Citrus Greening, Prevention, Identification and Treatment

Sarasota Fruit & Nut Club

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Sarasota, Florida

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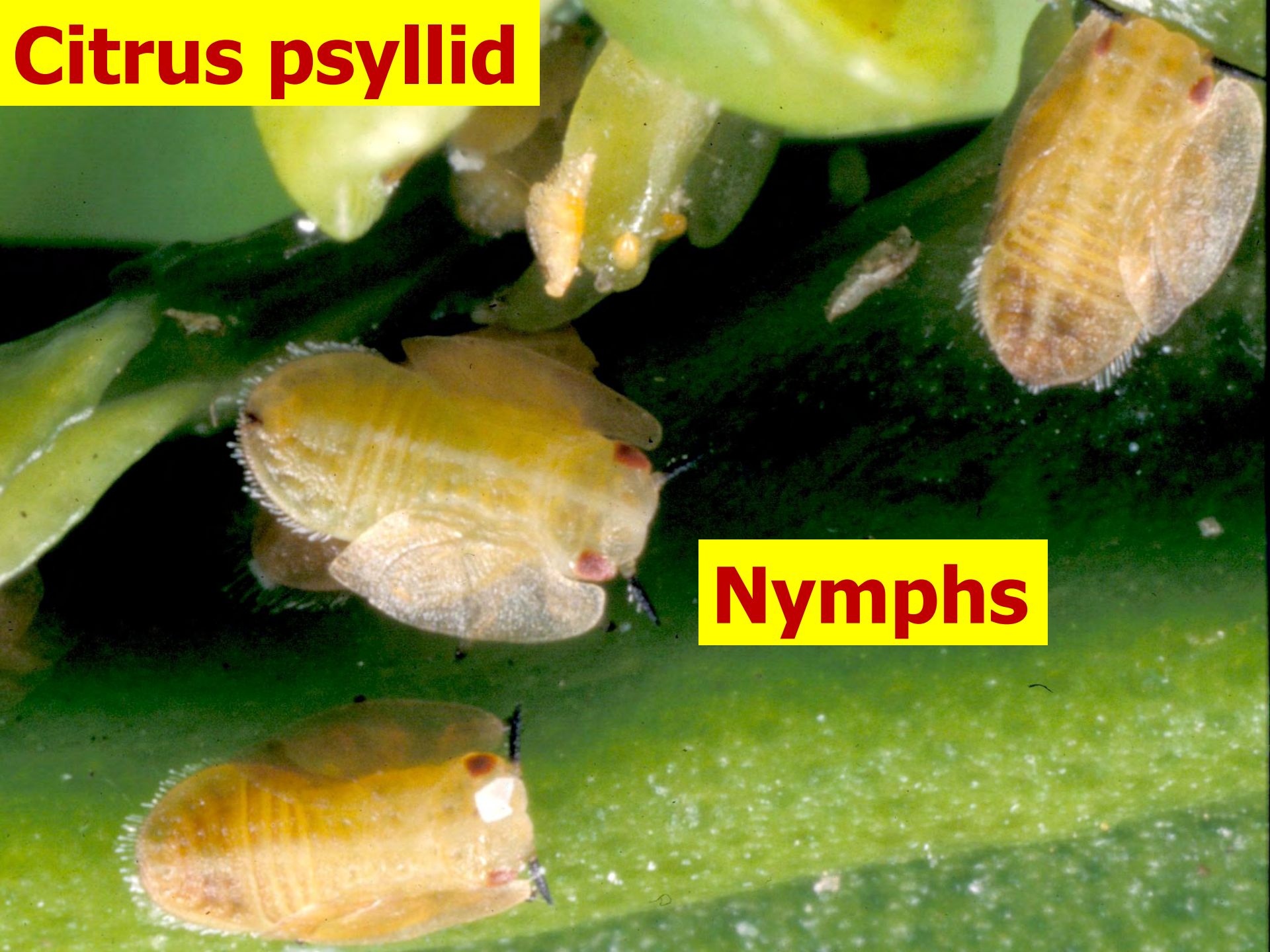
UNIVERSITY OF FLORIDA
Institute of Food and Agricultural Sciences

