

Exploring Citrus Hybrids Tolerant to HLB

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USDA, NIFA – Emergency Citrus Disease Research & Extension

- ☑ To identify HLB-resistant/tolerant hybrids with good flavor quality (orange-like and grapefruit-like, +/- Poncirus background)
- ☑ To identify DNA markers associated with tolerance to expedite screening
- ☑ To explore tolerance-related response to pathogen effector / pathogen-associated molecular pattern for use as screening tool
- ☑ To develop a transgenic strategy to enhance cultivars resistance response
- ☑ To characterize fruit and juice quality of HLB-tolerant scions, for either as stand-alone variety, or use in orange-like juice blends
- ☑ Transfer research findings to citrus industry and determine grower/processor acceptance of hybrids via website/UF extension



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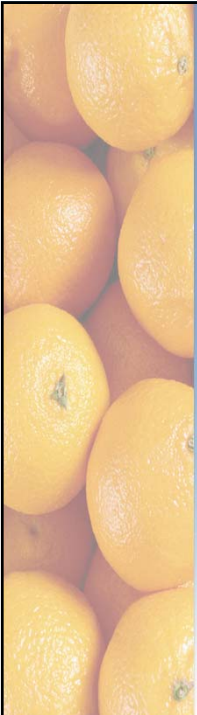
ACCELERATING IMPLEMENTATION OF HLB TOLERANT HYBRIDS AS NEW COMMERCIAL CULTIVARS FOR FRESH AND PROCESSED CITRUS

- 🍊 Liz Baldwin & Jinhe Bai, USDA, ARS, USHRL Fort Pierce (PD)
- 🍊 Ed Stover (USDA, ARS), Fred Gmitter (UF Lake Alfred), Mikeal Roose (UC Riverside) – **Breeders/geneticists**
- 🍊 Jinhe Bai, John Manthey, Anne Plotto (USDA, ARS); Yu Wang (UF) **Fruit quality & chemistry**
- 🍊 Gutam Gupta, NM Consortium – **Biologist**
- 🍊 Rhuanito (Johnny) Ferrarezi (UF IRREC) - **extension**



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Expected Outcome

- 🍊 Identification of genes associated with resistance or tolerance to HLB will increase confidence in selections
- 🍊 May suggest molecules for short-term therapeutic treatments, will provide markers for screening conventional hybrids for resistance, will guide gene selection for transgenic resistance development
- 🍊 Some hybrids may be classified as orange if aroma profile is similar enough to orange as was done with Ambersweet for juice

➤ **Characterize flavor quality of hybrids showing tolerance to HLB**

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PA-A1

Materials

- 🍊 trees planted 1986-2000 from USDA Leesburg farm
- 🍊 trees planted 1999-2000 from USDA Picos farm (Fort Pierce)
- 🍊 many own-rooted some on rootstocks
- 🍊 48 hybrids or named cultivars (reference), ~25 each year
- 🍊 One to 3 harvests per season

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Hybrids Less Susceptible to CLas



USDA/ARS, Ft. Pierce, FL
Photos Ed Stover

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PA-A1 Ed, can you please complete?

Plotto, Anne - ARS, 8/19/2020



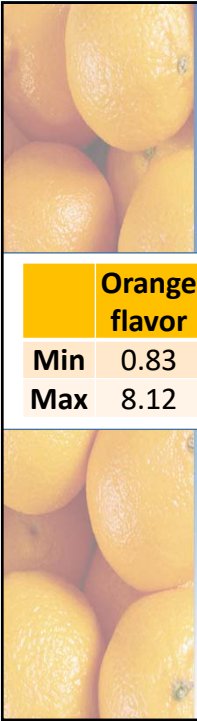
Sensory & Chemical Analysis

- 🍊 Fruit harvested at estimated maturity, multiple harvests
- 🍊 Wash, sanitize, juice
- 🍊 Take samples for volatiles, sugars, acids, SSC (Brix), TA, limonoids
- 🍊 Sensory evaluation – trained panel with reference standards, rate attributes on 0 to 15 points scale (low to high intensity).





