Nutritional Therapy
Treatments for HLB and what appears to be Working

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Florida Citrus Show

Havert L. Fenn Center, Fort Pierce

January 24, 2013

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


Orange Hammock Grove
Mature Val./Swg trees
100 trees
Young Val./Swg trees
100 trees


Spring 2006


February 29, 2012


January 8, 2013

Orange Hammock Grove Production

Season		Hamlin				Valencia		
	Wt. Boxes	Lb. slds/bx	Bx/ac	Avg.	Wt. Boxes	Lb. Slds/bx	Bx/ac	Avg.
2012-13	79,554	5.74	655	**589**				**463**
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	**569**	86,104	7.22	506	**460**
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	

Nutrition Program

Foliar Spray:

- Serenade
- Sonata
- Renew (N-P-K)
  - K-Phite (Phosphite)
  - SAver (SA)
- Magnesium Sulfate
- Manganese Sulfate
- Zinc Sulfate
- Sodium Molybdate
- 13-0-44 Spray Grade (K_2NO3)
- 435 Citrus Spray Oil
- AgPro (mined earth elements)
- Hydrogen peroxide

Ground Applied:

- Calcium Nitrate
- Triple Super Phosphate
- DAP
- SPM
- MOP
- Magnesium
- Iron
- Boron w/herbicide application
- Copper – as nutritional only when needed


Orange Hammock Grove
Mature Val./Swg trees
100 trees
Young Val./Swg trees
100 trees