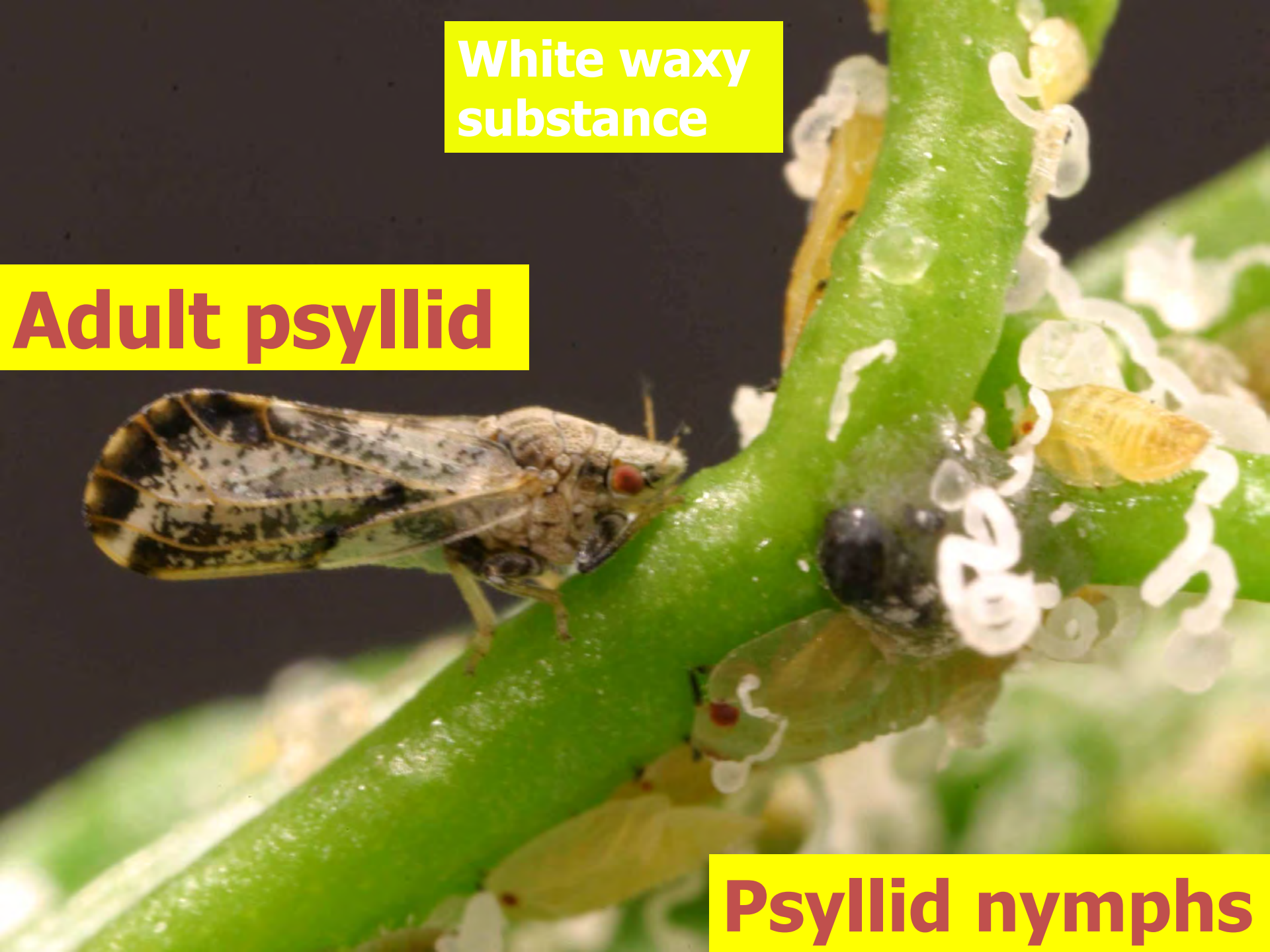
CITRUS GREENING AGENT

- Citrus Greening (HLB)
- Huanglongbing "yellow shoot"
- Bacteria (*Candidatus Liberibacter* CLas)
- Strains: Asiaiatic, Africanus, Americanus


Diaphorina citri.
Citrus psyllids


Citrus psyllid
Adult


Citrus psyllid
Nymphs


White waxy substance
Adult psyllid
Psyllid nymphs

Psyllid damage

HLB IDENTIFICATION

1. DNA PCR (Polymerase Chain Reaction)
2. Visual Field Identification


Citrus greening
Huanglongbing
(HLB)