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2016-2019 Quality Data

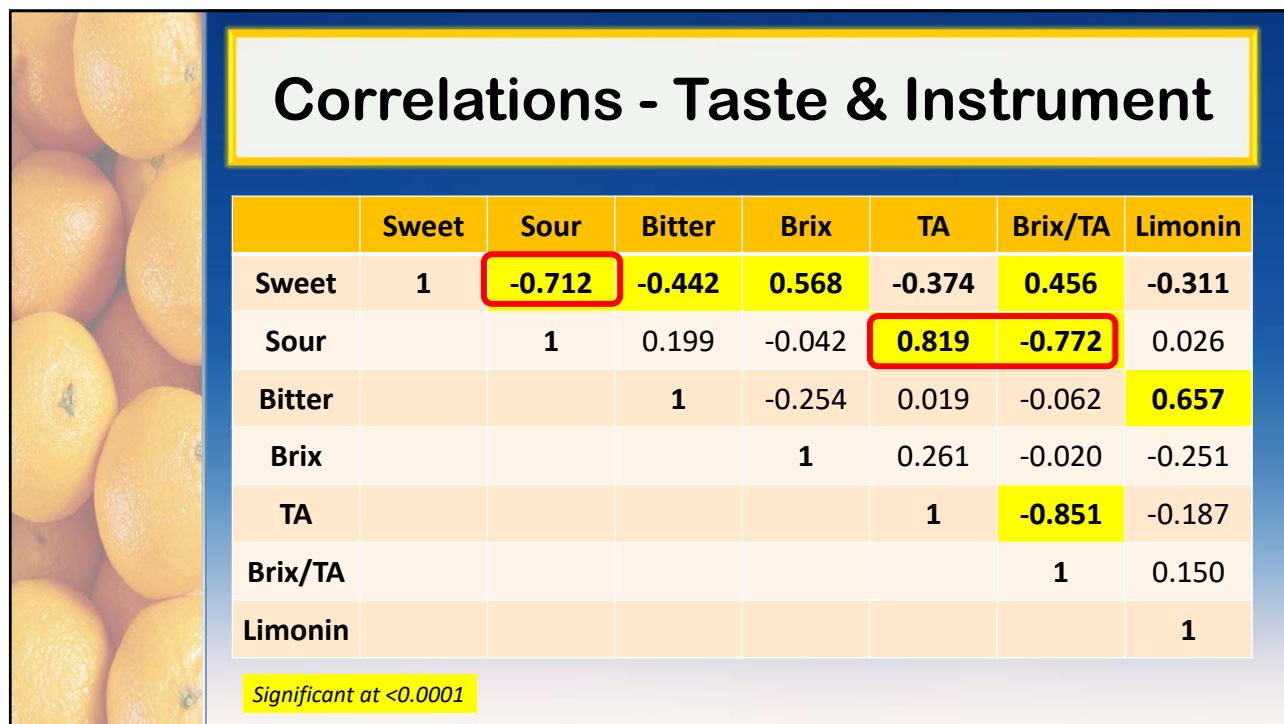
44 orange-like hybrids & named varieties (+ 1 grapefruit hybrid)

	Orange flavor	Mandarin flavor	Grapefruit flavor	Sweet taste	Sour taste	Bitter taste	% TA	Brix	Brix/TA	Limonin
Min	0.83	1.67	0.37	2.83	2.50	0.41	0.28	8.00	5.14	0.45
Max	8.12	7.69	5.77	9.50	13.50	11.83	2.16	15.60	54.76	18.91

