New scion and rootstock planting options for Florida growers, with emphasis on fruit quality and disease resistance

Expo - 2018

UF UNIVERSITY of FLORIDA
IFAS
Citrus Research and Education Center

Jude Grosser
Fred Gmitter and Bill Castle

And…..The UF/CREC Citrus Improvement Team

- Rootstocks
  - New UF, USDA, and CA options
- Scions
  - Sweet oranges for the juice business
  - Mandarin hybrids
  - Grapefruit and grapefruit like hybrids
  - Acid fruit, e.g. lemons
- Develop new, or recapture old, markets

Citrus breeding is a continuum, and requires a delicate and common sense balance between short/medium-term and long-term objectives!

Opportunities !

UF Citrus Rootstocks

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St. Helena Project – Projected Cumulative PS Comparing UFR Rootstocks to Standards

	Rootstock	Width	Trees/ acre	PS / Acre 2011	PS / Acre 2012	PS / Acre 2013	PS / Acre 2014	PS / Acre 2015	PS / Acre 2016	PS / Acre 2017	Cumulative PS / Acre
Valquarius	FG1731 - **UFR-13**	8.25	264	0	1047	3955	3374	3795	1434	1406	15010
Valquarius	Org3 - **UFR-1**	8.94	244	0	965	2647	2064	3663	1904	1342	12585
Valquarius	FG1733 - **UFR-14**	10.00	218	0	747	3397	1794	2940	1284	1501	11663
Vernia	Org19 - **UFR-4**	9.81	222	693.99	912	2331	1986	1796	1545	1618	10882
Valquarius	white4 - **UFR-5**	8.50	256	486.60	826	2636	1971	2185	941	1556	10601
Valquarius	Chang+50-7-**UFR-6**	8.44	258	727.56	1136	2719	1636	1829	1285	1243	10576
Vernia	white4 - **UFR-5**	9.44	231	570.91	340	2378	1865	2367	1541	1059	10121
Vernia	Swc	9.50	229	0	0	1929	1247	2714	876	3184	9951
Vernia	Chang+50-7 - **UFR-6**	7.96	274	621.43	979	2322	1934	1717	1249	1116	9939
Vernia	Org15 - **UFR-3**	9.25	235	0	923	1879	1961	2741	804	1555	9862
Valquarius	Org15 - **UFR-3**	9.56	228	460.13	473	2413	1394	2443	1325	1107	9615
Vernia	Org4 - **UFR-2**	9.67	225	0	772	2093	1974	2881	1130	570	9420
Valquarius	Volk	12.25	178	256.03	723	698	721	2305	2606	2016	9326
Vernia	Org3 - **UFR-1**	9.36	233	404.68	875	1944	1876	2223	735	1005	9062
Valquarius	Swc	9.75	223	376.69	970	1397	854	1550	1806	1857	8811
Valquarius	KCZ	11.37	192	0	0	2423	1175	3237	889	1071	8795
Vernia	Volk	11.62	187	0	0	1992	1237	2661	1246	1640	8776
Vernia	KCZ	9.75	223	144.70	727	1407	577	1323	2047	1768	7993
Valquarius	Org4 - **UFR-2**	8.81	247	473.17	338	2023	1378	1227	798	1036	7273
Vernia	RL	10.19	214	0	782	1723	1142	1966	987	622	7223
Vernia	Cleo	10.25	212	0	0	1882	924	2507	949	950	7212
Valquarius	Org19 - **UFR-4**	8.94	244	0	737	1964	1257	1357	450	1269	7035
Valquarius	Cleo	10.75	203	0	485	927	940	1204	1096	1449	6101
Valquarius	RL	9.29	234	0	0	0	0	1282	1465	1479	4226

St. Helena Project – Projected Cumulative PS per rootstock for 2nd set of trees after 7 years; trees planted among HLB-infected trees.

Scion	Rootstock	Width	Trees/ acre	Bxs/ acre 2017	PS / Acre 2014	PS / Acre 2015	PS / Acre 2016	PS / Acre 2017	Cumulative PS / Acre		
Vernia	**UFR-16**	7.77	280	280.0	0	1978	1142	**1672**	4792		
Vernia	46x31-02-S3	8.25	264	264.0	660	1942	1228	1407	5237		
Vernia	6058x6056-00-2	9.13	239	250.6	0	1543	966	1343	3853		
Vernia	Wmur+HBJL-7	8.06	270	202.6	571	990	1135	1319	4014		
Vernia	Amb+Volk	7.44	293	219.6	660	1945	2189	1318	6111		
Vernia	**UFR-17**	7.35	293	219.8	0	2073	1395	1270	4738		
Vernia	Nova+7-2-99-2	7.56	288	187.2	757	1394	1239	1200	4590		
Vernia	A-Macrophylla	7.44	293	190.3	1024	921	611	1112	3669		
Valquarius	White1	8.12	268	201.0	807	2259	833	1101	5000		
Vernia	N+HBP-SS-8	9.62	226	181.1	380	1164	1224	1074	3842		
Vernia	N+HBP-SS-9	6.56	332	165.9	649	922	562	1011	3143		
Vernia	6058x2071-01-02	7.31	298	178.7	1052	1611	967	981	4611		
Vernia	Amb+5-1-99-2	7.36	296	148.0	882	2765	821	950	5418		
Vernia	46x31-02-S9	6.87	317	158.5	1336	1248	786	946	4317		
Valquarius	6058x2071-01-02	5.58	390	195.0	0	599	2001	928	3528		
Vernia	46x31-02-9	6.87	317	126.8	624	1039	1501	744	3908		
Valquarius	HBJL-2B(n)	7.88	277	110.6	981	1459	994	705	4138		
Vernia	SR+SH-99-11	5.50	396	118.8	375	1279	1123	697	3474		
Vernia	Nova+7-3-99-1	7.50	290	87.1	836	494	673	535	2538		