Citrus Greening

"Yellow Shoot" disease

Green islands (spots) develop

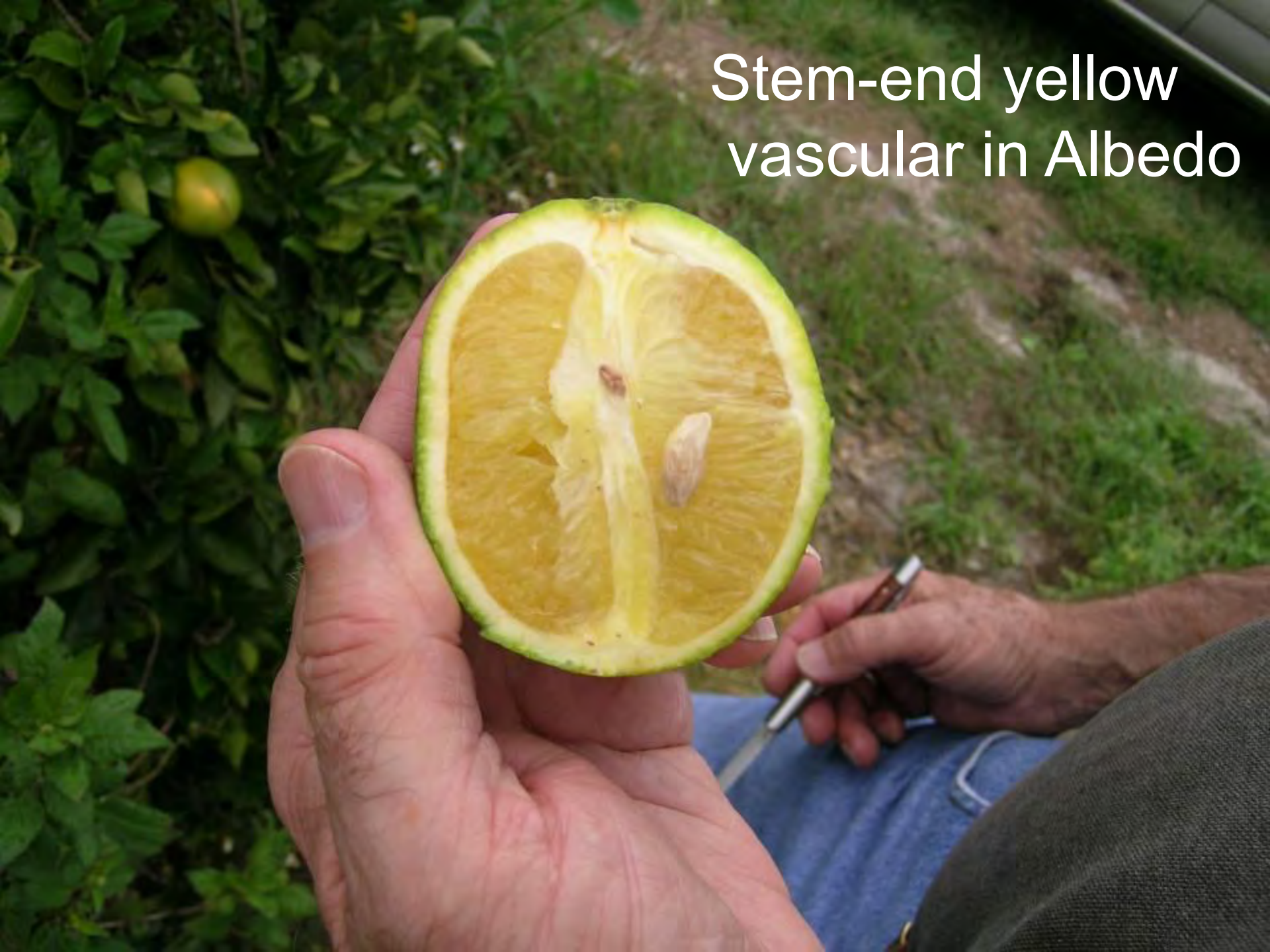

Clasic Blotchy Mottle


Blotchy mottle

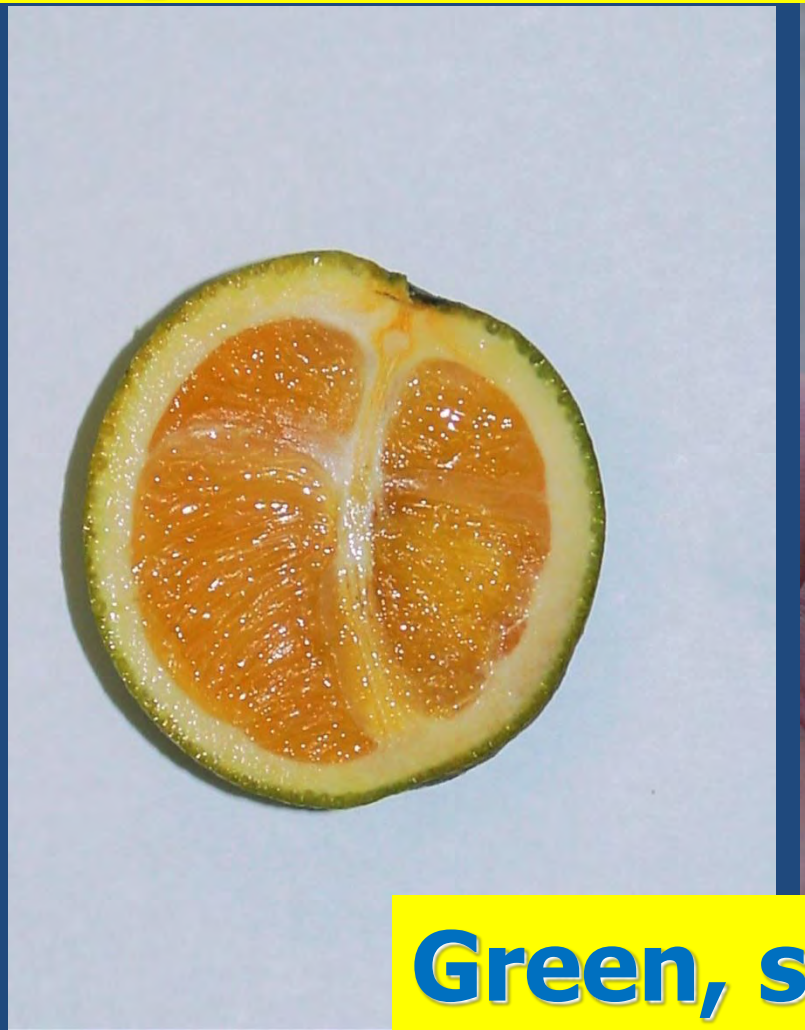
Blotchy mottle

Small Green Fruit, Non-symetrical, & Aborted Seed

Lopsided fruit


Stem-end yellow
vascular in Albedo

Lopsided fruit



Green, small size fruit

TREATMENT OF HLB TREES

1. Let the tree remain as it is productive
2. Remove the tree
3. Foliar nutritional sprays

Per acre (250 gal/acre)	Product
2.25 lbs (2010 Serenade ASO)	Serenade Max WP
2 qts	Di-Oxy Solv organic
8 gal	*14-7-8 w/K-phite (1-pt/gal)
or	
8 gal	3-18-20 w/K-phite (1-pt/gal)
8.5 lbs	Epsom Salts (MgSO4)
8.5 lbs	Techmangam (MnSO4)
2.8 lbs	Zinc Sulfate
0.85 oz	Sodium Molybdate
8.5 lbs	13-0-44 spray grade (KNO3)
1 qt	SAver w/ammonium sylicylate
5 gal	435 Oil
3.3 lbs.	Beau-Ron (B)

* When using 14-7-8 (spring) eliminate the 3-18-20

1	2	3	4	5
SAR				SAR
K-Phite	K-Phite			
Micro	Micro	Micro	*	*
~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~
K2NO3 +oil	K2NO3 +oil	K2NO3 +oil	K2NO3 +oil	K2NO3 +oil
6	7	8	9	10
SAR	SAR		SAR	untreated
K-Phite		K-Phite	K-Phite	
*	Micro	*	Micro	*
~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~	~~Hydrogen Peroxide~~		
K2NO3 +oil	K2NO3 +oil	K2NO3 +oil	K2NO3 +oil	

269 Hamlin Trees
Row

RESULTS

HLB Trees Before and After

NUTRIENT TREATMENTS

Pictures (worth 1000 words) tell the story

February 2008

February 2010

Trt 1

Micronutrients, K-Phite, SARs
+ (13-0-44, Oil, H_2O_2)


3-20W 10-04-10
before 12-15-10
freeze


Picture 01-14-11 after 12-15-10 freeze
3-20W

February 2008

February 2010

Trt 2

Micronutrients + K-Phite
+ (13-0-44, Oil, H_2O_2)


3-13W 10-04-10


3-13W

February 2008

February 2010

Trt 8

K-Phite
+ (13-0-44, Oil, H_2O_2)