Mature Valencia Trees

Jan. 2008 PCR
Mature Trees
40 % positive

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

Young Valencia Trees

Jan. 2008 PCR
Young Trees
81 % Positive

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

Mature Valencia Trees

Jan. 2010 PCR
Mature Trees
91 % Positive

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

Young Valencia Trees

Jan. 2010 PCR
Young Trees
100 % Positive

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

Mature Valencia Trees

Jan. 2012 PCR
Mature Trees
95 % positive

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

Young Valencia Trees

Jan. 2012 PCR
Young trees
100 % Positive

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

HLB Symptom Rating Systems

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

0 = Vigorous, no symptoms

1 = Vigorous, slight symptoms

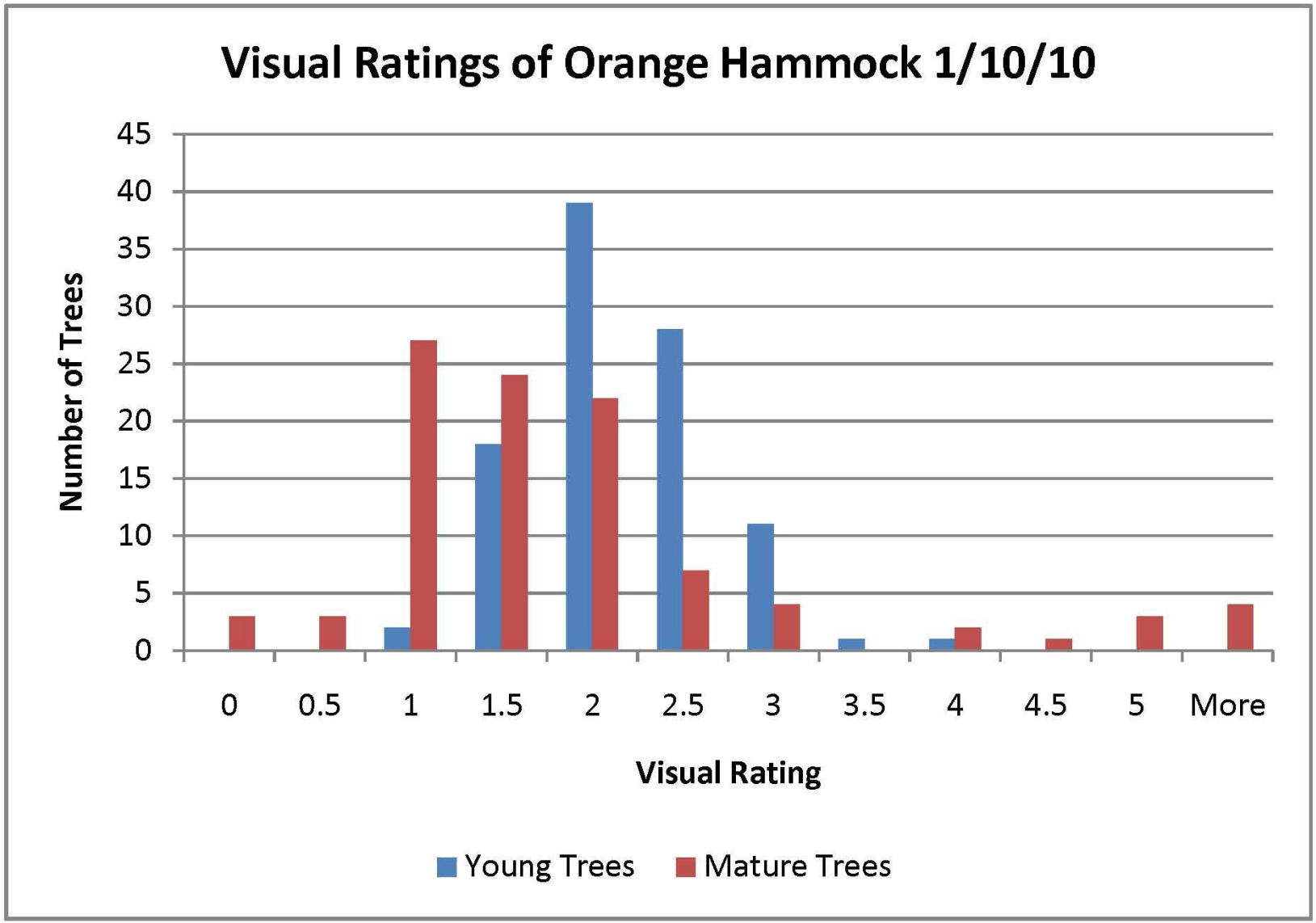
2 = Slight decline (symptomatic)

