Citrus Research and Education Center

Rootstock Field Day

December 12, 2013

St. Helena Project, Dundee, Florida

Care of: Orie Lee

Crop Production Services

UF IFAS Extension UNIVERSITY of FLORIDA

Harrell's Growing a Better World™

CREF Citrus Research and Education Foundation, Inc.

Southwest Florida Water Management District

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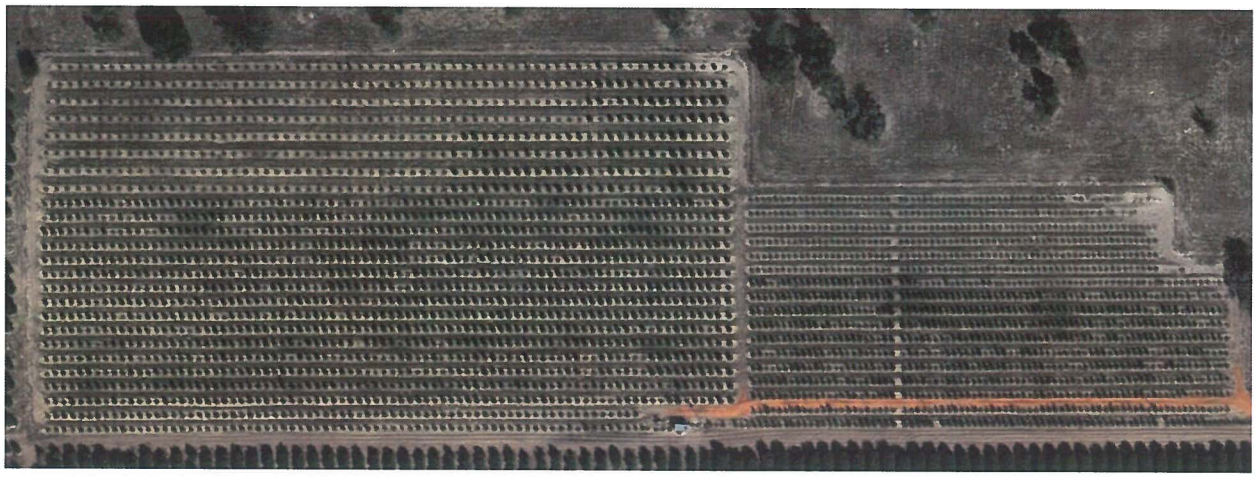
Field Day at The St. Helena Project

Field Day Overview – December 12, 2013

The St. Helena Project is a collaborative field research effort with Mr. Orie Lee, the UF/IFAS Citrus Research and Education Center (CREC), and the Citrus Research and Education Foundation (CREF) to evaluate mid-season Valencia quality processing sweet orange selections combined with a series of new rootstocks. The original primary goal was to identify superior disease-resistant rootstocks that will facilitate ACPS (Advanced Citrus Production Systems). This includes fast growth in the nursery and the first few years in the field followed by substantial early yield and subsequent production of high quality fruit on trees of rootstock-controlled size as needed for higher density plantings. More recently, focus is on identifying rootstocks that have potential to produce a profitable grove under HLB pressure.



SCIONS: Processing sweet oranges Vernia and Valquarius (a new early-maturing clone of Valencia, recently released by IFAS); both produce juice of Valencia quality, but with optimal harvest dates between mid-January to March 1st (potential for a single season Valencia crop amenable to mechanical harvesting).

ROOTSTOCKS: More than 80 selections, mostly from the research program of Dr. Jude Grosser, but also including selections provided by Drs. Fred Gmitter and Bill Castle (including selections from Argentina and Italy) and commercial controls. 12 acres were planted in April of 2008. Additional selections have been planted as trees have become available. Several hundred newly planted trees were lost in freezes during 2011 and 2012.

Description of Rootstocks

1. **Conventionally bred diploid (2x) rootstocks**. This group includes trifoliate hybrids provided by Dr. Bill Castle, developed by retired Argentine rootstock breeder Jose Luis Foguet. These rootstocks were all selected in Argentina for superior performance with lemon and sweet orange scions. Trees on these rootstocks vary in tree size with Pink 1802 producing the smallest trees. Featured selections include:
   1. **Yellow 1800** (grapefruit x trifoliate orange)
   2. **White 1801** (Ruby blood orange x Barnes trifoliate orange)
   3. **Pink 1802** (Cleopatra mandarin x Swingle citrumelo
   4. **Aqua 1803** (Cleopatra mandarin x trifoliate orange)
   5. **Orange 1804** (Cleopatra mandarin x trifoliate orange)
   6. **White 1805** (Ruby Blood orange x Barnes trifoliate orange)

   This group also includes *Citrus latipes* (papeda) x trifoliate orange hybrids provided by Dr. Fred Gmitter, developed by Guiseppe Reforgiato in Sicily. *C. latipes* is reported to be tolerant of HLB in India. Featured selections include:
   1. **68-1G-26-F4-P2**
   2. **68-1G-26-F4-P6**
   3. **68-1G-26-F4-P20**