4-11W 10-04-10


4-11W

February 2008

February 2010

Trt 9

Micronutrients, K-Phite, SARs
+ (13-0-44, Oil) no H_2O_2


5-23E 10-04-10


5-23E

February 2008

February 2010

Trt 10

Untreated Control


6-19E 10-04-10


6-19E

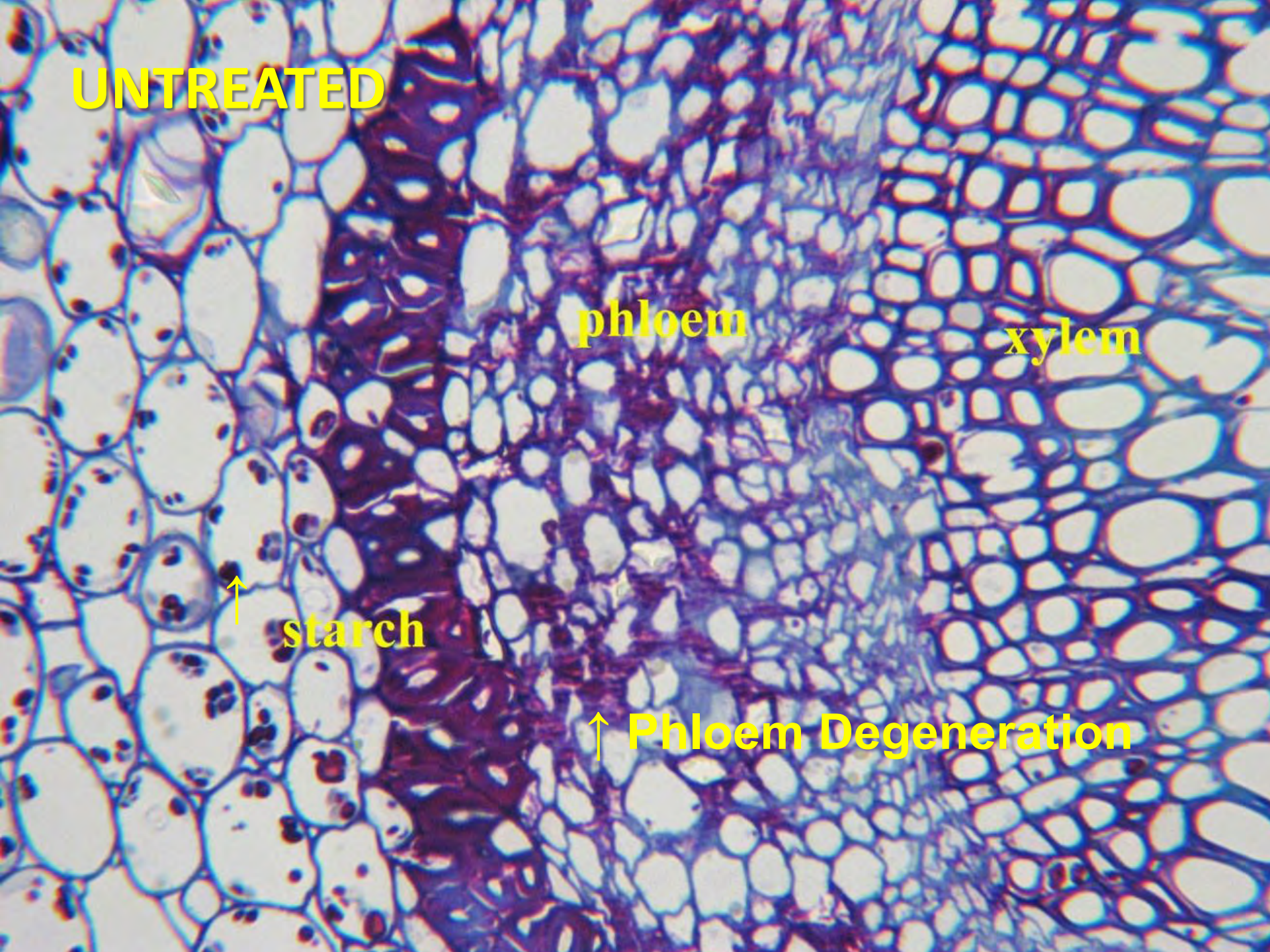

Why do roots under a tree treated with foliar nutrition look good when the tree has HLB?

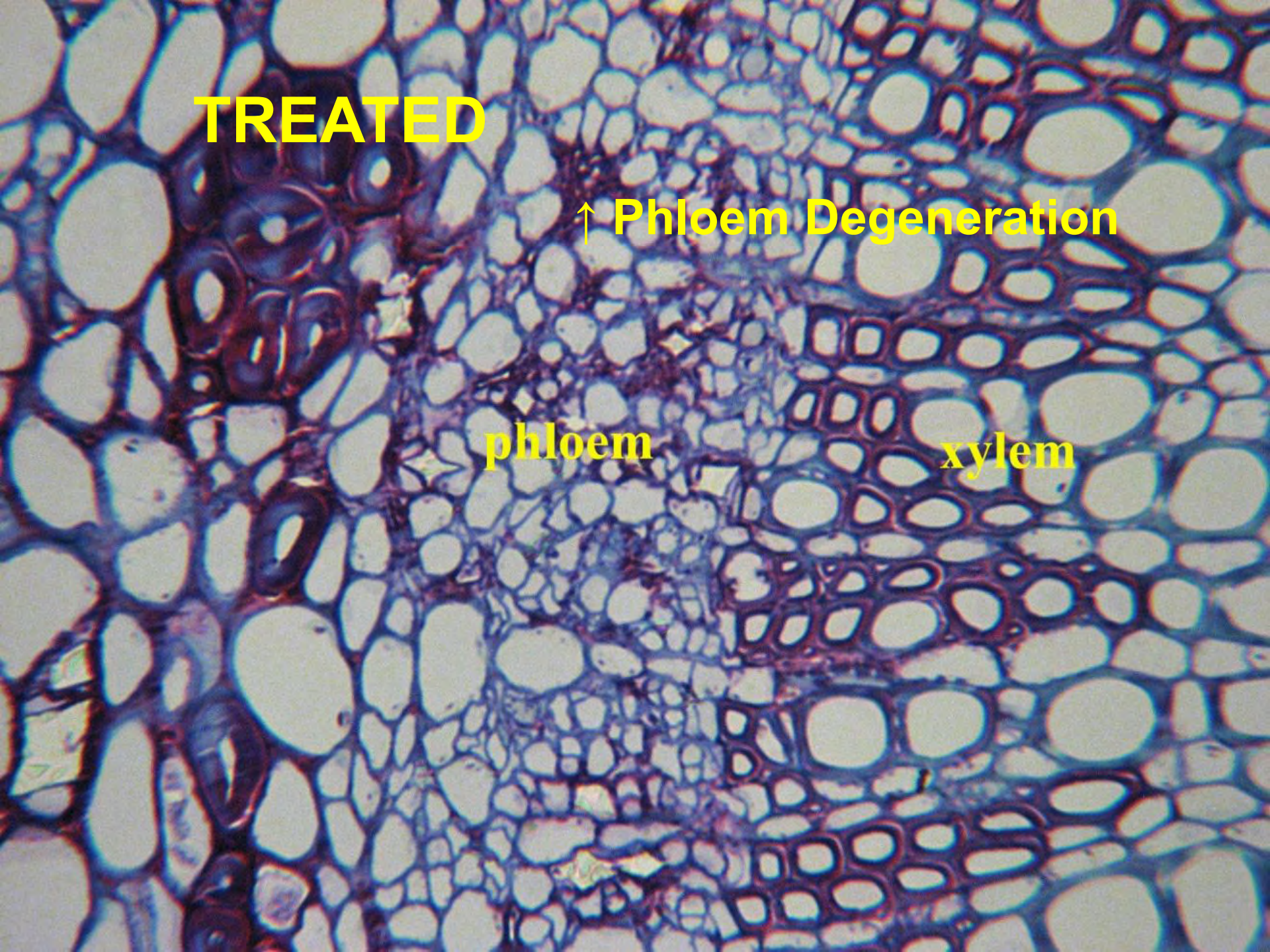
2009 & 2010 Root Study

Direction		Root density cm root/cm^3 soil	
2009	2010	2009	2010
N	NE	0.905 a	1.331 a
S	NW	0.901 a	1.331 a
E	SE	0.831 a	1.270 a
W	SW	0.871 a	1.375 a