Flatwoods reset trial – Jackson Citrus, LaBelle, planted in 2014

Sorted By Health

Cultivar	Rootstock	No. Planted	No. replaced	Mean Height	Mean Health	Mean Yield
OLL20/	UFR17	114	15	3.757575758	3.484848485	2.090909091
OLL8/	UFR4	214	20	4.12371134	3.278350515	0.108247423
B9-65/	White1	48	9	2.974358974	3.179487179	2.076923077
OLL20/	UFR4	95	15	3.853658537	3.12195122	0.926829268
OLL20/	White1	23	6	4	3.058823529	1.470588235
OLL8/	46x20-04-2	97	25	3.638888889	3.041666667	0.847222222
B9-65/	UFR4	72	12	3.133333333	3.016666667	1.9
B9-65/	UFR17	24	4	3.45	3	2.15
OLL8/	46x20-04-47	199	45	3.564935065	2.980519481	0.74025974
B9-65/	46x20-04-42	50	9	3.243902439	2.926829268	2.195121951
B9-65/	46x20-04-47	76	23	3.41509434	2.886792453	1.509433962
OLL8/	UFR17	6	0	4	2.833333333	0.333333333
OLL8/	46x20-04-42	75	10	4.230769231	2.8	0.692307692
OLL20/	46x20-04-42	75	11	3.84375	2.796875	1.34375
OLL20/	43x20-04-12	101	25	2.157894737	2.763157895	1.473684211
OLL8/	46x20-04-37	68	9	3.810344828	2.75862069	0.948275862
OLL8/	46x20-04-64	60	14	3.652173913	2.739130435	0.47826087
B9-65/	46x20-04-48	50	6	3.409090909	2.704545455	1.590909091
OLL20/	46x20-04-48	74	18	3.482142857	2.678571429	1.160714286
B9-65/	43x20-04-12	102	21	2.790123457	2.641975309	1.777777778
B9-65/	46x20-04-09	112	1	3.630630631	2.612612613	1.747747748
OLL8/	43x20-04-12	95	25	2.028571429	2.6	0.814285714
OLL8/	46x20-04-48	76	7	3.028985507	2.579710145	0.768115942
OLL20/	46x20-04-47	57	17	3.4	2.475	1.025
B9-65/	46x20-04-2	119	32	3.24137931	2.459770115	1.057471264
OLL20/	46x20-04-64	74	7	3.21875	2.4375	0.921875
OLL20/	46x20-04-12	24	4	2.894736842	2.421052632	1.368421053
OLL20/	46x20-04-37	63	7	3.625	2.410714286	0.857142857
OLL8/	46x20-04-12	16	6	2.9	2.4	0.9
B9-65/	46x20-04-37	57	2	3.690909091	2.381818182	1.927272727
OLL8/	43x20-04-2	161	32	2.565891473	2.372093023	0.837209302
B9-65/	46x20-04-12	30	8	2.272727273	2.363636364	1.818181818
OLL8/	46x20-04-09	130	10	3.775	2.291666667	0.816666667
OLL8/	White1	26	3	3.434782609	2.260869565	1
OLL20/	46x20-04-09	110	7	3.702970297	2.257425743	1.148514851
B9-65/	46x20-04-64	81	10	3.042253521	2.225352113	1.507042254

UFR-17 Emerging as good HLB-tolerant rootstock for higher-density plantings.

OLL-8 on UFR-17, February 2018

Same trees, July 2018

6-year old OLL-8/UFR-17 resets at Orie Lee Alligator Grove; HLB+ over 4 years, grown with only 2 psyllid sprays per year; picked 2.13 boxes/tree in 2018 season. UFR-17 is [Nova+HBPummelo x sour orange+Carrizo].

Citrus Rootstock Selection Guide, 3rd Edition

- **New UF and USDA options**
- **http://edis.ifas.ufl.edu/hs1260**
- William S. Castle, Kim D. Bowman, Jude W. Grosser, Fred G. Gmitter, Stephen H. Futch, and James H. Graham

And… Stay tuned – new CREC Citrus Improvement Website coming soon, will provide data and analyses from most relevant field trials!

UF Sweet Oranges

Jude Grosser

Fred Gmitter

- Current portfolio of Hamlin, Midsweet, and Valencia; is that where we want the future OJ business to be?
- New midseason options include Valquarius, Vernia, and an earlier maturing LS Midsweet
- Later season, higher quality options include improved clones of Valencia and some of the OLL series
- Early season options, not only high colored Hamlin, but now the groundbreaking 'Florida EV 1' and 'Florida EV 2'

New Sweet Oranges

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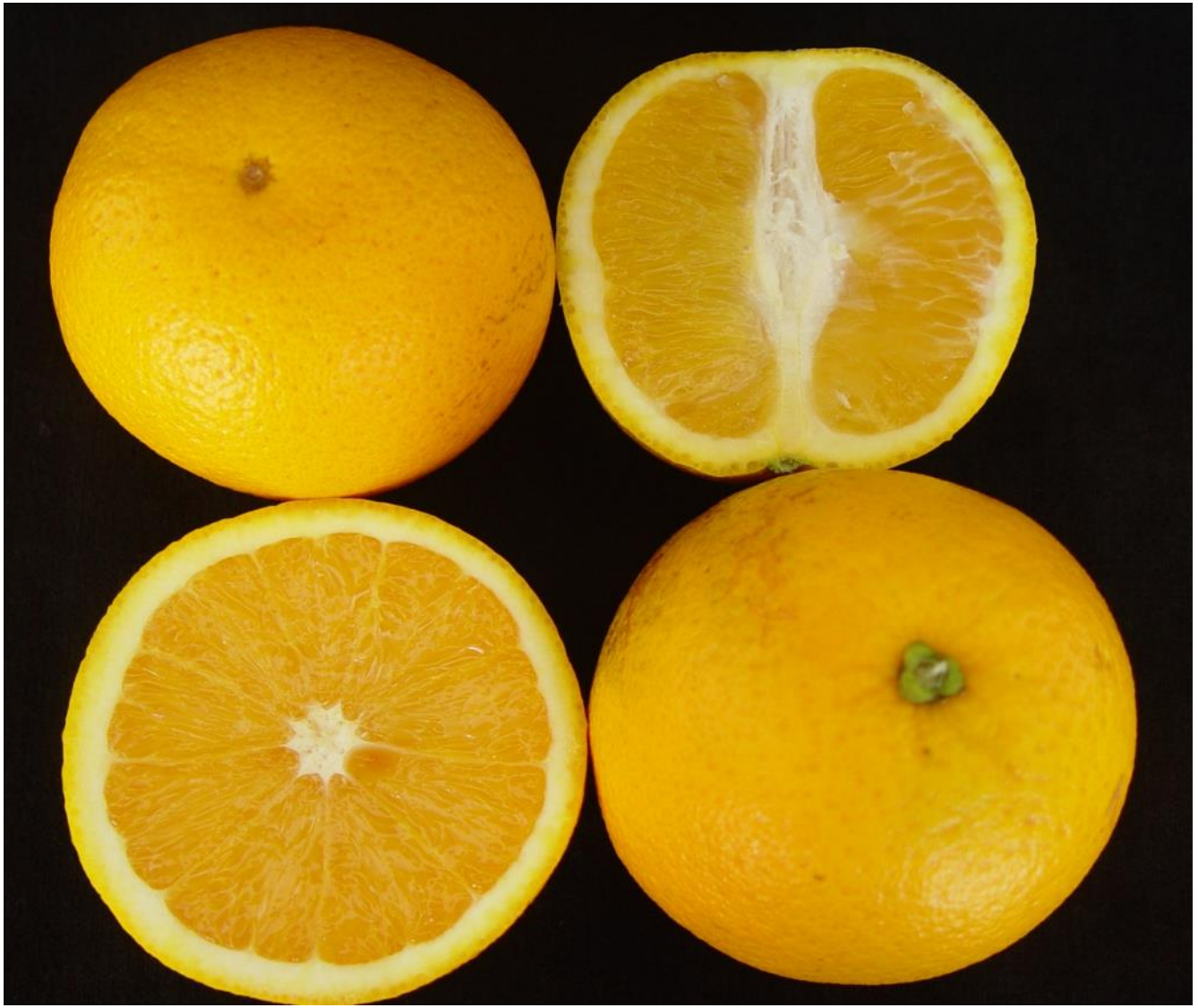


