Citrus breeding efforts to solve the Brix crisis

By Jude Grosser, Maria Brenelli, Ling Liu, Yu Wang and Fred Gmitter

he combination of HLB and hurricane Ian have made this a disastrous year for Florida citrus, drastically reducing the quantity and quality of processing oranges. Brix values are the lowest in history.

Early-season Hamlin juice with inferior quality is generally blended with late-season Valencia to achieve the target 12 Brix and 15 ratio for quality not-from-concentrate (NFC) juice. This is not possible when the Valencia crop is coming in around 9 to 10 Brix, even from fully mature trees. The only blending option available to processors this season is to use imported juice with higher quality. This article will discuss new options being developed by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Citrus Research and Education Center (CREC) citrus breeding team to permanently solve this growing problem for Florida growers.

NEW SWEET ORANGES WITH HIGHER BRIX

The CREC program has been evaluating thousands of new sweet orange clones derived from Hamlin, Vernia, Midsweet, Valencia and OLL (Orie and Louise Lee orange). Recently, researchers have been trying to target new clones that are capable of repeatedly producing high Brix and juice quality from trees with HLB.

Early-Mid Season

This season, N14-10, a Hamlin somaclone that produced 11.8 Brix from young trees the first week

of December (2 points higher Brix than the standard Hamlin), was identified.

From a population of new clones of Vernia that has been grown with no psyllid control, 10 new clones that mature in early December and produce fruit with a ratio of approximately 15 have been identified. Among these, Vernia clone MB-25-7 has produced juice with the highest Brix, around 11, the first week of December, but increasing to 13 by February.

From a large population of new OLL clones, also grown with no psyllid control, two new OLL clones, FB-7-35 and FB-4-13, have been identified that are maturing in early January. They have approximately 11 Brix and higher juice content and soluble solids than the selected Vernia clones.

All of these new clones have been entered into the Parent Tree Program (PTP) for subsequent commercial release and have potential to replace traditional Hamlin for the early-mid season.

Late Season

From the large OLL population mentioned above, researchers have identified multiple clones that have repeated for high Brix and soluble solids (12.5 to 13 Brix and approximately 7 pounds solids per box, again with no psyllid control). Three of these clones (FB-4-4, FB-7-29 and FB-10-19) were recently selected and entered into the PTP. These new OLL clones hold potential to reliably produce high-quality, high-Brix fruit in HLB-endemic Florida. Trees of all the above clones are being propagated for larger-scale field trials.

NEW SCION/ROOTSTOCK COMBINATIONS

Knowing that several million new sweet orange trees need to be planted in Florida to restore its historic juice production, there will subsequently be a lot of fruit from very young trees coming into the processing plants, making juice quality an issue. HLB-tolerant rootstocks that increase the Brix of young tree fruit could contribute substantially to producing a higher-quality NFC product during Florida's recovery. Thus, this has become a major target of the CREC breeding program.

This season, new scion/ rootstock combinations that were generating 11.4 to 11.9 Brix from 3.5-year-old reset trees were identified. The combinations were two new OLL clones (DC-3-36 and DC-3-40) on a super-root mutant of UFR-1 rootstock clone-55, identified by Beth Lamb at the Phillip Rucks Citrus Nursery tissue culture lab. These two new OLL clones, derived from OLL-8, were recovered from a large OLL clonal evaluation

trial that was lost to real estate development. After four years in the ground, these two clones were the only two trees in the trial of over 200 clones that had no HLB symptoms, and they tested negative for Candidatus Liberibacter asiaticus. The two clones were recovered and have been included in two U.S. Department of Agriculture/CREC HLB Multi-Agency Coordination Group scion trials to identify HLB-tolerant scions, and they are among the top-performing selections in these trials. Both new OLL clones have been entered into the PTP. Phillip Rucks Citrus Nursery is working to generate more liners of the super-root

mutant UFR-1 clone-55 rootstock. Thus, the production of trees for advanced trials is being expedited.

Other new rootstock candidates with excellent rootstock pedigree have been identified that are inducing precocious bearing of fruit with high Brix. These include hybrids of [(Amblycarpa + HBPummelo) x UFR-1] and [(Amblycarpa + HBPummelo) x UFR-4].

HLB-TOLERANT HYBRIDS FOR NFC BLENDING

Current rules allow NFC orange juice to contain up to 10% juice from hybrid fruit (not true sweet oranges), and there is an effort underway to increase this to 15%. Several HLBtolerant hybrids have been identified with excellent juice flavor, high Brix and dark orange color that could be used at 10% to enhance the quality of any sweet orange juice.