Depth (inches)	Root density cm root/cm^3 soil	
	2009	2010
0 - 6	1.016 a	1.576 a
6 - 12	0.734 b	1.081 b

Treatment		Root density cm root/cm^3 soil	
2009	2010	2009	2010
9	8	1.09 a	1.57 a
3	9	0.99 ab	1.55 a
2	7	0.93 abc	1.52 ab
8	4	0.93 abc	1.48 abc
4	6	0.92 abc	1.47 abc
7	5	0.85 abc	1.42 abc
5	1	0.84 abc	1.25 bcd
10	2	0.83 abc	1.21 cd
6	3	0.74 bc	1.02 de
1	10	0.67 c	0.77 e


UNTREATED
phloem
xylem
starch
Phloem Degeneration


TREATED
↑ Phloem Degeneration
phloem
xylem

Preliminary Conclusions

1. Nutrition works , macro and micronutrients core
2. Addition of Phosphite enhances yield response
3. SARs stimulate growth, but HLB uncertain
4. Hydrogen peroxide as applied no HLB effect
5. Trees with HLB less tolerant to stress (drought, freeze, canker, other diseases, etc.)
6. Preliminary data suggests phloem is functional where nutrients are applied

CASE STUDY

Southwest Florida Citrus Grove using the Foliar Nutritional Spray Program

Orange Hammock Grove

- 400 acres planted 1992
- Hamlin (125 ac) & Valencia (275 ac)
- Rootstocks Swingle & Carrizo
- Spacing: 22’ x 12’ (165 trees/acre)
- Flatwoods bedded grove
- Two row beds
- Maxijet emitters
- Psyllid control sprays aerial
- Dry ground applied fertilizer
- Foliar applied nutritionals & SARs


Orange Hammock Grove
Mature trees
100 trees
Valencia/Swingle
Carrizo
Young trees
100 trees
© 2009 LeadDog Consulting
© 2009 Europa Technologies
© 2009 Tele Atlas
Google
Imagery Date: 2005
26°31'16.53" N
81°27'41.52" W
elev 35 ft
Eye alt 6137 ft


Spring 2006


February 29, 2012

Young Valencia Tree Block

Summer 2007


March 2012

Nutrition Program

Foliar Spray:

- Serenade
- Sonata
- Renew (N-P-K)
  - K-Phite (Phosphite)
  - SAver (SA)
- Magnesium Sulfate
- Manganese Sulfate
- Zinc Sulfate
- Sodium Molybdate
- 44 Spray Grade (KNO_3)
- Spray Oil
- Turfpro
- Hydrogen peroxide

Ground Applied:

- Calcium Nitrate
- DAP
- Ammonium Nitrate
- SPM
- MOP
- Magnesium
- Iron
- Boron w/herbicide application
- Copper – as nutritional only 13-0- when needed