VALQUARIUS™

Juice Data from Valencia Somaclone SF14W-62 'Valquarius'						
Date	Orange	Brix	Acid	Ratio	lb solids	Color
2nd Generation Trees – Alligator Grove, east of St. Cloud (Control trees – mature budwood)						
1/26/2006	SF14W-62	10.6	0.84	12.6	n.d.	39.1
	Vernia	13.4	1.00	13.6	n.d.	38.5
	Midsweet	13.2	1.13	11.9	n.d.	37.7
1/23/2007	SF14W-62	10.9	0.76	14.3	n.d.	39.2
	Vernia	11.3	0.67	17.1	n.d.	39.5
	Valencia	11.1	1.14	9.7	5.88	37.5
4/11/2007	SF14W-62	12.6	0.57	22.0	6.19	39.0
	Valencia	14.1	0.83	17.0	7.76	39.8
1/17/2008	SF14W-62	11.1	0.76	14.6	5.90	38.2
	Vernia	12.4	0.97	12.8	6.40	38.5
2/25/2008	SF14W-62	10.8	0.70	15.6	n.d.	40.9
	Vernia	11.0	0.64	17.4	n.d.	40.3
	Valencia	11.7	1.4	8.6	n.d.	38.5
1/14/2009	SF14W-62	10.9	0.81	13.6	5.68	38.2
	Valencia	11.1	1.14	9.7	5.88	37.5

7-year old reset of SF14W62 on rough lemon, showing yield potential.

B9-65 Valencia for processing

Proposed name: 'ValAries' sweet orange

- A high yield, high solids selection with typical Valencia maturity, best of 30 selections in trial at Conserve II. Approved for release by IFAS Cultivar Release Committee

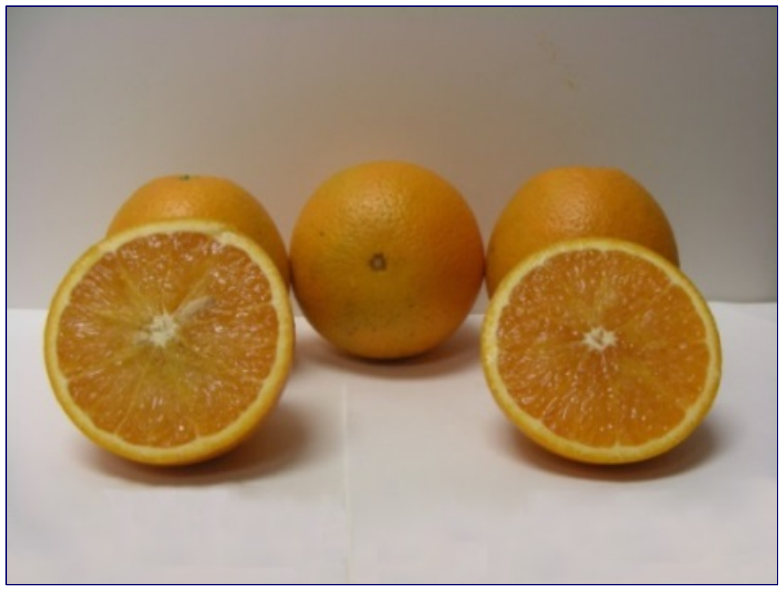
Table1. Yield Boxes / tree of Late Season sweet orange selections (somaclones, seedling introductions and controls) on Carrizo citrange rootstock planted 15' x25' at Water Conserv II, Winter Garden, FL, planted March, 2000.

Late season selections	2005-06	2006-07	2007-08	2008-09	2009-10	Cumulative Yield	Cumulative Rank
B-9-65	2.21	1.28	5.38	1.4	4.8	15.06	1
Appleby	2.46	0.98	4.61	1.82	4.91	14.78	2
T-4-43	1.8	1.02	4.4	0.73	5.81	13.76	3
T-2-25	2.08	1.27	4.15	1.08	4.68	13.26	4
S441-54-3 (Juv. 10-12-7)	2.27	1.24	4.4	0.83	4.38	13.13	5
T-3-62	1.59	1.58	3.8	1.21	4.52	12.7	6
S822-111-5 (Mat.10-12-7)	1.94	1.53	3.13	2.31	3.72	12.62	7
B-8-66	2.03	1.18	3.88	1.23	4.25	12.58	8
B-10-81	1.89	1.29	4.25	1.18	3.94	12.56	9
B-6-68	2.13	1.11	4.21	1	4.1	12.53	10
B-12-71	2.25	0.75	4.19	1.13	4.2	12.52	11
Jenner	2.08	1.18	4.52	1.18	3.48	12.44	12
Natal	1.48	1.46	4.07	1.04	4.27	12.32	13
Smith	2.11	0.99	3.93	1.01	4.26	12.3	14
T-1-13	2.35	0.84	4.28	0.91	3.8	12.18	15
T-1-23	1.82	0.7	4.07	1.42	4.18	12.18	16
T-2-62	1.8	1.06	3.82	1.22	4.18	12.08	17
Frost	2.14	0.79	4.52	0.84	3.77	12.06	18
B-8-76	1.84	0.89	4.43	0.66	4.13	11.96	19
T-1-25	1.61	0.69	4.61	0.43	4.38	11.72	20
T-1-26	1.66	0.72	4.29	0.81	4.22	11.7	21
T-1-33	1.62	0.67	3.75	0.77	4.47	11.27	22
Rohde Red Valencia	1.51	1.49	3.47	1.57	3.19	11.22	23
Valencia SF8-2-35	1.72	1.19	3.11	1.88	3.31	11.21	24
B-10-68	1.82	0.96	4.12	1.07	3.2	11.16	25
Vernia	1.35	1.34	3.18	1.29	3.12	10.28	26
Valencia SF11-1-69	1.54	1.17	2.06	1.47	3.4	9.64	27
B-10-62	0.99	0.74	2.58	1.25	2.27	7.82	28
Valencia SF9-1-86	0.93	0.73	2.04	1.05	2.83	7.58	29
B-6-66 (seedless, dwarfing)	0.82	1.06	1.48	1.03	2.38	6.77	30

OLL ORANGES

'OLL-8'

- Key attributes: Excellent color and quality, extends harvest window of 'Valencia' quality juice
- Produces round oranges with internal and external color similar to 'Rhode Red Valencia'
- Holds on the tree exceptionally well, and maintains quality into the summer
- Trees appear to yield better than standard 'Valencia'
- High juice content and good pounds solids
- Peels easier than a standard 'Valencia'
- With its added color, could also be a valuable addition to the Florida fresh market portfolio
- Most precocious bearing clone among the OLL somaclones



'OLL-4'

- Key attributes: excellent color and quality, extends harvest window of 'Valencia' quality juice; also believed to be higher yielding than 'Valencia'
- Produces fruit with excellent internal and external quality with exceptional juice color scores, juice content and soluble solids
- Holds on the tree exceptionally well
- Maintains quality into the summer; however, it matured earlier, and with better ratios than 'Valencia' in 2014
- Has been the highest yielding tree among the OLL somaclones

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Yield data from original OLL somaclone trees – Alligator Grove – Trees on Swingle citrumelo planted in 2001 (90 lb. boxes).