2. **Allotetraploid (4x) Somatic Hybrids**: produced in the Grosser laboratory (test tube babies) by fusing cells from two conventional diploid citrus genotypes with complementary traits and then regenerating a tetraploid plant that contains the entire diploid genome of each parent (additive hybridization). Featured somatic hybrid rootstock candidates include:
   1. **Sour orange + Carrizo citrange**
   2. **Cleopatra mandarin + Carrizo citrange**
   3. **Changsha mandarin + trifoliate orange 50-7**
   4. **Changsha mandarin + Benton citrange**
   5. **Sour orange + trifoliate orange 50-7**
   6. **White grapefruit + trifoliate orange 50-7**
   7. **Amblycarpa mandarin + Hirado Buntan pummelo sdlg.#1**

3. **Allotetraploid (4x) Tetrazygs**: produced by the conventional breeding of somatic hybrid parents at the tetraploid level. This approach is quite powerful genetically, because it allows for the mixing of genes from the genomes of four conventional diploid genotypes simultaneously. The tetrazygs featured in the Field Day all have the Nova mandarin+Hirado Buntan seedling pummelo somatic hybrid as a mother – this is because it is a sour-orange like hybrid that has shown tolerance to CTV and to the Diaprepes/Phytophthora complex, and it produces zygotic seed (as needed to make hybrids). Featured Tetrazyg roostock candidates include:

   A. Cross of Nova mandarin+Hirado Buntan seedling pummelo x Cleopatra mandarin+Argentine trifoliate orange: **Orange #2; Orange #4; Orange #13; Orange #14; Orange #15; Orange #16; Orange #18; Orange #19; and Orange #21.**

   B. Cross of Nova mandarin+Hirado buntan seedling pummelo x sour orange+Carrizo: **Green #7.**

   C. Cross of Nova mandarin + Hirado buntan seedling pummelo x sour orange+Palestine sweet lime: **Blue #1; Blue #2, Blue #3, Blue #4 and Blue #9**

   D. Cross of Nova mandarin + Hirado buntan seedling pummelo x Cleopatra+sour orange: **Purple #4.**

4. **Commercial Diploid Rootstocks as Controls: Swingle, Volk, rough lemon, Cleopatra and Kuharske.**

ROOTSTOCK SEED TREES: Three rows along the clay road into the trial are available for rootstock seed trees (planting in progress, with the fence row completed).

GROVE OUTLAY: The grove is split into 3 sections, each with a different tree spacing. The Eastern block is planted in a 9 x 20 [242 trees/acre] higher density spacing. This block did not have water for cold protection, and there was significant cold damage and young tree loss following the 2011 freeze. The Southwestern block is planted in a 12 x 20 [181 trees/acre] medium-high density spacing. The Northwestern block is planted in a traditional 15 x 25 [116 trees/acre] spacing, and includes the commercial control rootstocks. The latter two blocks had water for cold protection.

PLANTING: Approximately 12 of the 19.9 acres were planted in April, 2008 and are now about 5 ½ years old. Trees were planted in 4-tree rectangles to facilitate yield data collection. The remaining acreage was planted as new trees became available, with trees on additional new rootstock selections from the CREC citrus improvement program. The latest planted rootstocks include diploid hybrids of Flying Dragon trifoliate orange developed by Fred Gmitter, diploid Shekwasha mandarin x pummelo hybrids developed by Jude Grosser, as well as new somatic hybrids and tetrazygs. **Resets in the older trees**: a few of the rootstock selections were from seed trees that unexpectedly produced zygotic seeds rather than nucellar-derived seeds, and thus many of these zygotic rootstocks were not growing off well – these trees were replaced with more promising selections.

CULTURAL PRACTICES: the goal was to apply the principles of open hydroponics, but with lower initial costs and inputs. Trees are being grown with slow release fertilizer from Harrell's, with daily 45 – 60 minutes per zone irrigation (unless there is adequate rainfall). The initial planting was started on Harrell's 12-month nursery mix and was used for the first two years; in 2010 we switched to a Harrell's/UF-CREC research mix (10-month) containing calcium nitrate, boron and additional micronutrients (formulas provided). All fertilizers were applied by hand thru 2010, after which they were applied using a Killebrew young tree spreader. Since 2008, the SR-Fertilizer has been applied in staggered applications in January and July as follows:

Year 1 (2008) 1.5 lbs/trees Harrell's 15-5-10 Nursery mix split into 2 applications (0.5lb @ planting, 1 lb summer)
Year 2 (2009) 2.5 lbs/tree Harrell's 15-5-10 Nursery mix split into 2 applications
Year 3 (2010) 5.2 lbs/tree Harrell's 13-4-9 UF mix split into 2 applications
Year 4 (2011) 5.2 lbs/tree Harrell's 13-4-9 UF mix split into 2 applications
Year 5 (2012) 6.0 lbs/tree Harrell's 13-4-9 UF mix split into 2 applications
A supplemental Zn application was applied to correct a minor element deficiency (Tiger-Sul 18% Zn - 65% S, 1 oz/tree July/2012)
Year 6 (2013) 6.0 lbs/tree Harrell's 13-4-9 UF mix split into 2 applications
Supplemental Tigersul Zn (5.85%), Mn (15%), Fe (3.85%), S(62%) custom mix applied in July 2013, 0.33lbs/tree.