HLB Symptom Rating Systems

100 trees (10 trees x 10 rows) in 2 blocks

0 = Vigorous, no symptoms

1 = Vigorous, slight symptoms

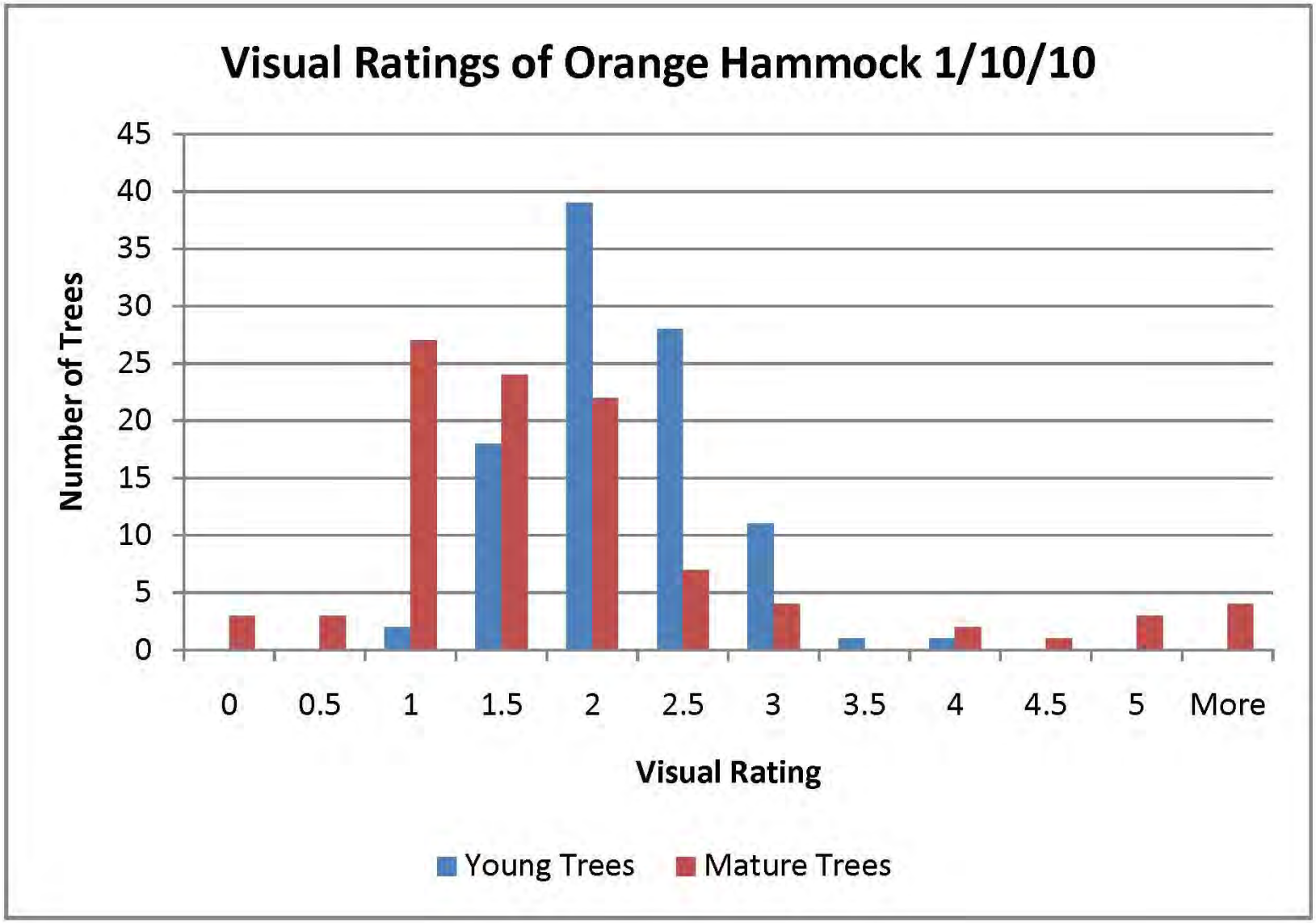
2 = Slight decline (symptomatic)

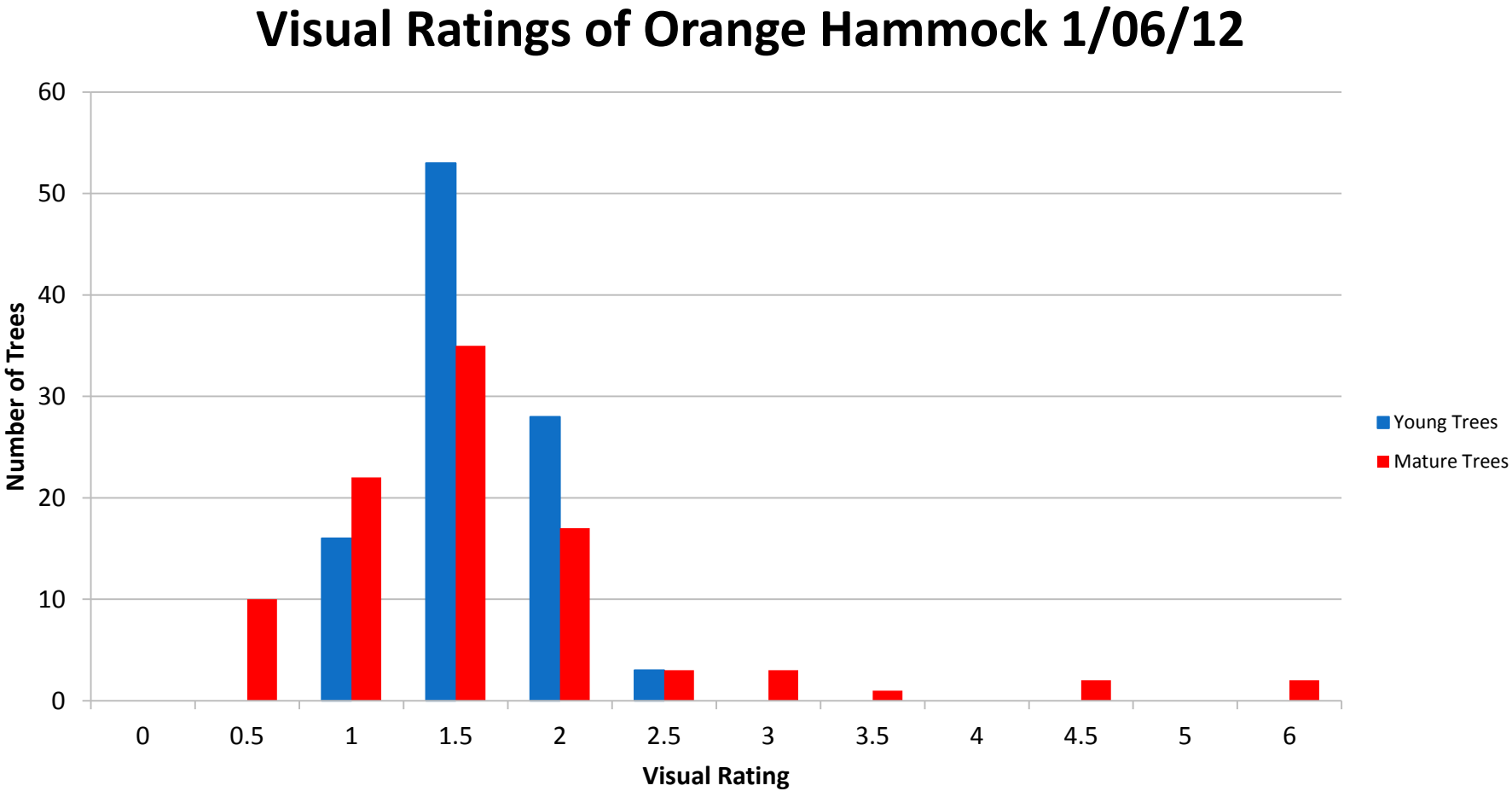
3 = Moderate decline (symptomatic)