	2012 BOXES	2013 BOXES	2014 BOXES	TOTAL BOXES	AVG. BOXES
OLL-1	4.00	4.75	3.88	12.63	4.21
OLL-2	3.00	3.75	2.34	9.09	3.03
OLL-3	2.75	4.75	4.13	11.63	3.88
OLL-4	5.75	5.25	6.13	17.13	5.71
OLL-5	4.75	3.75	3.38	11.88	3.96
OLL-6	2.75	2.75	5.88	11.38	3.79
OLL-7	2.75	4.25	3.88	10.88	3.63
OLL-8	1.75	0.00	0.00	1.75	0.58
OLL-9	4.25	4.00	3.13	11.38	3.79
OLL-10	5.00	5.75	5.38	16.13	5.38
OLL-11	1.00	1.50	1.38	3.88	1.29
OLL-15	2.00	2.75	2.88	7.63	2.54
OLL-16	3.00	3.75	2.63	9.38	3.13
OLL-19	4.00	5.00	3.88	12.88	4.29
OLL-20	2.00	5.25	4.13	11.38	3.79
OLL-21	3.75	4.75	4.13	12.63	4.21
OLL-22	5.25	4.50	3.38	13.13	4.38
OLL-23	3.75	6.75	3.88	14.38	4.79
OLL-25	3.25	3.75	2.38	9.38	3.13
OLL-27	4.25	4.50	5.38	14.13	4.71

Hamlin Somaclones – Advanced Selections

ANALYSIS DATE	Hamlin Clone ID		BRIX	ACID %	RATIO		Color	
1/3/12	T8-40		11.65	0.51	22.84		33.92	
1/3/12	N16-23		13.84	0.69	20.06		32.51	
1/3/12	N13-32		11.01	0.60	18.35		36.14	
1/3/12	N14-10		11.64	0.57	20.42		32.95	
1/3/12	Standard Hamlin		11.86	0.53	22.38		32.81	

Hamlin Somaclone N13-32 - a new and distinct early season clone of Hamlin sweet orange improved juice color and typical or better soluble solids for processing.

BUT…..

WHY PLANT HAMLIN?

New Early Valencia clones EV-1 and EV-2 harvest can begin around Thanksgiving!

EV-1 (Valencia Somaclone B7-70) - a new and distinct early-maturing clone of Valencia sweet orange; matures approximately 3 months earlier than standard Valencia and has potential to replace ‘Hamlin’ in Florida processed NFC (December photo).

EV-2 (Valencia Somaclone SF14W-65) - a new and distinct early-maturing clone of Valencia sweet orange; matures approximately 3 months earlier than standard Valencia and had potential to replace ‘Hamlin’ in Florida processed NFC (December photo).

Table 3. Juice data from 6-year old trees on rough lemon rootstock – Alligator Grove, St. Cloud, FL. Pilot-Plant Data from samples run on December 10, 2014.

Variety	Wt. Sample	Wt. Juice	Lbs. Juice Per Box	Acid	Total Brix	Ratio	Fruit Ct	Lbs. Solids	Lbs. Solids Per Box	Juide Color
Vernia	26.83	16.07	53.906	0.87	11.04	12.69	78	5.9512	5.95	35.3
B7-70	26.94	15.24	50.913	0.71	11.30	15.92	61	5.7532	5.75	36
Hamlin	25.36	14.91	52.914	0.94	11.17	11.88	64	5.9105	5.91	34.5
Valuarius	25.69	14.48	50.728	0.84	9.87	11.75	55	5.0069	5.01	35.7
SF14W-65	26.75	14.95	50.299	0.67	11.06	16.51	63	5.5631	5.56	36
TI-19	28.14	16.71	53.443	0.98	9.53	9.72	58	5.0931	5.09	35.4

EV-1 and EV-2 Early Valencias generally reach 15 ratio by Thanksgiving!

3.5 year-old resets of EV-1 (Early Valencia) on UFR-15 at the St. Helena project in Dundee. Overall tree health and cropping both excellent.

Safe Planting Options:

- Mid-season processing sweet oranges (harvest mid-January to March): Valquarius and Vernia. Both produce Valencia quality juice; Valquarius has better shape and color for crossover to fresh market.

- Late-season processing sweet oranges (harvest mid-February to June) Valencia B9-65, OLL-8 and OLL-4. B9-65 is the most precocious bearing among these. OLL's have exceptional fresh market potential.

- Rootstocks for small-medium sized trees: UFR-6; US-897, UFR-17

- Rootstocks for medium-sized trees: US-942, US-812, UFR-1, UFR-2, UFR-3, UFR-4, UFR-5, UFR-16, C-22, x639

- Rootstocks for larger sized trees: US-802, UFR-15, Volk, rough lemon, C-54, C-156, (UFR 9 and UFR-10 now available via TC)

- Rootstocks for Diaprepes areas: UFR-4 and UFR-5

BETTER ORANGES MAKE BETTER JUICE!

Improved Processing Sweet Oranges can significantly improve our NFC product! Better flavor and color makes the product more attractive in the store, and will certainly have purchasers coming back for more! This will facilitate marketing and build a larger consumer-base.

Left: juice from OLL-8:

Right: Florida NFC purchased at Publix

Early oranges (and grapefruit) are more of a challenge!

- We think the combination of rootstock/optimized nutrition will solve the fruit drop problem.
- We are planting EV-1 and EV-2 (early Valencias) on multiple new rootstocks in efforts to identify HLB tolerant rootstocks that hold fruit on the tree until harvest. The same approach is being conducted with grapefruit.
- We have nutrition/rootstock treatments in progress designed to minimize drop – could have answers as early as February.

Hamlin N13-32 trees on rootstock 2247x2075-02-26 (Dickinson Frielander trial, Lake Wales) survived Irma and were still holding fruit in April. These trees have been treated with enhanced CRF to see if the current large crop can hold. Hamlin on 46x20-04-6 is also a candidate showing promise in this regard.

UF Fresh Fruit Selections

Jude Grosser

Fred Gmitter

LB8-9 (Sugar Belle®)

Sugar Belle® near Vero Beach, HLB+ >8 years !

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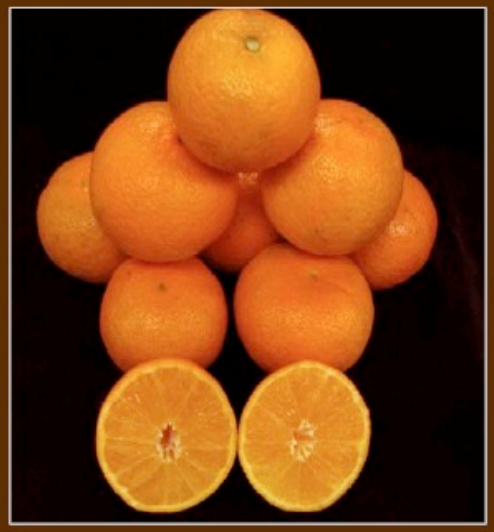
Typical fruit from young HLB-infected (3 years) LB8-9 SugarBelle™ trees treated with controlled release fertilizer containing extra manganese and boron, and Tiger-Sul micros.