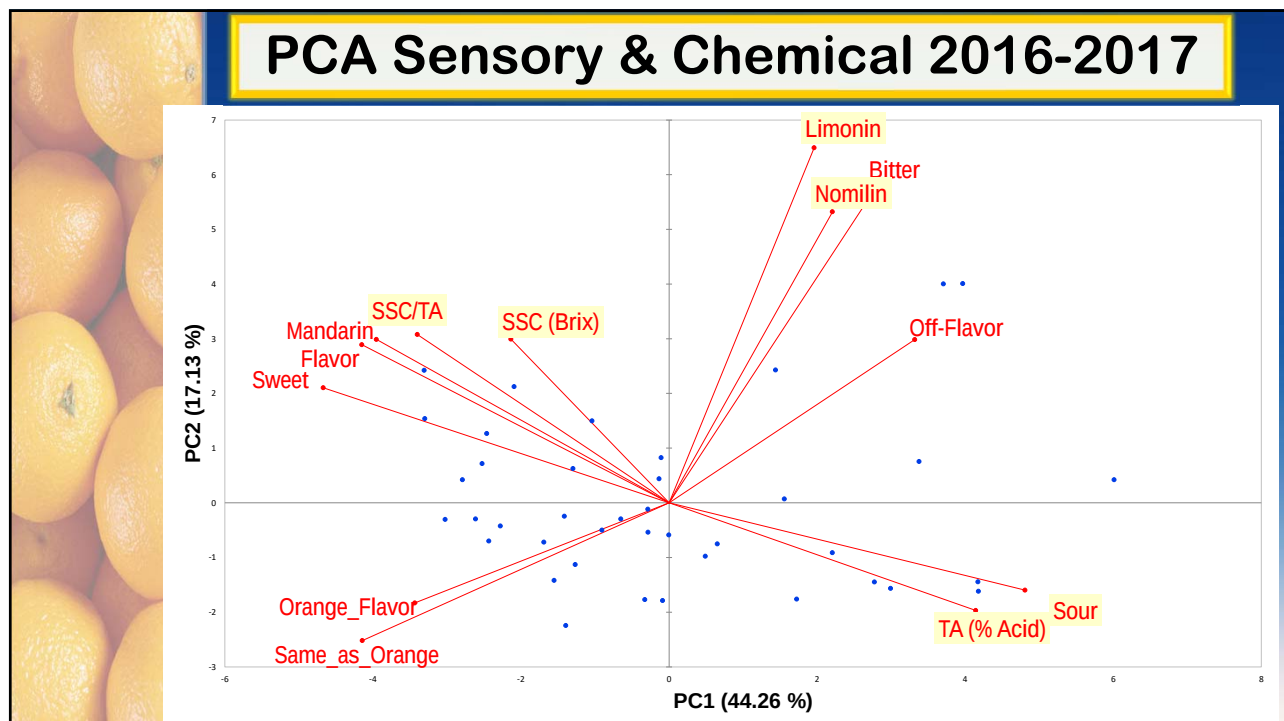
High bitterness correlated w/ high limonoids, but not always

Hybrid	Bitter (0-15 scale)	Limonin (ppm)
FF-1-17-170	7.49	16.9
FTP-6-46-15	5.0	3.4
FF-1-10-90	4.9	8.1