4 = Sever decline (symptomatic)

5 = Won’t recover

6 = Missing tree


Visual Ratings of Orange Hammock 1/10/10
Number of Trees
45
40
35
30
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
More
Visual Rating
Young Trees
Mature Trees


Visual Ratings of Orange Hammock 1/06/12
60
50
40
30
20
10
0
Number of Trees
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
6
Visual Rating
Young Trees
Mature Trees

Mature Valencia Trees

2008 PCR Results
40 % positive

		+							
				+	+		+		
				+			+		
?		+		+	+		+		
?		+					+	+	
?			+		+		+	+	+
?		+	+		+		+	+	+
+				+			+	+	
+			+			+	+	+	
	+		+		+	+	+	+	+

2010 PCR Results
91 % Positive

+	+	+		+	+	+	+	+	
+		+	+	+	+	+	+	+	+
+		+		+	+	+	+	+	+
blight	+	+		+	+	+	+	+	+
blight	+	+		+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
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+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	blight	+

Young Valencia Trees

2008 PCR Results
81 % positive

+	+		+	+		+	+	+	+
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	+		+		+	+	+	+	+

2010 PCR Results
100 % Positive

+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+
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+	+	+	+	+	+	+	+	+	+

Mature Valencia Trees

Jan. 2012
PCR Results
95 % positive

+	+	+	+	+	+	+	+	+	+
+		+	+	+	+	+	+	+	+
+		+	+	+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
blight	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	
+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	blight	+

Young Valencia Trees

Jan. 2012
PCR Results
100 % Positive

+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+
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+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+

Production

Orange Hammock Grove (Hendry County)

Season		Hamlin				Valencia	
	Wt. Boxes	Lb. slds/bx	Bx/ac		Wt. Boxes	Lb. Slds/bx	Bx/ac
2011-12	72,697	5.62	599		87587	6.37	514
2010-11	70,996	5.67	586		74,223	6.36	436
2009-10	54,942	5.52	453		70,660	6.43	415
2008-09	87,938	5.67	725		75,580	6.63	444
2007-08	73,671	6.14	608		105,045	6.64	617
2006-07	65,495	5.73	540		68,791	7.10	404
2005-06	65,981	5.49	544		69,423	7.36	408
2004-05	73,381	6.00	605		86,104	7.22	506
2003-04	83,403	4.97	688		107,933	6.56	634
2002-03	65,004	5.17	536		76,911	6.15	452
2001-02	66,565	5.33	549		80,376	6.23	472
2000-01	67,425	5.39	556		57,659	5.89	339
1999-00	58,206	5.21	480		61,602	6.51	362

Conclusions

- ✓ Yield has maintained for 6 years since HLB confirmed
- ✓ Trees with HLB have been maintained for 7 seasons
- ✓ HLB in Valencia increased from 40%, 81% to 95%
- ✓ HLB in young Blk Val increased from 81%, 100%, 100%
- ✓ Symptom ratings improved in both mature and young Valencia over the past 2 years

Hamlin

6/01/2012


Valencia
6/01/2012

Parasitized psyllid nymph


Ladybug
Ladybird beetle

Chemical Control with pesticides
Ex: *Ultra-Fine Oil*

SunSpray®
Ultra-Fine®
YEAR-ROUND PESTICIDAL OIL

A superior horticultural spray oil for insect and mite pest management

Active Ingredient: Paraffinic Oil	98.8 wt%
Inert Ingredient: Emulsifier	1.2 wt%

ectively kills insects year-round
r dormant and growing season applications
an also be used as a leaf polish
akes up to 25 gallons

product controls Adelgids, Aphids, Lace Bugs,
thoppers, Leafminers (larvae), Mealybugs, Mites,
nt Bugs, Psyllids, Sawfly larvae, Scales, Thrips,
itefly and eggs of Aphids, Mites and certain cater-

READ DIRECTIONS THOROUGHLY BEFORE USI
MANUFACTURER AND SELLER WILL NOT ACCE
LIABILITY FOR DAMAGE OR INJURY RESULTIN
FROM MISUSE OF THIS PRODUCT.

CAUTION:
KEEP OUT OF REACH
OF CHILDREN

Chemical Control with pesticides

Ex: *Malathion-Oil*

Citrus & Ornamental Spray

Young trees less than 4 years old

Foliar Nutritional

Thank You
For
Your Attention