Typical fruit from young HLB-infected (3 years) LB8-9 SugarBelle™ trees with standard fertilization regime.

‘N40W-6-3’



Fruit size: small to medium
Fruit flavor: unique and robust sweet flavor and should compete favorably with Fall-Glo in the fall fresh mandarin market
Fruit peel: not a zipper-skin, but can be peeled cleanly
Seeds per fruit: seedless, an occasional seed found
Brix-Acid ratio: Brix 12.03, acid 0.59, ratio 20.39 (November)
Harvest season: can begin in October, but the fruit reaches maximum flavor and quality around Thanksgiving
Rootstock selection: small, compact tree when grown on Swingle citrumelo rootstock
Disease Tolerance: no issues so far with canker or alternaria
Comments: like many mandarins, fruit is smaller with heavy cropping

‘N40W-6-3’ Seedless Snack – showing good HLB tolerance!

N40W-6-3 on UFR-5 @ Picos USDA Farm

N40W-6-3 on WGFT+50-7 @ CREC

N40W-6-3 Seedless Snack showing very good HLB tolerance on several rootstocks at multiple locations. This variety requires grower patience as young tree fruit has an issue with granulation. We are hoping to find an HLB tolerant rootstock that will minimize this problem.

MANDARIN HYBRIDS

411 MANDARIN HYBRID

Fruit size: large, attractive fruit, firm
Fruit flavor: excellent quality when harvested at maturity
Fruit peel: easy to peel cleanly
Seeds per fruit: less than 10 seeds
Brix-Acid ratio: typical juice quality in late January is 15.0, 1.3, and 11.5, respectively
Harvest season: January
Rootstock selection: no data supporting adaption to different rootstocks
Disease Resistance: rigorously tested against Alternaria and is resistant in lab and greenhouse tests
Comments: superior easy peeling, attractive and delicious fruit that may be produced between the Sunburst and Murcott harvest seasons; vigorous growing tree with a dense canopy; prone to alternate bearing

900 MANDARIN HYBRID

Fruit size: medium-large
Fruit flavor: excellent early season flavor – better than other commercial mandarins available in September!
Fruit peel: easy to peel
Seeds per fruit: usually less than 10 seeds
Brix-Acid ratio: achieves 13+ ratio in September
Harvest season: September - October
Rootstock selection: no data supporting adaptation to different rootstocks
Disease Resistance: rigorously tested against Alternaria and is resistant in lab and greenhouse tests
Comments: good early season color without de-greening (see natural September color in photo above)

411 Mandarin Hybrid – Resurgence against HLB!

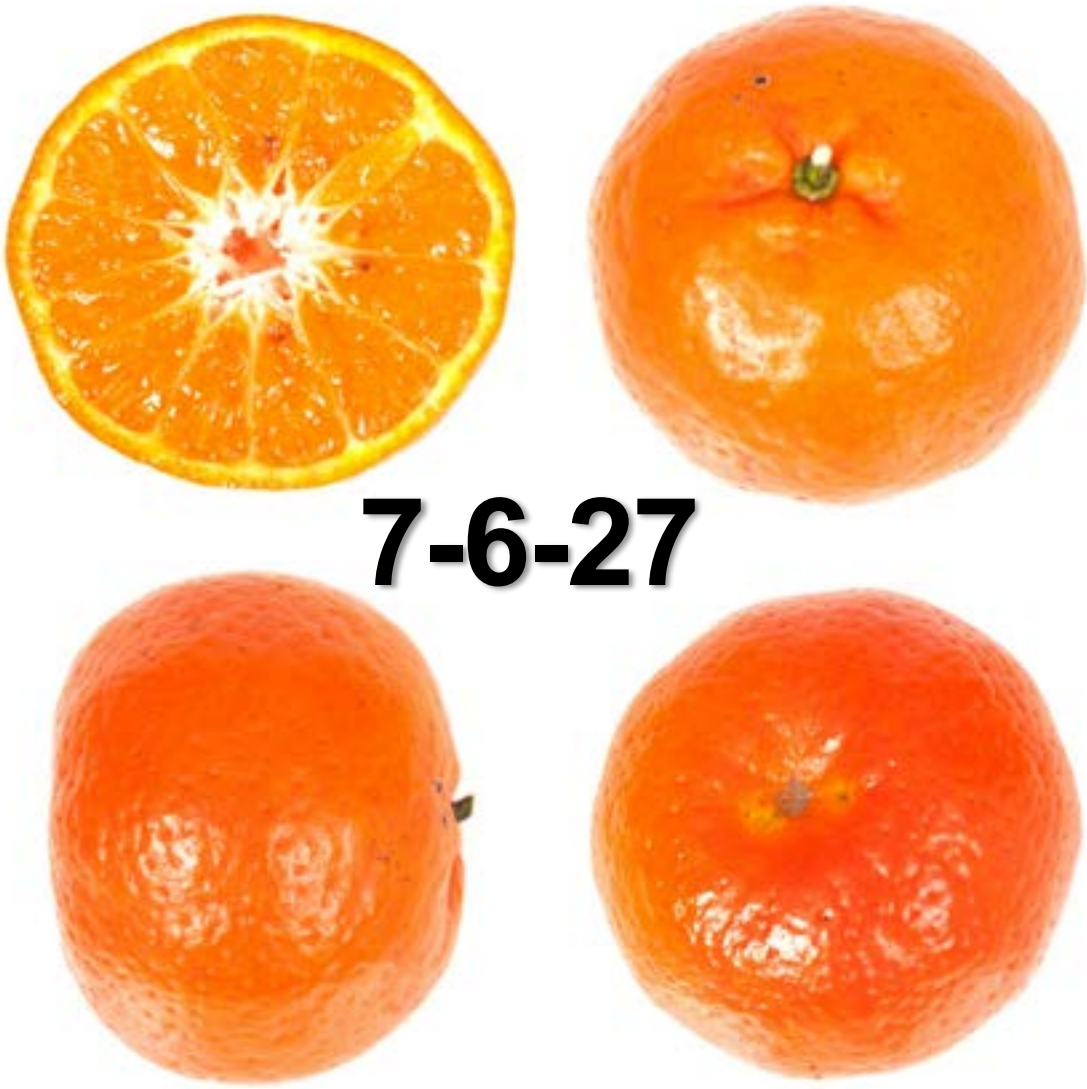
411 mandarin hybrid showing a resurgence against HLB on multiple rootstocks. HLB+ tree on WGFT+50-7 rootstock shown on right dug up from lost Haines City trial and moved to CREC 4 years ago, among several showing a remarkable recovery and productivity! An absolutely delicious piece of fruit!

UF 950

- Easy to peel
- Seedless
- Clementine size
- Convenient to eat
- Crisp texture, like Ponkan
- Better color and flavor than Clementine
- Dec maturity; ratio 13-16
- Alternaria resistant
- Showing HLB tolerance

UF 950 – Good HLB Tolerance!