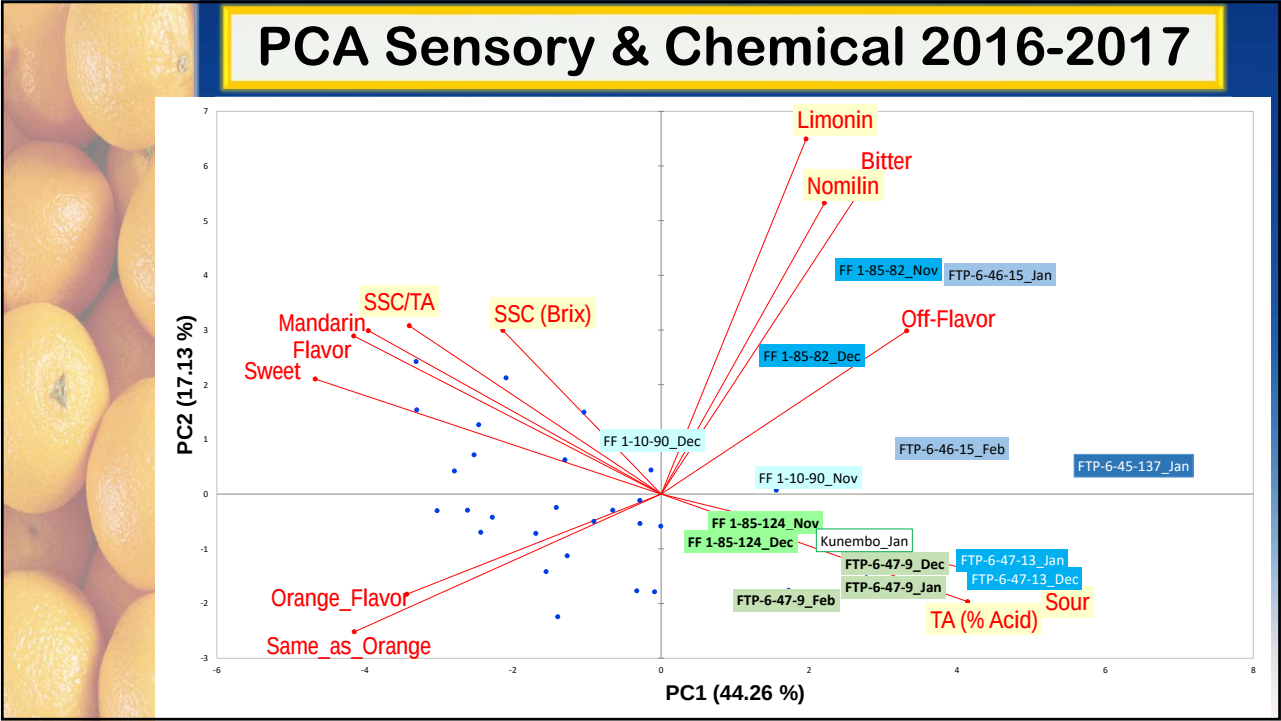
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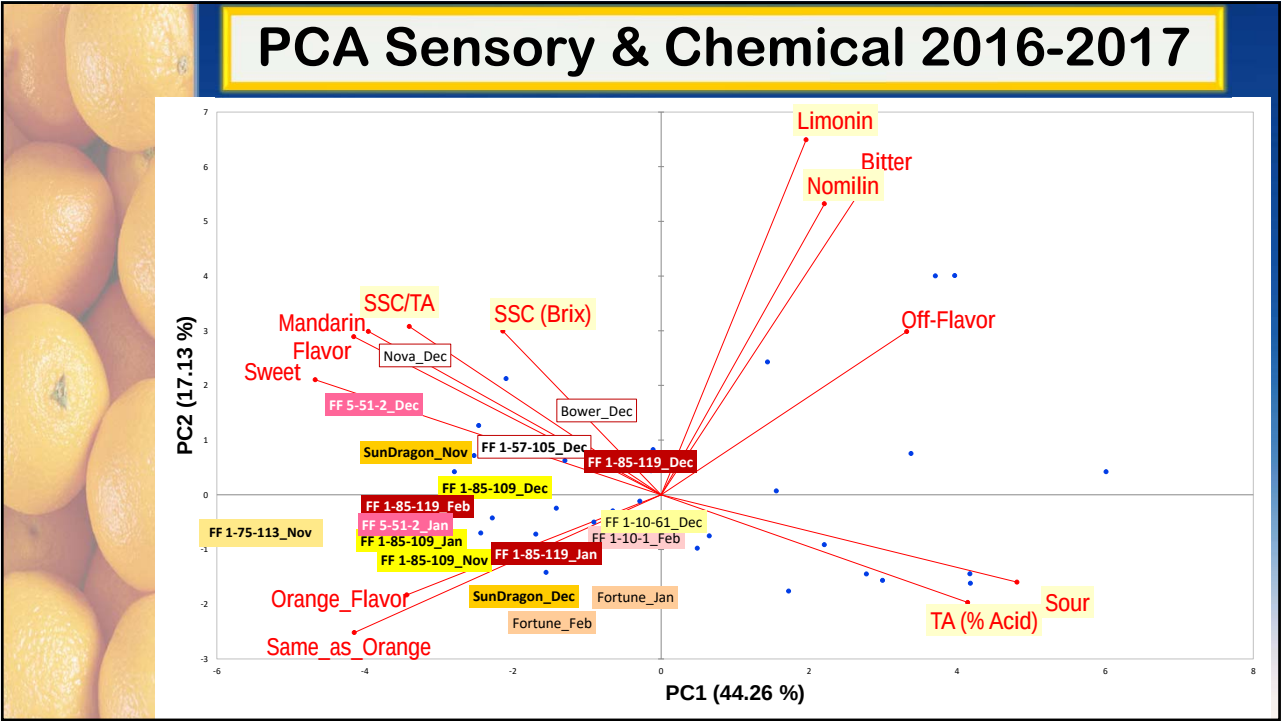
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