– Thanks to Jack Gentry and Lykes Corp. for providing leaf sampling and nutrient analysis! Estimated fertilizer cost (commercial) thru year 6 was $26.60 per tree.

HLB INCIDENCE: Considering the location of the grove, a high HLB incidence is expected due to the neighbor effect. We have an older unsprayed block of K-Earlies to the northeast, and both a top-worked and organic grove to the south. The last inspection by the CREC HLB/canker scouts was completed in October, 2013. The HLB incidence in fall of 2011 was about 8% and increased to 26% in the fall of 2012; infection frequency at present is 59%. The highest infection frequencies are on commercial rootstocks. The frequencies of HLB infections remain less on tetraploid rootstocks (57%) as compared to diploid rootstocks (67%) and commercial rootstocks (89%). We have not yet removed HLB infected trees; we plan to begin removing unproductive trees this winter. The first tree with HLB was found in 2009, and is still present in the grove. We are now studying rootstock effects on disease severity. Rootstock differences are apparent, but need to be studied over time. A present goal is to identify rootstocks that can remain productive after infection, and that could possibly grow through the disease.
CANKER: CREC scouts have an aggressive program to identify and remove branches with canker (now discontinued). Copper sprays are now being used to suppress canker.

OTHER ISSUES: We have had a significant problem with clogged micro-jets causing severe tree wilting; this problem was remedied by more frequent scouting and jet clearing. Excessive thorniness on some of the Valquarius trees is due to the fact that the trees were propagated from 1st generation budwood (less thorny 2nd and 3rd generation sources of budwood were destroyed by the state-run canker eradication effort). We have re-entered a more mature budline of Valquarius into the DPI Parent Tree Program; pathogen-free budwood is now being grown in Chiefland and should be available soon.

Harrell's
Professional Fertilizer Solutions

16-5-10

Batch #:

12 Month.

NPK+ Minors

GUARANTEED ANALYSIS

* Total Nitrogen (N)	16.0000%
5.8630% Nitrate Nitrogen	
6.8750% Ammoniacal Nitrogen	
3.2620% Urea Nitrogen	
** Available Phosphate (P2O5)	5.0000%
*** Soluble Potash (K2O)	10.0000%
Magnesium (Mg)	1.0830%
1.0830% Soluble Magnesium (Mg)	
Copper (Cu)	0.0620%
0.0620% Soluble Copper (Cu)	
Iron (Fe)	0.2580%
0.2580% Iron (Chelated)	
Manganese (Mn)	0.1000%
0.1000% Soluble Manganese (Mn)	
Molybdenum (Mo)	0.0090%
Zinc (Zn)	0.0620%
0.0620% Soluble Zinc (Zn)	

Derived From: Polymer Coated Ammonium Nitrate, Polymer Coated Copper Sulfate, Polymer Coated EDTA Iron Chelate, Polymer Coated Magnesium Sulfate, Polymer Coated Manganese Sulfate, Polymer Coated Mono-Ammonium Phosphate, Polymer Coated Sodium Molybdate, Polymer Coated Sulfate of Potash, Polymer Coated Urea, Polymer Coated Zinc Sulfate, Polymer-Coated Potassium Nitrate

* Has 14.05% slow release NITROGEN derived from Polymer Coated Ammonium Nitrate, Polymer Coated Mono-Ammonium Phosphate, Polymer Coated Urea, Polymer-Coated Potassium Nitrate
** Has 4.5% slow release PHOSPHATE derived from Polymer Coated Mono-Ammonium Phosphate
*** Has 8.916% slow release POTASH derived from Polymer Coated Sulfate of Potash, Polymer-Coated Potassium Nitrate

Warning: — This fertilizer is to be used only on soils which respond to Molybdenum. Crops high in Molybdenum are toxic to ruminants.

Density - 61 lb./(cu. ft.)

CAUTION MAY CAUSE STAINS ON CONCRETE

MANUFACTURED BY HARRELL'S INC. (F342) 720 KRAFT ROAD, LAKELAND, FL 33801 - (863) 687-2774 - (800) 282-8007
DISTRIBUTED BY HARRELL'S INC. (F352) 720 KRAFT ROAD, LAKELAND, FL 33801 - (863) 687-2774 - (800) 282-8007

