage

Living With Greening, Micronutrients

- Greenhouse studies that showed root mass and HLB-infected tree growth were improved when slow-release minor elements, especially manganese, were applied at three times the normal rate.
- Limited field trials have shown a positive response as well.

florikan CRF

MEG-IRON V

Micro Nutrient Mix

GUARANTEED ANALYSIS:

Calcium (Ca)	5.00%
Magnesium (Mg)	10.20%
8.10% Water Soluble Magnesium (Mg)	
Sulfur (S)	15.50%
15.5% Combined Sulfur (S)	
Copper (Cu)	0.45%
0.32% Water Soluble Copper (Cu)	
Iron (Fe)	5.30%
2.05% Water Soluble Iron (Fe)	
0.37% Chelated Iron (Fe)	
Manganese (Mn)	1.05%
Zinc (Zn)	0.74%
0.58% Water Soluble Zinc (Zn)	
Boron (B)	0.05%

DERIVED FROM: Ferrous Sulfate, Iron Sucrate, Magnesium Sulfate, Magnesium Sucrate, Iron EDTA, Iron Citrate, Sodium Borate, Manganese Sucrate, Zinc Sulfate, Zinc Sucrate, Copper Sulfate, Copper Sucrate, Calcium Sulfate

The below rates are provided as a guide only. Specific rates will vary by region, soil type, and performance requirements. Before deciding which formulation, release type, and rate to use, contact your Florikan Technical Representative. They will advise you in choosing the right product for your crop and conditions.

INCORPORATION RATES - LBS PER CUBIC YARD	LOW	MED	HIGH	HEAVY
LBS	0.68	1.36	1.81	2.27

BROADCAST RATES - LBS PER 1000SQFT	LOW	MED	HIGH	HEAVY
LBS	0.91	1.36	1.81	2.27

NOTE: low/med/high is crop specific information. HIGH refers to heavy feeding crop, LOW is for sensitive feeding crop.

Conversion
5 Grams = 1 Teaspoon | 15 Grams = 1 Tablespoon

TOP DRESS RATES - GRAMS PER CONTAINER				
VOL	LOW	MED	HIGH	HEAVY
1 GAL	5	5	10	15
3 GAL	10	15	20	25
7 GAL	15	20	30	40
10 GAL	20	25	35	45
15 GAL	25	35	45	60
20 GAL	30	40	55	70
25 GAL	35	50	65	85
45 GAL	50	60	100	150
65 GAL	80	100	155	220

This product was developed in conjunction; and with assistance from NASA using cutting edge research, quality control and scientific methodology.

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Living With Greening, Micronutrient Sprays

- CONTAINS: Iron 1.2%, Zinc 1.7%, Manganese 1.2%, Magnesium 1.0% and Sulfur 4.1%.
- USE ON: Citrus, avocados, mangoes and other tropical fruits.
- CONTROLS: Most common minor element deficiencies.
- RATE: 1 tablespoons per gallon of spray. Apply 2-3 times a year

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Living With Greening, Summary

- Things are probably going to get worse before it gets better
- New varieties take time to verify resistance and even more time to be made available to public
- No treatment is curative
- Overcoming nutrient uptake problems by use of slow release fertilizers and micronutrients is a way of prolonging productivity

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ANY QUESTIONS

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