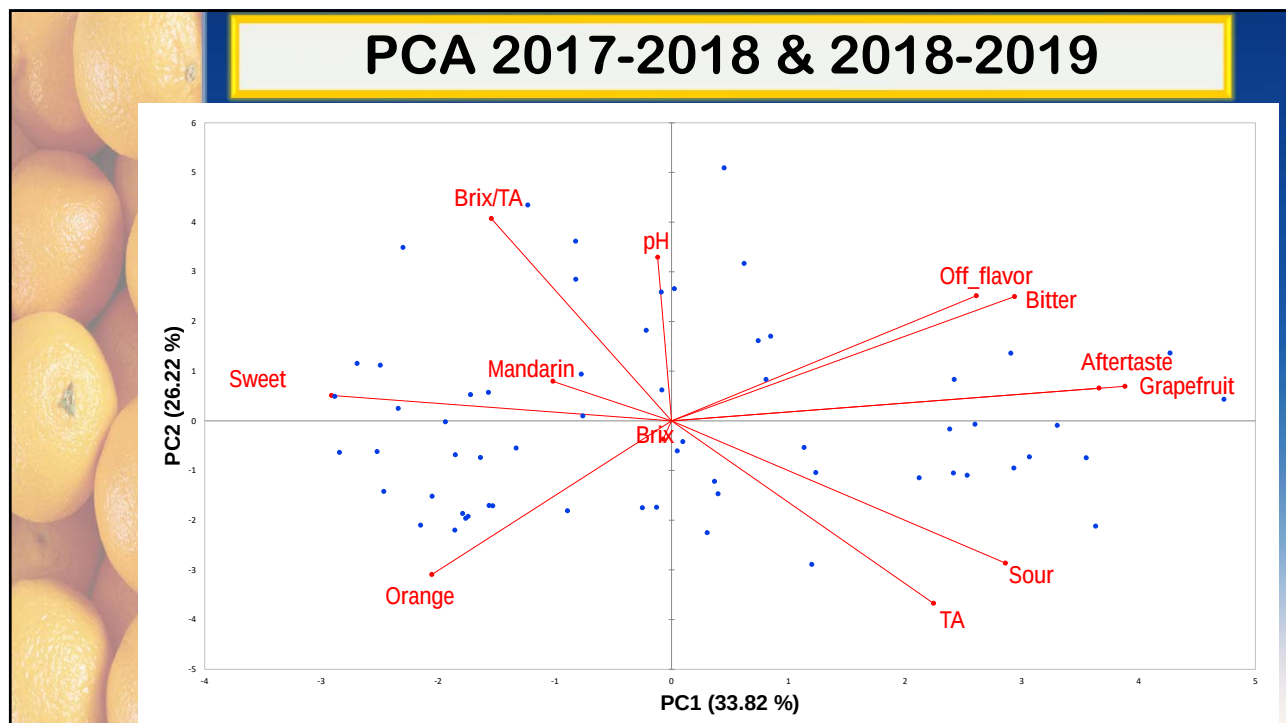
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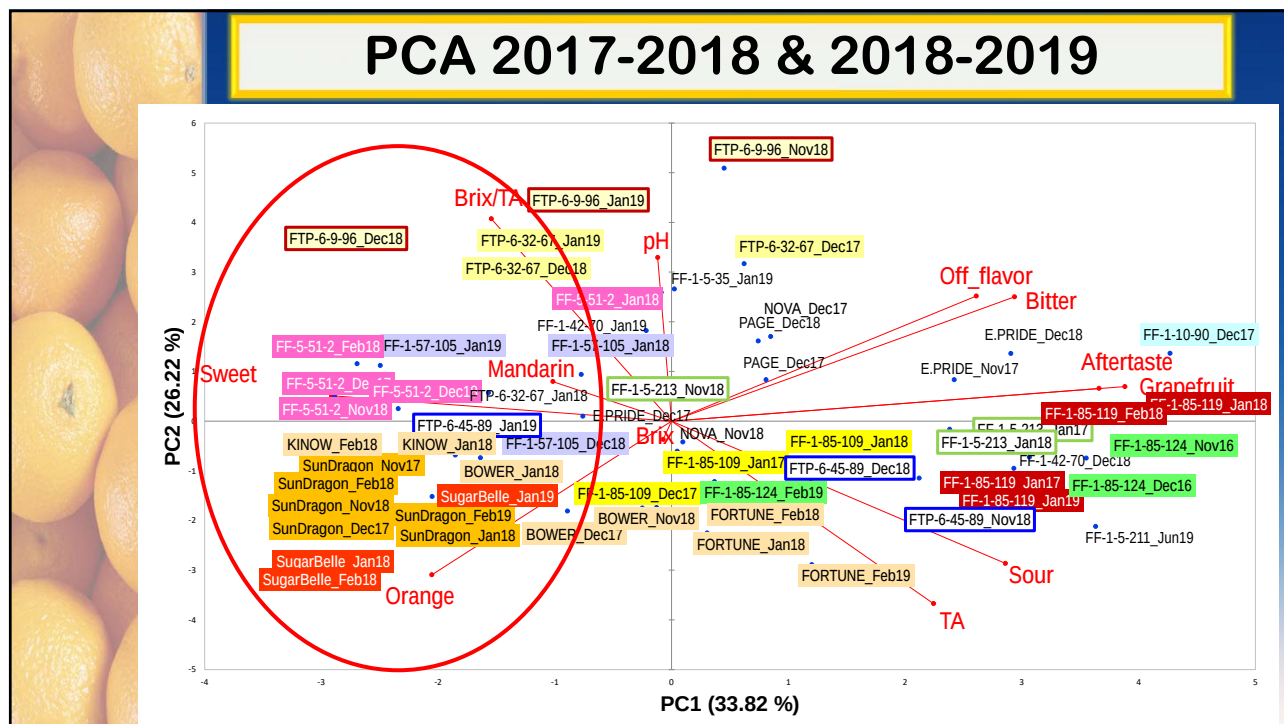