UF 950 showing good HLB tolerance! HLB+ trees on WGFT+50-7 rootstock dug up from lost Haines City trial and moved to the CREC 4-years ago thriving!



Commercialization: Fast Track Suite III

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7-6-27 on 4/4/16

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- October-November maturity
- Small to medium size fruit
- Seedless, though contains inconspicuous seed traces
- Deep orange-red color, inside and out
- Very easily peeled and consumed, good segment integrity
- Excellent flavor
- Brix = 11.6; acid = 0.81; ratio = 14.32 (10/20/14)

Fruit Attributes of 7-6-27

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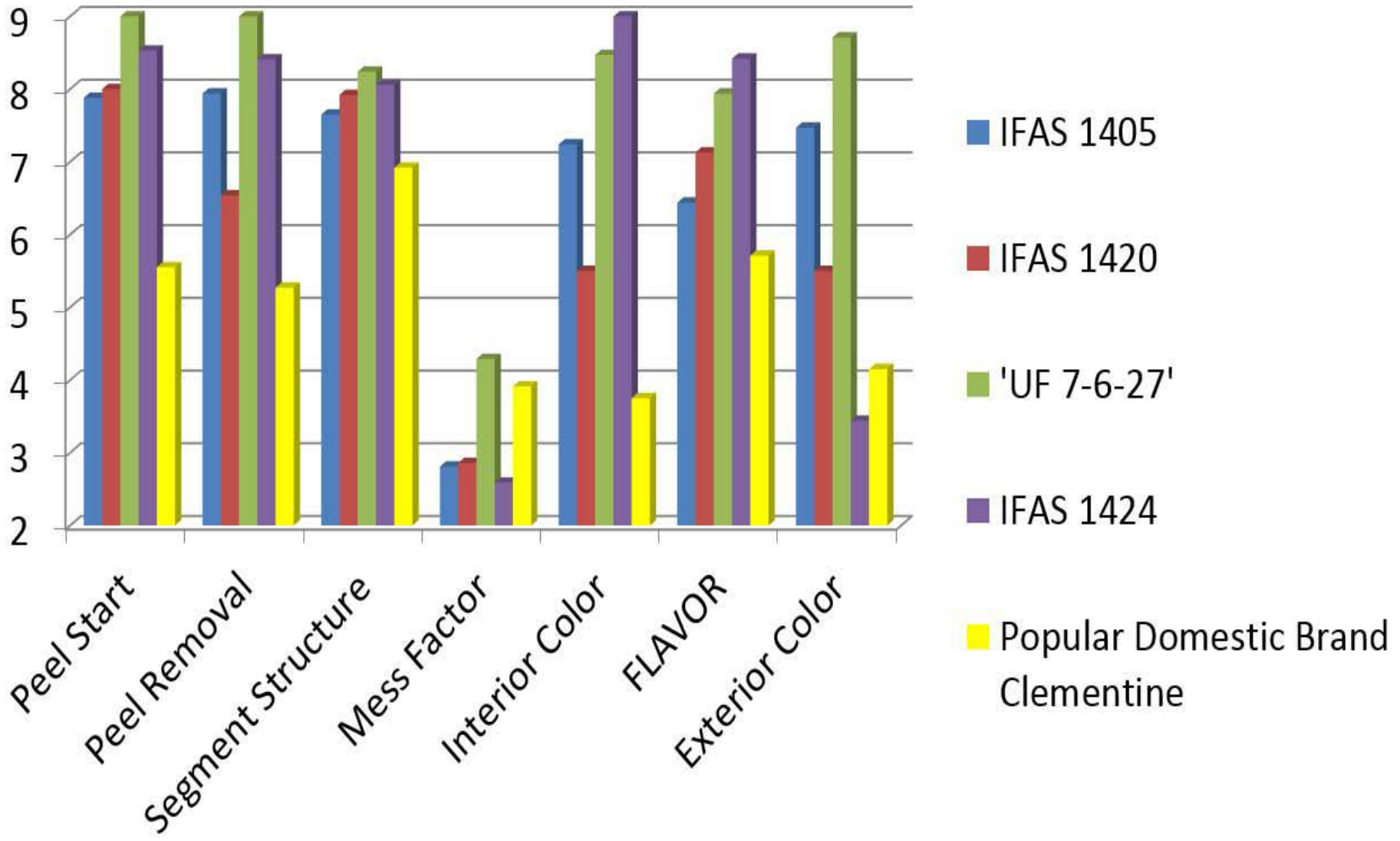

Fruit Display Day Results 2014

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UF Mandarin Selection 1420

Suggested name: ‘Marathon’

A FAST-TRACK Release

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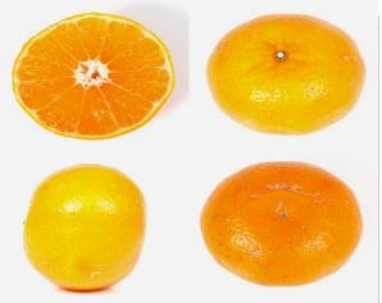
Fred G. Gmitter Jr.
University of Florida



…on behalf of the Team!

Typical Fruiting Habit and Foliage

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- Seedless under all circumstances, and easy to peel
- Good color, good flavor, and segment structure
- Very early maturity, with long on-tree storage capacity
- Firm fruit that can be harvested without clipping, saving labor costs at harvest
- Responds well to ethylene, and performs very well in long term cold storage
- ‘Daisy’ mandarin x ‘Mukaku Kishu’ parentage