NET WEIGHT 50 LBS

020904

Harrell's
Professional Fertilizer Solutions

13-4-9

Batch #: 1101-0201

Fertilizer - UF Citrus Research Center

GUARANTEED ANALYSIS

* Total Nitrogen (N)	13.0000%
7.4700% Nitrate Nitrogen	
5.0000% Ammoniacal Nitrogen	
0.5300% Urea Nitrogen	
** Available Phosphate (P205)	4.0000%
*** Soluble Potash (K20)	9.0000%
Calcium (Ca)	4.2800%
Magnesium (Mg)	1.1180%
1.1180% Water Soluble Magnesium (Mg)	
Boron (B)	0.0360%
Copper (Cu)	0.0460%
0.0460% Water Soluble Copper (Cu)	
Iron (Fe)	0.9480%
0.1620% Water Soluble Iron (Fe)	
0.3000% Iron (Chelated)	
Manganese (Mn)	0.1580%
0.1580% Water Soluble Manganese (Mn)	
Molybdenum (Mo)	0.0070%
Zinc (Zn)	0.0630%
0.0630% Water Soluble Zinc (Zn)	

Derived From: Calcium Nitrate, Polymer Coated Ammonium Nitrate, Polymer Coated Copper Sulfate, Polymer Coated EDTA Iron Chelate, Polymer Coated Magnesium Sulfate, Polymer Coated Manganese Sulfate, Polymer Coated Mono-Ammonium Phosphate, Polymer Coated Sodium Molybdate, Polymer Coated Sulfate of Potash, Polymer Coated Sulfate of Potash-Magnesia, Polymer Coated Sulphate of Potash, Polymer Coated Urea, Polymer Coated Zinc Sulfate, Iron Chelate, Iron EDTA, Iron Humate, Iron Oxide, Iron Sulfate, Iron Sucrate, Manganese Sulfate, Sodium and Calcium Borate, Zinc Sulfate

*** 8.611% slow release NITROGEN derived from Polymer Coated Ammonium Nitrate, Polymer Coated Mono-Ammonium Phosphate, Polymer Coated Urea**

**** 3.984% slow release PHOSPHATE derived from Polymer Coated Mono-Ammonium Phosphate**

***** 8.134% slow release POTASH derived from Polymer Coated Sulfate of Potash, Polymer Coated Sulfate of Potash-Magnesia, Polymer Coated Sulphate of Potash**

Warning: — Some crops may be injured by Application of Boron.
— This fertilizer is to be used only on soils which respond to Molybdenum. Crops high in Molybdenum are toxic to ruminants.

Density - 54 lb./(cu. ft.)

CAUTION MAY CAUSE STAINS ON CONCRETE

Directions for Use

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DISTRIBUTED BY HARRELL'S LLC. (F352) 720 KRAFT ROAD, LAKELAND, FL 33801 - (863) 687-2774 - (800) 282-8007

Net Weight 50 LBS

1101-0201 101101

Note that the calcium nitrate has a 6-month polymer coating, whereas all other nutrients have a 12-month polymer coating. Overall this makes for a 10-month product.

Table 1. Yield, Fruit Quality and HLB Infection Frequency for Rootstock Candidates in the St. Helena Trial. Somatic Hybrid Rootstocks are in orange; Tetrazyg Rootstocks are in Blue; both of these types of rootstocks induce tree size control, as needed for ACPS.