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Potentially Good Cultivars

Hybrid	Harvest	Orange flavor	Mandarin flavor	TA (% citric)	SSC (°Brix)	Brix/TA
Sugar Belle®	Jan.-Feb.	6.5 - 7.2	6.5 - 5.6	0.88 - 0.93	11.7 - 13.2	12.1 - 14.7
SunDragon	Dec.-Jan.	6.9 - 8.1	3.9 - 5.3	0.66 - 0.87	10.3 - 14.0	13.6 - 19.8
Kinnow	Jan. - Feb.	5.7 - 6.0	5.2 - 5.9	0.65 - 0.72	11.7 - 12.1	16.8 - 18.2
Bower	Dec.-Jan.	5.4 - 6.0	6.5 - 7.7	0.89 - 1.03	13.5 - 14.3	13.8 - 15.6
Fortune	Jan.-Feb.	5.6 - 6.8	5.2 - 6.2	0.99 - 1.44	12.0 - 14.6	10.5 - 12.5
Page	Dec.	3.7 - 5.2	4.6 - 5.0	0.43 - 0.52	9.4 - 9.7	18.7 - 22.3
Nova	Nov. - Dec.	4.2 - 6.5	5.1 - 6.6	0.51 - 0.76	11.2 - 13.2	17.8 - 22.0
Early Pride	Nov.-Dec.	4.0 - 4.9	5.0 - 6.4	0.61 - 0.86	9.9 - 11.0	12.8 - 18.4




US Sundragon (ARS) Sugar Belle® (UF)