Unique Characteristics

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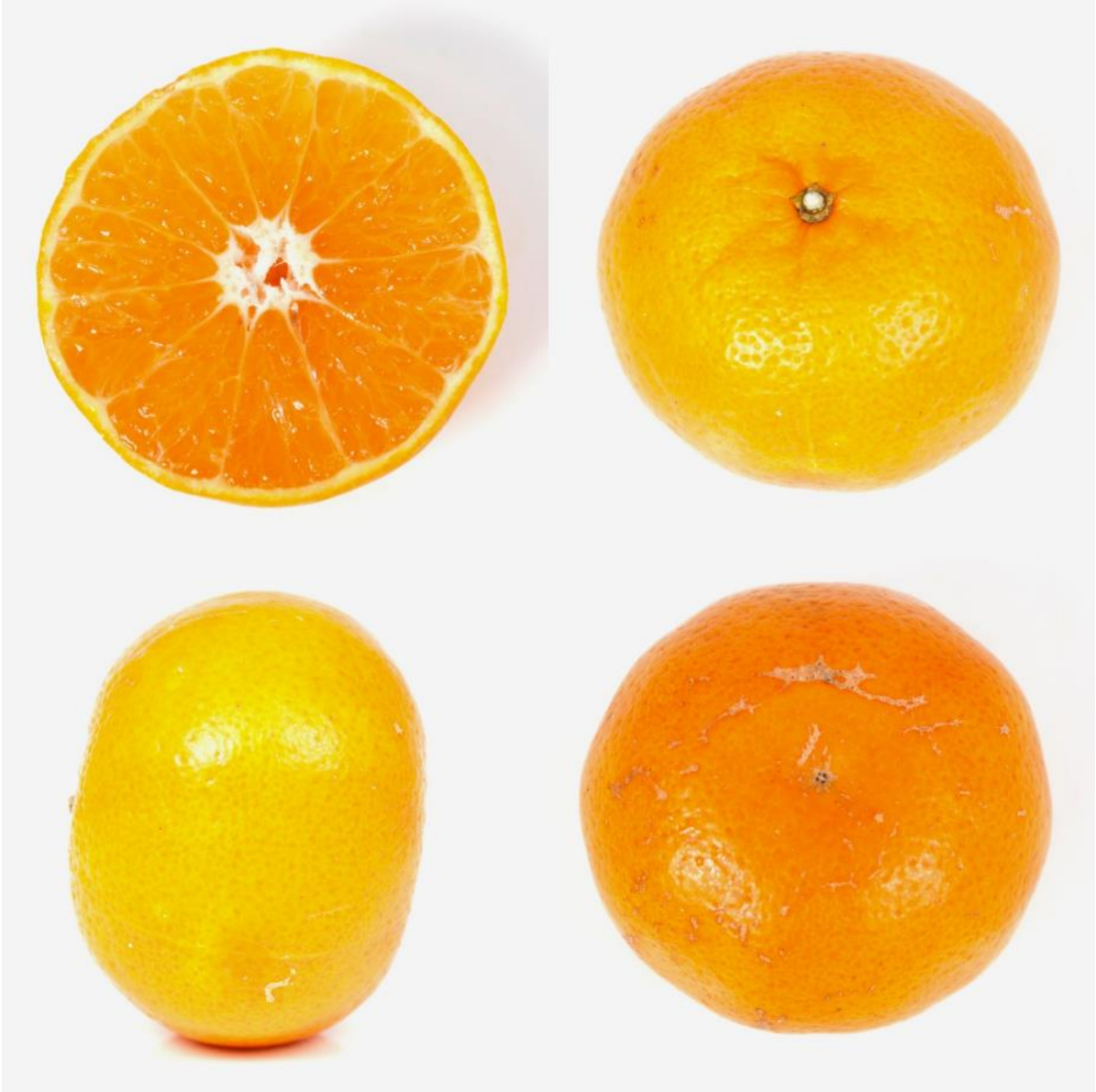

‘Marathon’

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- Brix: 12.5 Acid: 0.89 Ratio: 14.04 19 August 2015
- Brix: 13.0 Acid: 0.59 Ratio: 22.03 25 September 2015
- Brix: 14.0 Acid: 0.69 Ratio: 20.28 29 October 2015
- Brix: 17.4 Acid: 0.62 Ratio: 28.06 17 December 2015
- Fruit remained in sound condition until early January
- No clipping required

1420: Long Maturity Window

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1420

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Selection	Degreening	6 weeks of storage	8 weeks of storage		
		Healthy Fruit (%)	Healthy Fruit (%)	Total Decay (%)	Total Peel Breakdown (%)
BB-4-8-20	yes	100.00	62.50	25.00	12.50
	No	100.00	75.00	12.50	12.50
Bingo	yes	100.00	92.30	7.70	0.00
	No	100.00	92.85	0.00	7.15
1420	Yes	100.00	100.00	0.00	0.00
	No	100.00	100.00	0.00	0.00
Fallglo	Yes	100.00	66.66	33.33	0.00
	No	100.00	83.33	16.66	0.00

Post-harvest behavior

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UF Mandarin Selection 13-51

For Gift Fruit and Dooryard Uses

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University of Florida

…on behalf of the Team!

Typical Fruit Characteristics

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- Easy to peel, attractive deep orange color, and exceptional flavor
- Produces seeds
- Potential for GIFT MARKET because of appearance and eating quality
- Very good tolerance of HLB, has DOORYARD potential
- Maturity from mid-November through early January (Gift)
- Can be held on-tree through April in most seasons (Dooryard)
- ‘LB8-9’ x ‘Murcott’ parentage

Unique Characteristics

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UF 914

- Red flesh color
- Attractive peel blush
- Grapefruit size (+)
- Grapefruit flavor and aroma
- Tender and juicy flesh
- Very low in FC's (GJE)
- Seedless
- Good brix, lower acid
- Slightly thicker peel than grapefruit

Unique Characteristics

- Uniform large fruit (avg. 680 g); harvest from October through early April
- External red blush; uniform internal color
- Very similar to grapefruit in aroma and flavor attributes
- **Very low amounts of furanocoumarins**
- Sweeter and less acidic than ordinary grapefruit
  - **914 Brix/acid=9.9/0.99= 10**
  - **Ruby Red Brix/acid=9.2/1.21= 7.6**

N2-28 Summer Gold Grapefruit

Table 1. Comparison between summer N2-28 'Summer Gold Grapefruit' and controls 'Ruby Red' and 'Pink Marsh" for the Brix, color and titrable acidity value (average of 20 fruit per selection, test conducted July, 2013).

	Brix°	Color	Titrable Acidity (ml)
Summer Gold N2-28	11.6	34	0.98
'Ruby Red' grapefruit	9.4	34.5	0.85
'Pink Marsh' grapefruit	8.2	34.3	1.2

- Cybrid with 'Dancy' cytoplasm
- Sweeter than Ruby Grapefruit
- Harvest from December to August!
- No granulation or seed germination

What's Coming Soon?

- Advances in root nutrition have led to a resurgence in the UF/CREC Citrus Breeding Program – We have about 10-times more scion hybrids fruiting this year than we have had in the past 8 years – and most are seedless!
- High-quality HLB-tolerant parents are being identified and utilized, both for scion and rootstock improvement.
- Numerous HLB-tolerant, easy-peel, seedless and delicious mandarins in the pipeline.
- New HLB-tolerant orange-like hybrids that produce high quality juice amenable to processing (many that will also be seedless)
- Look for new improved, seedless pigmented grapefruit/pummelo hybrids with better HLB and canker tolerance.
- New seedless acid fruit (lemon/lime) hybrids with unique flavors.
- Rootstocks that can mitigate HLB without monthly psyllid sprays, that will work with all commercial scions (>10,000 hybrids screened so far).

LEMONS FOR INDUSTRY/FRESH MARKET?