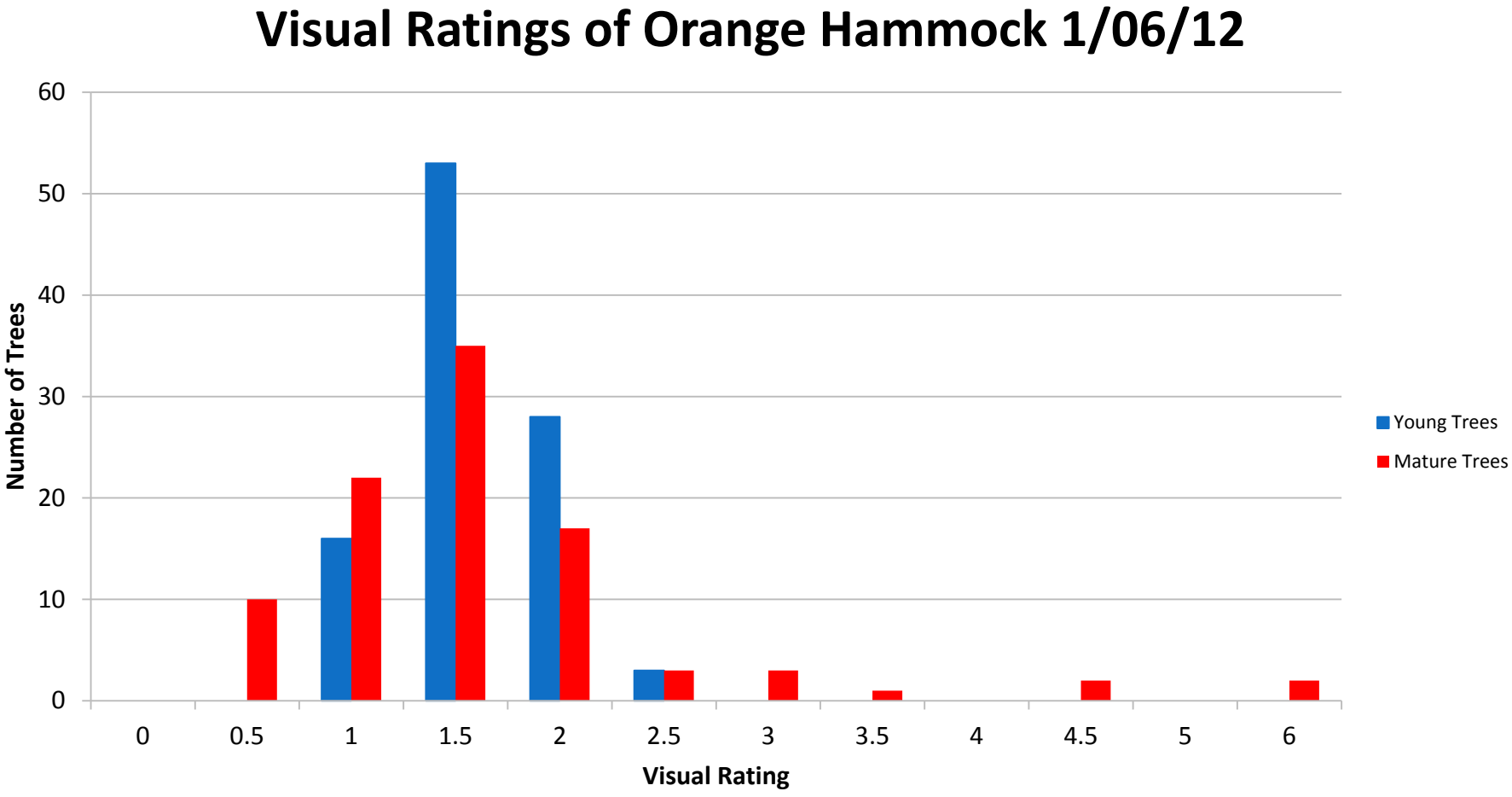
3 = Moderate decline (symptomatic)

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

Conclusions on Boyd's Nutritional Therapy Program

- ✓ Trees with HLB have been maintained for 8 seasons
- ✓ Yield has maintained for 8 years since HLB confirmed
- ✓ HLB in Valencia increased from 40%, 91% to 95%
- ✓ HLB in young Valencia increased from 81%, 100%, 100%
- ✓ Symptom ratings and tree condition improved in both mature and young Valencia over the past 2 years

Evaluation of Boyd Cocktail Trials and Objectives (Began 2008)

A. ***OBJECTIVES***

1. Duplicate Orange Hammock Grove Results
2. Define components of nutrient/SAR that are contributing to maintaining tree health & production

B. ***TRIALS started in 2008***

Three sites	Size	2008	2011
1) SWFREC (Hamlin)	2 acres	infected 100%	100%
2) Commercial (Valencia)	30 acres	infected 15%	98%

Per acre (250 gal/acre)	Product
2.25 lbs (1 gal, 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 ($MgSO_4$)
8.5 lbs	Techmangam ($MnSO_4$)
2.8 lbs	Zinc Sulfate
0.85 oz	Sodium Molybdate
8.5 lbs	13-0-44 spray grade (KNO_3)
1 qt	SAver w/ammonium salicylate
5 gal	435 Oil
3.3 lbs (added fall 2009)	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
KNO_3 +oil	KNO_3 +oil	KNO_3 +oil	KNO_3 +oil	KNO_3 +oil
6	7	8	9	10
SAR	SAR		SAR	Control
K-Phite		K-Phite	K-Phite	
*	Micro	*	Micro	*
Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide		
KNO_3 +oil	KNO_3 +oil	KNO_3 +oil	KNO_3 +oil	