Scion	Rootstock	Lbs Solids/Box		Yield Boxes/Tree			Cumulative Yield	Percentage HLB Infected
		2012	2013	2011 (35 mo.)	2012 (47 mo.)	2013 (59 mo.)		
VALQUARIUS	WHITE 1805	5.17	4.89	NS	1.19	2.84	4.03	79 %
VALQUARIUS	FG 1733	5.12	5.63	NS	0.67	2.77	3.44	40 %
VALQUARIUS	AQUA 1803	4.58	5.58	NS	0.98	2.38	3.36	74 %
VALQUARIUS	AMB+HBJL1	5.15	5.79	0.51	0.63	2.13	3.27	60 %
VERNIA	BLUE 1	5.71	4.98	0.5	0.84	1.91	3.25	57 %
VALQUARIUS	ORANGE 13	4.88	5.25	0.43	0.84	1.98	3.25	62 %
VALQUARIUS	CH+50-7	5.64	5.43	0.5	0.78	1.94	3.22	59 %
VALQUARIUS	ORANGE 1804	4.20	5.16	NS	1.02	2.10	3.12	89 %
VALQUARIUS	ORANGE 14	5.41	5.60	0.33	1.08	1.67	3.08	55 %
VERNIA	AQUA 1803	5.49	6.17	0.34	0.81	1.91	3.06	74 %
VALQUARIUS	69-LTX-AM-F14-P37	4.19	4.78	NS	0.53	2.50	3.03	100 %
VERNIA	ORANGE 19	5.79	6.07	0.54	0.71	1.73	2.98	53 %
VERNIA	CLEO+CZO	5.88	5.61	0.5	0.75	1.72	2.97	72 %
VALQUARIUS	ORANGE 3	5.50	4.87	NS	0.72	2.23	2.95	45 %
VALQUARIUS	ROUGH LEMON	3.66	4.22	NS	1	1.91	2.91	88 %
VALQUARIUS	FG 1731	5.83	6.81	NS	0.68	2.20	2.88	60 %
VERNIA	CH+BENTON	5.66	5.68	0.5	0.72	1.56	2.78	56 %
VALQUARIUS	ORANGE 15	4.84	5.05	NS	0.81	1.97	2.78	47 %
VALQUARIUS	PINK 1802	3.99	5.25	0.25	0.76	1.73	2.74	65 %
VALQUARIUS	ORANGE 16	5.09	5.39	NS	0.81	1.91	2.72	65 %
VALQUARIUS	WHITE 4	5.76	5.72	0.33	0.56	1.80	2.69	49 %
VALQUARIUS	SO+CZO	5.69	5.06	0.24	0.66	1.79	2.69	61 %
VALQUARIUS	CLEO+CZO	5.52	5.02	0.4	0.62	1.66	2.68	72 %
VERNIA	AMB+HBJL1-2B	4.91	5.80	0.38	0.5	1.77	2.65	50 %
VALQUARIUS	ORANGE 19	4.65	5.07	NS	0.65	1.59	2.64	53 %
VERNIA	ORANGE 18	5.84	5.82	0.6	0.65	1.37	2.62	65 %
VERNIA	WHITE 4	5.89	5.34	0.42	0.25	1.93	2.60	49 %
VALQUARIUS	VOLK	NS	4.12	NS	NS	2.58	2.58	95 %
VERNIA	ORANGE 15	5.46	5.82	0.37	0.38	1.82	2.57	47 %
VERNIA	BLUE 4	5.77	6.16	0.4	0.61	1.54	2.55	55 %
VERNIA	ORANGE 1804	6.10	6.34	0.25	0.25	1.98	2.48	89 %
VALQUARIUS	ORANGE 4	4.57	5.37	NS	0.75	1.73	2.48	63 %
VALQUARIUS	BLUE 1	4.75	4.62	0.5	0.31	1.66	2.47	57 %
VALQUARIUS	CH+BENTON	5.79	5.12	0.4	0.43	1.62	2.45	56 %
VALQUARIUS	FG 1793	5.53	5.15	NS	0.83	1.62	2.45	80 %
VERNIA	CH+50-7	5.67	6.01	0.4	0.63	1.41	2.44	59 %
VERNIA	GREEN 7	5.20	5.85	0.39	0.42	1.63	2.44	66 %
VALQUARIUS	68-1G-26-F6-P20	5.84	5.32	NS	0.88	1.53	2.41	59 %
VALQUARIUS	BLUE 9	5.15	5.60	0.2	0.63	1.58	2.41	53 %
VERNIA	ORANGE 14	5.54	5.08	0.36	0.83	1.20	2.39	55 %
VERNIA	ORANGE 2	5.37	5.88	0.33	0.25	1.79	2.37	47 %
VERNIA	ORANGE 1	5.66	5.93	0.4	0.25	1.71	2.36	67 %
VERNIA	VOLK	3.60	4.73	0.4	1.13	0.83	2.36	95 %
VALQUARIUS	WHITE 1801	5.35	5.58	NS	0.75	1.60	2.35	73 %

Table 1. (cont.) Yield, Fruit Quality and HLB Infection Frequency for Rootstock Candidates in the St. Helena Trial. Somatic Hybrid Rootstocks are in orange; Tetrazyg Rootstocks are in Blue; both of these types of rootstocks induce tree size control.