*UF has several high oil producing/nearly seedless clones available

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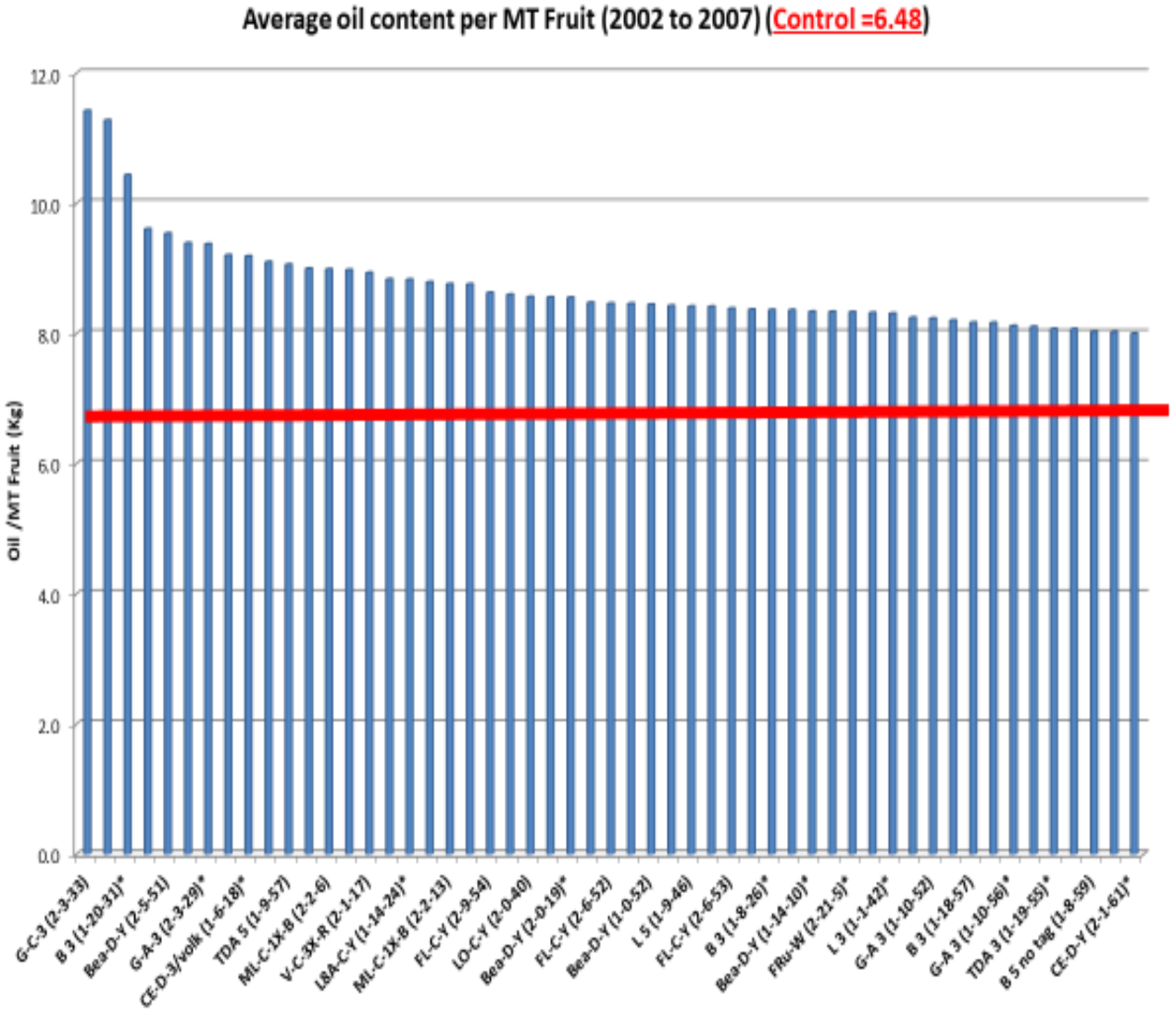

Average peel oil content of advanced lemon selections grown in Florida. Red line is the control group mean value across the same time period. A few clones are nearly seedless and one is completely seedless.

New hybrids from quality parents showing HLB tolerance that exceeds SugarBelle!

Can SugarBelle transmit it's high level HLB-tolerance to progeny? YES! Above see two seedless triploid hybrids of SugarBelle x [Nova+Osceola] with HLB tolerance as good or better than SugarBelle.

HLB-Tolerance + Commercial Quality!

HLB-tolerant SugarBelle

HLB-tolerant C7-12-18

Yes! We are now finding HLB-tolerant hybrids of SugarBelle that have commercial quality fruit. On right above: SugarBelle x [Succari + Murcott], late maturing, easy-peel seedless mandarin with outstanding flavor rivaling Shiranui (15.5 brix in March).

Many of our promising but seedy scions have been irradiated in efforts to generate seedless clones. This includes mandarins 900, 411, 711 and 13-51. Above see a seedless selections of the delicious red pummelo 5-1-99-5, which has been entered into the Parent Tree Program for release.

9-year old Valencia on 46x20-04-6 (HB Pummelo x Cleo) grown at Lee Alligator Grove (St. Cloud) with only 2 psyllid sprays per year and no special nutrition.

S10xS15-12-25 (Shekwasha/Cleo/pummelo)

Several hybrids of 8-1-99-2B x C22 (pummelo x citrandarin)

GAUNTLET rootstock screening (Final stage at USDA-Picos Farm, Fort Pierce, FL); HLB+ Valencia trees grown from the get-go with Clas-infected budsticks; also passed through a hot psyllid house. More than 10,000 hybrids screened to date. Some now in large-scale trials!

Alligator Matthew Block Nutrition Study – 2017 December PCR and yield results

Vernia/rough lemon (10-years old; treatments started fall of 2015, 12 trees per treatment (2-six tree reps); 2017 harvest heavily impacted by PFD. Last column is boxes per treatment (12 trees) since trial began (2-years of production). Products: Harrells CRF St. Helena mix, TigerSul mn, Florikan polycoated boron. CT value 32 or above considered negative for Liberibacter.

Treatment	CT Value mean	SD	# trees 32+ ct	Yield (B/T): 2016	2017	2018	Cumm
1 standard	23.19	4.8	0	1.67	0.56	1.71	27.2
2 + Harrells	27.81	5.3	5	1.50	1.02	1.75	33.2
3 + Harr/2x mn	27.57	5.3	3	1.50	0.83	1.54	28.4
4 +Harr/2x bn	29.48	5.4	5	1.92	0.83	1.71	30.5
5 +Harr/2x mn&bn	30.32*	5.5	5	1.50	0.94	1.71	31.8
6 +4x mn	**32.75***	**5.7**	**7**	**1.75**	**0.92**	**2.21**	**37.6**
7 + 4x bn	28.07	5.3	5	1.58	0.44	1.63	24.8
8 +4x mn & bn	23.81	4.8	0	1.50	0.90	1.79	32.3

*significantly different than standard at 95% CI

Evidence: Overdoses of manganese can be therapeutic against HLB!!!!!!!

WHATEVER YOU PLANT, GROW IT RIGHT!

- First 2-3 years, use CRF!
- After year 3, go to 'hybrid' program, combining traditional soluble dry with CRF
- If using fertigation, provide constant micro-nutrients year-round; augment with CRF during rainy season
- According to my experiences, you need 20-33 lbs. of elemental manganese/year and 10-13 lbs. elemental zinc/year to maximize HLB tolerance!
- Best of Luck!

To HALL OF FAME CITRUS GROWER-RESEARCHER
and Outstanding Industry Collaborators: Mr. Orie Lee

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PI's Laboratory Staffs, Steve Mayo & the USDA Picos Farm Crew, many others, and Troy Gainey and the CREC Grove Crew (including our scouts!).

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Thanks!

UF-CREC Citrus Genetic Improvement Team
2018