SWFREC Immokalee site

PCR Ct values for 3 test sites

Site	Year	Range	Mean	Incidence
SWFREC	2008	29.97 - 25.87	28.097 a	100%
	2009	27.32 - 24.43	26.065 b	100%
	2010	25.88 - 24.56	24.994 b	100%
	2011	30.57 - 28.13	29.179 a	100%
Meador	2008	32.58 - 27.21	29.884 a	41%
	2009	30.21 - 27.13	28.498 a	79%
	2010	26.22 - 24.82	25.643 b	99%
	2011	27.00 - 25.85	26.491 b	100%
B.Collier	2008			About 15%
	2009	34.27 -30.22	32.234 a	40%
	2010	26.88 - 25.18	25.896 b	85%
	2011	27.04 - 23.99	25.226 b	98%

SWFREC Hamlin Yield

SWFREC (Hamlin)									
2008		2009		2010		2011*		2012	
Trt.	Lb. tree	Trt.	Lb. tree	Trt.	Lb. tree	Trt.	Lb. tree	Trt.	Lbs. tree
2	37.0 a	2	78.2 a	2	118.1 a	2	196.2 a	2	360 a
4	30.4 ab	4	58.8 ab	1	109.4 ab	6	195.8 a	7	346 a
9	24.9 ab	9	56.0 ab	3	96.2 abc	3	188.7 a	4	330 a
3	24.1 ab	6	48.3 bc	7	85.6 abc	4	187.3 a	9	329 a
1	21.5 ab	1	48.0 bc	9	79.6 bcd	7	181.4 a	6	324 ab
6	18.9 b	3	42.5 bc	4	74.0 cde	9	174.5 a	1	286 ab
5	18.6 b	7	38.0 bc	10	67.0 cde	1	170.7 a	5	269 ab
7	18.3 b	5	35.6 bc	5	63.4 cde	5	149.6 b	3	251 ab
8	14.8 b	8	28.7 c	6	45.6 de	8	108.3 b	8	207 bc
10	6.9 c	10	18.2 d	8	43.6 e	10	56.5 c	10	132 c

*Experienced citrus canker on leaves with severe leaf loss

2012 FRUIT DROP

	Trt. 1	Trt. 2	Trt.3	Trt. 4	Trt. 5	Trt. 6	Trt. 7	Trt. 8	Trt. 9	Trt. 10
% Drop	31	27	32	26	29	23	30	37	33	32
Boxes	0.63	.68	.53	.61	.53	.57	.71	.51	.70	.30


Ht. = 2.56 m (8.3 ft.)
Trt. 2
1-12E


Ht. = 3.29 m (10.7 ft.)
Trt. 2
1-12W


Ht. = 2.56 m (8.3 ft.)
Trt. 2
1-13E


Ht. = 2.41 m (7.2 ft.)
Trt. 1
1-17E


Ht. = 2.63 m (8.5 ft.)
Trt. 1
1-18E

Valencia 30 acre Commercial Trial

B.Collier (Valencia)								
2008		2009		2010		2011		Treatment coc
Trt.	Lb. tree	Trt.	Lb. tree	Trt.	Lb. tree	Trt.	Lb. tree	
2	72.3 a	1	63.3 a	1	60.4 a	3	148.3 a	1= Micro+Macro+PO_3+SAR+H_2O_2
8	67.2 a	2	63.1 a	2	60.0 a	2	148.2 a	2= Micro, Macro, H_3PO_3
1	65.4 a	9	50.2 ab	9	55.9 ab	1	144.8 a	3 = Micro + KNO_3+H_3PO_3
9	65.1 a	5	46.2 ab	7	52.2 ab	7	144.7 a	4 = KNO_3
5	63.3 a	8	45.7 ab	5	45.6 ab	9	139.8 a	5 = SAR + KNO_3
10	62.2 a	7	42.3 ab	3	44.0 ab	5	129.3 ab	6 = Macro, H_3PO_3, SAR
3	59.1 a	3	41.8 ab	4	39.8 ab	4	121.2 ab	7 = Micro, KNO_3, SAR
7	59.1 a	4	33.4 b	8	37.0 ab	8	110.4 b	8 = Macro +H_3PO_3
6	49.8 a	10	32.1	6	32.9 b	6	108.9 b	9 = Micro+ Macro +PO_3+ SAR
4	38.4 a	6	27.2 b	10	28.9 b	10	91 c	10 = Control

What Appears to be Working?