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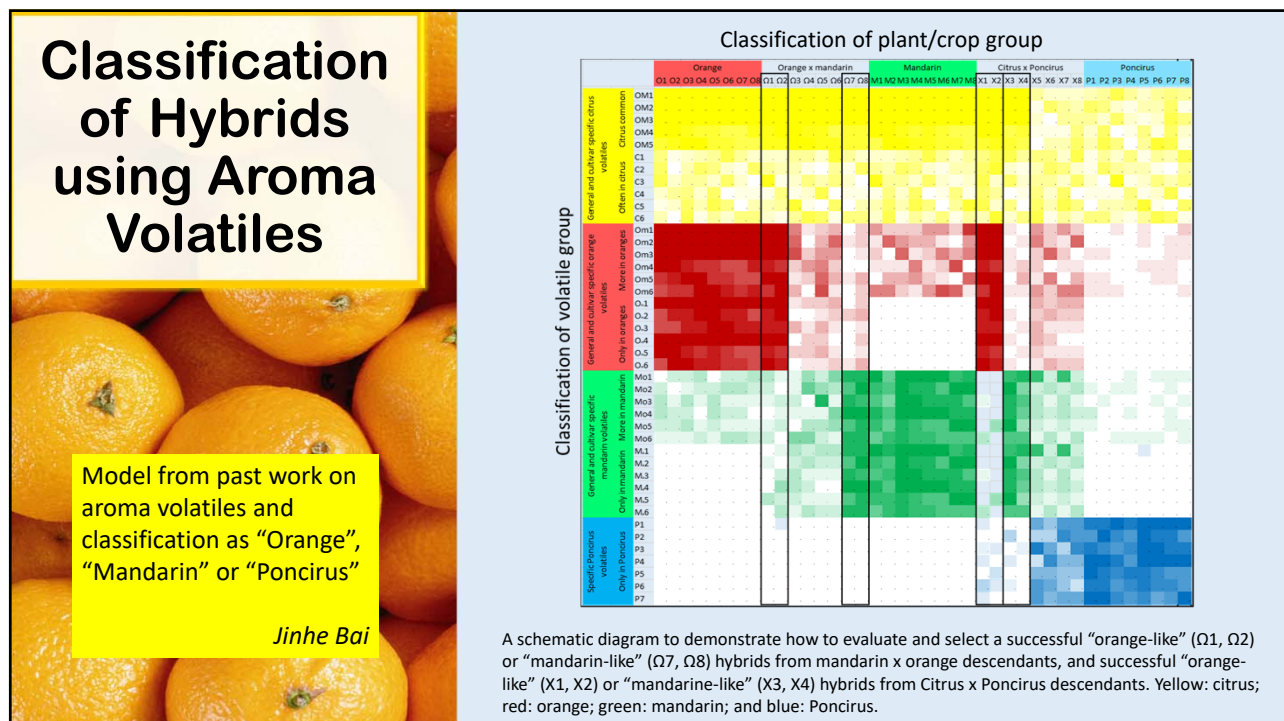
Promising Hybrids						
Hybrid	Harvest	Orange flavor	Mandarin flavor	TA (% citric)	SSC (°Brix)	Brix/TA
FTP-6-9-96	Dec.-Jan.	4.7-5.6	6.3-6.4	0.28-0.30	14.8-15.6	53.5-54.8
FTP-6-32-67	Dec.-Jan.	4.2-5.5	5.5-7.0	0.31-0.50	10.8-13.3	21.5-41.0
FF-5-51-2	Dec.-Jan.	2.5-6.2	4.5-6.5	0.40-0.55	11.1-11.9	21.8-29.6
FF-1-85-109	Nov.-Jan.	4.9-7.1	4.3-5.6	0.91-1.38	12.1-14.8	10.1-13.3
FF-1-85-124	Feb.	6.6	4.9	1.02	13.6	13.5
FF-1-85-119	Jan.-Feb.	4.6-6.9	4.0-5.4	1.1-1.3	12.5-14.2	10.5-12.7
FF-1-57-105	Dec.-Jan.	4.5-6.2	5.2-6.2	0.45-0.76	11.7-13.2	18.0-27.6

Comments

6-9-96: low citrus flavor, pumpkin, very sweet
 6-32-67: pumpkin, carrot, grassy
 5-51-2: sweet & fruity

1-85-109: good orange and mandarin flavor blend
 1-85-124: good orange flavor, a little tart, some poncirus flavor
 1-85-119: poncirus flavor, metallic, medicinal, minty
 1-57-105: sulfury, pumpkin. Overall no good comments for flavor

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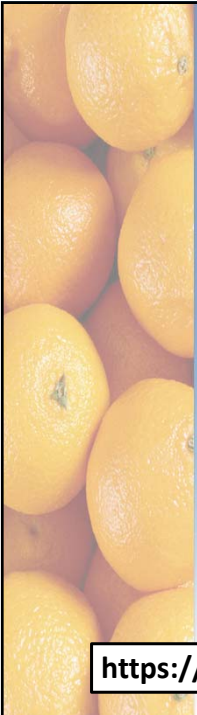
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General Summary

- ☐ 48 hybrids and named cultivars were evaluated 2016-2019
- ☐ Bitter hybrids were eliminated
- ☐ Harvest maturity adjusted for some hybrids
- ☐ Confirm quality for Sugar Belle® (fresh & juice) & SunDragon (juice)
- ☐ Other hybrids of interest, FF-5-51-2, FF-1-85-109, FF-1-84-124
- ☐ Use hybrids with high Brix for juice blends?

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Thank You!



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