Scion	Rootstock	Lbs Solids/Box		Yield Boxes/Tree			Cumulative Yield	Percentage HLB Infected
		2012	2013	2011 (35 mo.)	2012 (47 mo.)	2013 (59 mo.)		
VALQUARIUS	ORANGE 2	5.26	5.75	NS	0.74	1.60	2.34	47 %
VERNIA	WGFT+50-7	5.45	5.74	0.5	0.25	1.59	2.34	53 %
VERNIA	ORANGE 3	5.61	6.28	0.31	0.67	1.33	2.31	45 %
VALQUARIUS	68-1G-26-F2-P12	5.56	5.50	NS	0.63	1.67	2.30	40 %
VALQUARIUS	ORANGE 21	3.97	4.88	0.42	0.65	1.23	2.30	72 %
VERNIA	YELLOW 1800	4.83	5.91	0.39	0.25	1.66	2.30	82 %
VALQUARIUS	FG 1709	5.24	5.18	NS	0.68	1.58	2.26	25 %
VERNIA	SWINGLE	5.11	5.79	0.33	0.85	1.08	2.26	80 %
VERNIA	MG-11	5.82	6.44	0.33	0.54	1.37	2.24	35 %
VERNIA	ORANGE 13	5.88	5.76	0.31	0.48	1.45	2.24	62 %
VALQUARIUS	KCZ	NS	5.75	NS	NS	2.20	2.20	95 %
VALQUARIUS	WGFT +50-7	4.66	5.29	0.48	0.51	1.19	2.18	53 %
VALQUARIUS	FG 1707	5.70	5.79	NS	0.33	1.77	2.10	67 %
VALQUARIUS	PURPLE 4	4.96	5.26	0.3	0.38	1.42	2.10	52 %
VERNIA	BLUE 2	6.16	5.69	0.2	0.41	1.48	2.09	40 %
VALQUARIUS	SO+50-7	4.25	5.17	0.4	0.41	1.28	2.09	42 %
VALQUARIUS	BLUE 4	5.07	5.07	NS	0.25	1.83	2.08	55 %
VERNIA	BLUE 3	5.38	6.04	0.3	0.43	1.31	2.04	42 %
VERNIA	ORANGE 21	5.32	na	0.44	0.25	1.35	2.04	72 %
VALQUARIUS	BLUE 2	5.32	5.78	NS	0.15	1.86	2.01	40 %
VALQUARIUS	GREEN 7	5.32	4.44	NS	0.61	1.40	2.01	66 %
VERNIA	PURPLE 4	5.23	5.63	0.4	0.25	1.35	2.00	52 %
VERNIA	WHITE 1805	5.70	6.13	0.46	0.25	1.29	2.00	79 %
VERNIA	WHITE 1801	5.93	6.37	0.56	0.33	1.10	1.99	73 %
VERNIA	KCZ	4.34	5.83	0.15	0.75	1.08	1.98	95 %
VERNIA	ORANGE 4	5.47	5.93	0.35	0.25	1.38	1.98	63 %
VERNIA	BLUE 9	5.77	5.90	0.3	0.25	1.35	1.90	53 %
VALQUARIUS	FG 1792	NS	5.32	NS	NS	1.90	1.90	50 %
VALQUARIUS	ORANGE 18	4.45	4.86	0.46	0.59	0.85	1.90	65 %
VALQUARIUS	PURPLE 2	4.59	5.66	NS	0.13	1.75	1.88	50 %
VALQUARIUS	68-1G-26-F4-P6	5.39	5.74	NS	0.4	1.45	1.85	31 %
VERNIA	SO+50-7	5.92	5.66	0.4	0.48	0.95	1.83	42 %
VALQUARIUS	MG-11	4.98	5.51	NS	0.75	0.98	1.73	35 %
VALQUARIUS	CLEO	NS	5.21	NS	NS	1.70	1.70	67 %
VERNIA	SO+CZO	6.02	6.23	0.28	0.25	1.12	1.65	61 %
VERNIA	PURPLE 2	5.56	5.70	NS	0.45	1.20	1.64	50 %
VALQUARIUS	AMB+HBJL1-2B	5.03	5.12	NS	0.38	1.20	1.58	50 %
VALQUARIUS	68-1G-26-F4-P2	5.37	5.44	NS	0.34	1.22	1.56	42 %
VALQUARIUS	SWINGLE	NS	5.61	NS	NS	1.50	1.50	80 %
VERNIA	CLEO	4.79	5.51	NS	0.5	0.83	1.33	67 %
VERNIA	SORP X SH99-5*	5.55	5.76	NS	0.43	0.83	1.26	40%
VALQUARIUS	FG 1702	NS	5.27	NS	NS	1.15	1.15	50 %
VALQUARIUS	BLUE3	NS	4.97	NS	NS	0.93	0.93	42 %
VERNIA	ROUGH LEMON	3.67	na	NS	0.78	na	0.78	88 %

Table 2. HLB Infection Frequency Data Per Diploid and Tetraploid Rootstock; Commercial Rootstocks in Blue.

Rootstock	Number of Trees in Trial	Percent Infection 2012	Percent Infection 2013
Diploid			
HBJL-2B (n)	23	4%	26%
68-1G-26-F4-P6	13	0%	31%
MG11	40	13%	35%
68-1G-26-F2-P12	10	20%	40%
FG 1733	5	20%	40%
68-1G-26-F4-P2	12	17%	42%
46X31-02-11	15	6%	47%
48-OP-01	28	29%	54%
46X31-02-S3	19	27%	58%
68-1G-26-F6-P20	17	18%	59%
FG 1731	5	20%	60%
46X31-02-5	13	14%	62%
Chandler A1-11	8	50%	63%
Pink 1802	18	22%	65%
Cleo	16	25%	67%
46X31-02-9	18	36%	72%
46X31-02-S9	15	14%	73%
White 1801	11	45%	73%
Aqua 1803	19	26%	74%
46X31-02-13	8	11%	75%
White 1805	19	21%	79%
FG 1793	5	40%	80%
Swingle	20	70%	80%
Yellow 1800	11	18%	82%
Rough Lemon	18	56%	88%
Orange 1804	18	39%	89%
Volk	20	85%	95%
Kuharske Carrizo	63	92%	95%

Total	487	42%	67%
Total Commercial Rootstocks	137	64 %	89%

Table 2. HLB Infection Frequency Data Per Diploid and Tetraploid Rootstock; Commercial Rootstocks in Blue.