- Micronutrients (Mg, Mn sulfate, Zn sulfate, Mo, B)
- Macro nutrient (KNO_3, Urea, DKP)
- Phosphite for disease
- Salicylic acid for growth flush stimulation

Appreciation to:

- CRDF (Citrus Research & Development Foundation)
- The citrus growers in Florida
- Diamond R Fertilizer
- Plant Food Systems
- Everris' Agrocote Fertilizer
- AgraQuest
- Flo-Tec, Inc.
- Bayer CropScience
- Valent USA
- Yara
- Florida Phosphorus, Inc.
- Triangle Chemical

Pruning with Nutritional Therapy for Rehabilitating HLB infected Citrus Trees

Objective

1. Salvage and Rehabilitate HLB Trees to Avoid Cost and Time with Replanting
2. Rebalance the Shoot Root/Ration of Trees with Decline
3. Prune to Stimulate Regrowth and Feed new Foliage with Nutritionals
4. Maintain Psyllid Mangement

Rationale

- $ = Tree Removal of Declining Tree
- $ = Cost of New Nursery Tree
- $ = Planting New Tree
- $ = Care Costs for 4 yrs. till Production Begins
- $ = Care Costs for additional 3 yrs. till Yield covers Production costs

Treatments

A. Severe buckhorn pruned and un-pruned trees (2-row bed, 1-row pruned & 1-row unpruned)
B. Foliar Nutritionals to feed re-growth of pruned & un-pruned trees
    1. Boyd cocktail (macro + micro nutrients, phosphite, SA, SARs)
    2. Fortress (Phosphite Mg, Zn, Mn, Mo, Ca, Cu, Co + B, Ni)
       + 20 lbs/ac KNO_3 spray and Calcium Nitrate ground applied
    3. Fortress (Phosphite Mg, Zn, Mn, Mo, Cu, Co, + B, Ni)
       + Urea (trizoned) spray and Calcium nitrate ground applied
    4. *Control - 2 qts./ac maintenance liquid foliar with summer oil sprays*

Trees 100% HLB infected January 2010


February 2010


February 2010

August 2010

2010 Regrowth Shoot Lengths (cm)

Tree Shape	March flush	May flush	Summer flush
Buckhorn	19.5 a	41.6 a	26.4 a
Standard	10.4 b	13.7 b	22.7 b

2011 Regrowth Shoot Lengths (cm)

Tree Shape	March flush	May flush	Summer flush
Buckhorn	23.5 a	27.1 a	16.1 a
Standard	19.4 b	23.7 b	11.1 b


March 2011

2010 & 2011 CROP YIELD second season

Un-pruned trees	2010 Crop Boxes/acre	2011 Crop Boxes/acre
Control	49.3 b	164.3 c
Boyd	77.4 a	228.5 a
Fortress + KNO_3	75.7 a	195.2 ab
Fortress + Urea	75.7 a	197.3 ab
Pruned (Buckhorn)		
Control	27.4 c	174.2 bc
Boyd	22.0 c	211.2 a
Fortress + KNO_3	29.5 c	181.6 b
Fortress + Urea	29.5 c	195.1 ab

2011 Crop Fruit Sizes

There were **no statistical differences among sizes** between pruned and un-pruned trees.

Undersize (Less than 125's)

125's

100's

80's

64's

56's (no fruit)

48's (no fruit)


01/18/2011


January 18, 2011


Pruned June 2010
Picture March 30, 2011


Grower doubled his crop
from previous season

Take Home Message Bottom Line

1. HLB Trees can be Rehabilitated
2. Observation: (Most citrus growers are practicing a foliar nutrition program and seeing positive results)
3. Psyllid Management + Foliar Nutritional Reduces Continued Inoculations & Allows Foliar Nutrition to Improve and Maintain Tree Health while Maintaining Economical Production.

Thank You
For
Your Attention