The most obvious candidate among these is Sugar Belle, which at present has the most HLB tolerance of any commercial variety. Fresh-squeezed

Is your farm FSMA ready?



www.FDACS.gov/FSMA

This ad is supported by the Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award U2FFD007446 totaling \$1,179,719 with 100 percent funded by FDA/HHS. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by FDA/HHS, or the U.S. Government.

and pasteurized Sugar Belle juice has been served straight up and blended with sweet orange juice at multiple juice/fruit displays. Consumers actually prefer Sugar Belle juice over currently marketed NFC orange juices.

This season, pasteurized Sugar Belle juice was blended from young field trees (with approximately 12 Brix) with NFC of a major brand purchased from Publix. Three juice samples were served to guests at the annual UF/IFAS Flavors of Florida event:

- A) 50/50 blend of Sugar Belle/Publix bought NFC
- B) 10/90 blend of Sugar Belle/Publix bought NFC
- C) 100% Publix bought NFC

Guests tasting the juice were asked to vote for their favorite. The votes were 57 for A, 16 for B and only four for C. Thus, the flavor of Sugar Belle juice is well liked by consumers, and these results would have been even more dramatic had we used the highest quality Sugar Belle juice (which typically reaches 15 Brix from trees not compromised by HLB).

Other HLB-tolerant hybrids, some with Sugar Belle as a parent (including the C4-10-42 hybrid in Figure 1), produce up to 18 Brix with color scores over 42. Some of these routinely produce over 8.5 pounds solids per box and have tremendous blending potential. One clever idea put forward by Ricardo Violante (Cutrale Citrus) is to include such hybrids in new plantings of sweet oranges, using hybrids with matching maturity dates, and planting a hybrid tree every 10 trees or so. This would increase the pounds solids of every load, benefiting the growers and processors alike.

There also are a few HLB-tolerant hybrids that produce sweet orangelike fruit. These have potential to be classified as sweet oranges if the ongoing efforts to modify the definition of a legal sweet orange are changed



Figure 1. Results from juice tasting at the December 2021 Citrus Research and Education Center display day. Early-maturing Vernia clones MB-R25-T7 and MB-R25-T9 were preferred over traditional Hamlin. The hybrid juice blend included in this comparison did not contain any sweet orange juice but was a blend of triploid hybrids C4-16-12 and C4-10-42.

> to be based more on organoleptic/ biochemical juice quality than narrow traditional *C. sinensis* genetics.

One such hybrid is 1859, which has shown good HLB-tolerance and routinely produces 15 Brix fruit with delicious, sweet orange juice flavor with an added tropical note. The fruit also has beautiful color and is more

Read Citrus Industry Magazine Anytime From Anywhere!

Whether you are in the field, in the office or on the go, **Citrus Industry magazine** is always available. Access the digital edition from your phone, computer or tablet.





New Vernia clone MB-25-9 at Orie Lee Family Groves in St. Cloud, grown with no psyllid control

Fruit of OLL-FB-7-35 cut for fresh juice squeezing (January 2023)

attractive for the fresh market than typical Florida oranges. Another similar candidate is C7-11-7, also morphologically indistinguishable from true sweet orange, but produces over 8 pounds solids per box, higher than any traditional sweet orange.

CONCLUDING REMARKS

The CREC citrus improvement pipeline contains many new sweet oranges, sweet orange-like hybrids and other HLB-tolerant hybrids that produce juice with exceptional quality. Much research is still needed to determine if the flavor of these hybrids holds up to pasteurization, and if the fruit is firm enough that it can be successfully trucked to the processing plants.

The breeding program is also identifying HLB-tolerant rootstock candidates that drive up Brix in precociously bearing young trees. With strong industry participation (growers and processors), future plantings can be designed to assure that Florida processors can continue to produce the gold standard of NFC orange juice worldwide. \checkmark Acknowledgments: The authors thank Orie Lee Family Groves, Beth Lamb and Phillip Rucks Citrus Nursery, as well as the New Varieties Development & Management Corporation for support of this research.

Jude Grosser and Fred Gmitter are professors, Yu Wang is an associate professor, Maria Brenelli is a graduate student, and Ling Liu is a laboratory assistant — all at the UF/IFAS CREC in Lake Alfred.

Supporting Soil and Tree Health with Advanced Testing, and Quality MicroFertilizers.



www.SandtoSoilServices.com | Contact: Brad Turner (813) 478-1349 or Ed James (352) 406-4691