Rootstock	Number of Trees	Percent Infection 2012	Percent Infection 2013
Tetraploid			
SR+SH-99-11	7	14%	14%
Nova+8-1-99-4B	5	0%	20%
AMB+5-1-99-2	18	13%	28%
Orange 8	46	20%	35%
Blue 2	24	17%	40%
SORPXSH99-5	15	0%	40%
SO+50-7	45	13%	42%
Blue 3	44	23%	42%
6058X2071-01-02	27	0%	44%
Orange 3	60	18%	45%
Orange 15	43	7%	47%
Orange 2	74	12%	47%
White 4	72	21%	49%
AMB+HBJL-2B	16	13%	50%
Milam+Kinkoji	8	0%	50%
Green 2	16	13%	50%
Purple 2	20	30%	50%
White 1	24	33%	50%
Purple 4	64	23%	52%
Orange 19	128	15%	53%
Blue 9	30	23%	53%
WGFT+50-7	86	37%	53%
N+HBP-SS-9	26	23%	54%
Orange 10	20	20%	55%
Orange 14	62	24%	55%
Blue 4	37	27%	55%
Chang+Bent	34	21%	56%
Blue 1	69	19%	57%

Table 2. HLB Infection Frequency Data Per Diploid and Tetraploid Rootstock; Commercial Rootstocks in Blue.

Rootstock	Number of Trees	Percent Infection 2012	Percent Infection 2013
Tetraploid (continued)			
SO+RPXSH 99-4	26	14%	58%
Orange 12	33	12%	58%
Nova+7-2-99-2	46	36%	59%
Chang+50-7	60	35%	59%
AMB+BENT	20	7%	60%
Purple 3	5	20%	60%
AMB+HBJL1	12	25%	60%
SO+CZO	265	20%	61%
Orange 13	50	32%	62%
WM-HBJL-12	8	25%	63%
Orange 4	70	31%	63%
Orange 16	27	22%	65%
Orange 18	45	29%	65%
Green 7	69	26%	66%
Murc+SN3	6	17%	67%
Green 6	6	17%	67%
Orange 1	24	25%	67%
SR+SH-99-18	6	0%	67%
SR+SH-99-6	6	0%	67%
AMB+VOLK	35	37%	69%
Nova+7-3-99-1	16	29%	69%
Orange 21	46	17%	72%
Cleo+CZO	160	37%	72%
N+HBP-SS-8	22	38%	73%
A-MAC	19	22%	79%
WMUR+HBJL-7	27	44%	81%
6058X6056-002	19	53%	84%
AMB+HBJL-12	5	0%	100%
Total	**2253**	**23%**	**57%**

St. Helena Spray Program History (Administered by Troy Gainey, CREC Field Manager).

2008		
May	Admire 2F	4oz acre
June	Admire 2F	4oz acre
August	Admire 2F	4oz acre
October	Admire 2F	4oz acre
2009		
February	Danitol 2.4 EC	1 pint acre
March	Admire 2F	8 oz acre
April	Dimethoate 4E	1 pint acre
	435 spray oil	4 gallons acre
	Kocide	4 lbs acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
May	Alias 2F	8 oz acre
June	Provado 1.6F	10 oz acre
	435 spray oil	4 gallons
	Kocide	4 lbs acre
July	Lorsban 4E	5 pints acre
	435 spray oil	4 gallons
	Kocide	4 lbs acre
Early July	Alias 2F	8 oz acre
September	Movento	10 oz acre
	435 spray oil	4 gallons
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons
	Kocide	3 lbs acre
Late Sept.	Alias 2F	8 oz acre
October	Danitol 2.4 EC	1 pint acre
2010		
January	Danitil 2.4 EC	1 pint acre
February	Dimethoate 4E	1 pint acre
	Man-zinc	1 quart acre
	Boron	10 oz acre
	Copper Sulfate	2 lbs acre
	Li 700	.25 % V/V
March	Alias 2F	8 oz acre
April	Nexter	4.3 oz acre
May	Alias 2F	8 oz acre
	Movento	10 oz acre
	435 spray oil	4 gal acre
	11-8-5	.5lbs acre
	Ksar	10 oz acre
	Kocide	2.5lbs

June	Delegate WG	4 oz acre
	435 spray oil	4 gallons
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons
	Kocide	2.5 lbs acre
July	Alias 4F	4 oz acre
	Imidan 70W	1 lb acre
	435 spray oil	2 gallons
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
	Trigger	7 oz acre
	Li 700	.25% v/v
	Kocide 3000	2.5 lbs acre
Late August	Actrara 25WG	4 oz acre
	Delegate	4 oz acre
	435 spray oil	2.5 gallons acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
	Kocide 3000	2.5 lbs acre
September	Alias 4F	4oz acre
October	Danitol 2.4 EC	16 oz acre
	435 spray oil	2 gallons acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre

2011

January	Dimithoate 4E	16 oz acre
	Urea 3.26%	27lbs acre
	Li 700	.25% v/v
February	Danitol 2.4 EC	16 oz acre
	Solubor	1 lb acre
	Calcium Nitrate	5 lbs per 100 gallons water
April	Alias 4F all resets	4 oz acre
	Mustang	4.3 oz acre
	435 spray oil	3 gallon acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
May	Provado 1.6F	10 oz acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
	435 spray oil	2 gallons acre
June	Alias 4F all resets	4 oz acre
	Movento	10 oz acre
	435 spray oil	3 gallons
	Delegate	4 oz acre
	Nitro 30 SRN	1 gallon acre
	Recover RX 3-18-18	2 gallons acre
	Microtech AG	2 quarts acre
	TKO 0-29-26	1 quart acre
	Compainion 2-3-2	1 quart acre
Late June	Admire Pro all mature trees	14 oz acre
July	Imidan	1 lb acre

	Li 700	.25% v/v
	435 spray oil	2 gallons acre
	Zn 2.0% Mn 2.0% Fe 1.6%	2 gallons acre
August	Alias 4F all resets	4oz acre
September	Actara 25wg	4 oz acre
	435 spray oil	2 gallons acre
	Calcium Nitrate	5 lbs per 100 gallons
	Magnesium Sulphate	5lbs per 100 gallons
October	Alias 4F all resets	4 oz acre
	Danitol 2.4 EC	16 oz acre
	Calcium Nitrate	5 lbs per 100 gallons
December	Imidan 70 W	1 lb acre

2012

January	Danitol 2.4 EC	16 oz acre
	Calcium Nitrate	5 lbs per 100 gallons
	Solubor	1 lb per 100 gallons
	Induce	16 oz per acre
February	Dimethoate 4E	1 pint acre
	TKO	30 oz acre
	Induce	16 oz per acre
February	Admire Resets	2.8 oz acre
March	Mustang	4.3 oz acre
	Oil 435	2 gallon acre
	Kocide 3000	2 lbs acre
Late March	Imidan 70 W	1 lb acre
	Pottassium Nitrate	5 lbs acre
April	Admire Resets	2.8 oz acre
	Delegate	4 oz acres
	Oil 435	2 gallon acre
	Kocide 3000	2 lbs acre
May	Agri-flex	8 oz acre
	Oil 435	2 gallon acre
	Zn 2.0% Mn2.0% Fe1.6%	2 gal acre
	Kocide 3000	2 lbs acre
June	Admire Resets	2.8 oz acre
	Actara	4 oz acre
	DPK	2 gallon acre
	Kocide 3000	2 lbs acre
July	Kocide 3000	2 lbs acre
	Danitol 2.4 EC	16 oz acre
	Oil 435	2 gallon acre
	Pottassium Nitrate	5 lbs acre
	Key Plex	5 pints acre
August	Admire Resets	2.8 oz acre
	Delegate	4 oz acres

	Oil 435		2 gallon acre
	Kocide 3000		2 lbs acre
September	VoliamFlexi		7 oz acre
	Key Plex		5 pints acre
	Kocide 3000		2 lbs acre
October	Admire	Resets	2.8 oz acre
	Mustang		4.3 oz acre
	Oil 435		2 gallon acre
	Kocide 3000		2 lbs acre
November	Malathion		5 pints acre
	CN9		36 oz acre
	Induce		16 oz acre
	Solubor		1 lbs acre
December	Admire	Resets	2.8 oz acre

2013

January	Danitol		16 oz acre
	CN9		36 oz acre
	Induce		16 oz acre
	Solubor		1 lbs acre
February	Admire	Resets	2.8 oz acre
	Movento		16 oz acre
	Oil		3 gal acre
	TKO		29 oz acre\
	Recover RX		2 gal acre
March	Actara		4 oz acre
	Pottasium Nitrate		5 lbs acre
	Microtech CT		1Gal acre
	Induce		16 oz acre
	Copper		2 lbs acre
March	Admire	Resets	2.8 oz acre
April	Dimethoate 4E		1 pint acre
	TKO		29 oz acre
	Induce		16 oz per acre
	Recover RX		2 gal acre
	Induce		16 oz acre
	Citrus Fix		5 mil acre
Late May	AgriFlex		5 oz acre
	Oil		2 gal acre
	Copper		2 lbs acre
June	Admire Resets		2.8 oz acre
	Delegate		4 oz acres
	Oil		2 gallon acre
	Recover RX		2 gallon acre
	Copper		2 lbs acre
July	Mustang		4.3 oz acre

	Oil	2 gallon acre
	Pottasium Nitrate	5 lbs acre
	Microtech CT	1Gal acre
Early August	Copper	2 lbs acre
August	Admire Resets	2.8 oz acre
Late August	Imidan	1 lbs acre
	Oil	2 gal acre
	TKO	29 oz acre
	Recover RX	2 gal acre
September	VoliamFlexi	7 oz acre
	Copper	2 lbs acre
October	Actara	4 oz acre
	Oil	2 gallon acre
	Pottasium Nitrate	5 lbs acre
	Microtech CT	1Gal acre
December	Delegate	4 oz acre
	Oil	2 gal acre
	TKO	29 oz acre
	Recover RX	2 gal acre

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