

Field Testing to Identify Elite Rootstocks that can Mitigate or Prevent HLB in Scions Commercially Important to US Citriculture

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Year 3 of 5 (60% Complete)

Objectives

1. Identification of best possible HLB-tolerant rootstocks for profitable citriculture for commercially important scions in US citriculture (Florida, California, Texas)
2. Monitor tree health and bacterial titers (years 3-5)
3. Plant seed trees of elite rootstock candidates (Years 2-4)
4. Identify best rootstocks for each scion (Years 4-5)
5. Initiate seed and tissue culture (TC) propagation with commercial companies as necessary for largescale movement of best rootstocks into commercial plantings in all 3 states (years 4-5)

Problem and Significance

Citrus Greening Disease or HLB (huanglongbing) is the most devastating disease known to citrus and threatens the entire US citrus industry. The disease is now endemic in Florida and Texas and is present in California. The disease is vectored by psyllid insects that are now spreading throughout US citrus growing regions, and expensive psyllid control has not been effective in Florida. All important commercial scions are susceptible, and the disease causes significantly reduced yields, and can also cause diminished fruit quality. Numerous

approaches, including thermotherapy and the application of antibiotics, have thus far not proven to be successful. Identification and validation of a rootstock that can mitigate or prevent the disease is the ultimate non-GMO solution, and could work for all scions. Such a new rootstock could be used for new trees but could also be inarched into existing trees.

Benefit to Industry

Successful commercialization of rootstocks that can mitigate or prevent HLB can save the entire US citrus industry from this devastating disease and contribute substantially to sustained, profitable citriculture into the distant future. This can be a permanent solution that doesn't require additional expensive inputs after tree planting. This project also has potential to match tolerant rootstocks with the different categories of citrus scions, which should contribute to identification of HLB-tolerant (or resistant) scion/rootstock combinations that maximize fruit quality.

Progress Summary

This is a continuous project, and elite new rootstock candidates from the UF-CREC and USDA breeding programs are being entered into the project as propagations become available. Rootstocks are being tested in the HLB-endemic environment using the 6 following scions representing the USA citrus industry: 1. Rio Red grapefruit; 2. Lisbon Lemon; 3. EV-1 (Early Valencia); 4. Glenn Navel; 5. Low-seeded Murcott 18A-10-47 (highly susceptible); and 6. Tango (or W. Murcott). The trial block is located in a CREC research grove in Eagle Lake, FL, approximately 10 miles south of the CREC. Many of the new rootstock candidates are emerging from direct HLB screening as an initial step in new rootstock development, and thus seed source trees are not available. Liners are therefore being propagated often by rooted cuttings or via TC with the help of commercial rootstock TC propagation companies.

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The first Cohort of 479 trees have now been in the field for a year and a half, and most are growing off quite well. All cohort trees were assessed for tree health and growth, but no statistical differences were observed. Two rootstocks performing especially well across all scions are A+VolkxOrange19-11-8 and UFR-1 clone#28 (a super-root mutant found by Beth Lamb at Ruck's TC lab). Super-root mutants are off-types of rootstocks being micropropagated in TC that exhibit more robust root systems and thus more vigorous liners than the standard. The second half of cohort 2 (approximately 700 trees) were planted this spring (grown at AgriMasters Citrus Nursery). Most cohort 2 trees are growing off well, we only lost a few trees that did not establish. All Cohort 3 trees have been grafted, and some of the trees propagated at the CREC have been planted. Some of the trees with Murcott and W. Murcott are being re-grafted. The majority of Cohort 3 trees are expected to be planted this fall and early 2022 (mostly coming from Himrod Citrus Nursery). Cohort-3 includes the top (to date) 'gauntlet' rootstock selection S10xS15-12-25 (a hybrid of two salinity-tolerant pummelo x mandarin hybrids), and the first 'gauntlet' SugarBelle-rootstock hybrid LB8-9xS13-15-16 [(salinity tolerant pummelo x Cleopatra] x SugarBelle)] that continues to show great promise. Both of these are easily propagated by rooted cuttings or by TC micropropagation. Cohort 3 includes two of Dr. Gmitter's new University of Florida Rootstock (UFR) citranges, and 10 selections from Dr. Bowman (USDA), along with a total of 10 selections from Dr. Grosser (22 total selections).

Cohort 4 propagations are underway. The Cohort 4 list was adjusted by adding promising rootstocks and removing a few that are not holding up or are difficult to propagate. The most interesting addition is the S11x50-7-16-12, a hybrid of [(salt tolerant HBPummelo x Shekwasha) x (trifoliate orange 50-7)]. In the 'gauntlet' screen, this rootstock does not allow *CLas* replication in the rootstock, and is suppressing it in the Valencia scion, with the 'gauntlet' tree (HLB+ when planted) showing no symptoms. Cuttings of this and it's sibling 16-4,

along with LB8-9xS10-15-18, LB8-9xS10-15-9, LB8-9xS13-15-16 and S10 x X639-12-32 were recently moved up to 4x4 citripots. Rootstocks LB8-9xS13-15-16, S10xS15-12-34, LB8-9xS10-15-18, LB8-9xS10-15-9, S10 x 50-7-16-4 and S10 x 50-7-16-12 are all now established in TC at Agromillora. We have also provided material of A+HBPxChangsha+50-7-12-39 and A+HBPxWhite 1-12-29 to Agromillora for TC initiation. They have been unsuccessful micropropagating UFR-14.

Table 1 provides a list of the rootstock candidates within the 4 Cohorts. As mentioned, this is a progressive project, and genetic patterns for HLB tolerance, and possibly even resistance, are emerging. Efforts are continuing to quickly include the most promising rootstocks in the project as they become available. We also have a group of rootstock seed trees wrapped and labeled, ready for field planting expected to occur before the end of the year.

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Publications and Presentations

Grosser, J.W., F.G. Gmitter, W.S. Castle, L. Cano, U. Albrecht, A. Omar and A. Fadli. 2021. Update on Breeding Rootstocks for an HLB-Endemic Florida. The Florida Citrus Show, Fort Pierce (May) <https://irrec.ifas.ufl.edu > media > 2021-florida-citrus-show>

Kunwar, S., J.W. Grosser, F.G. Gmitter, W.S. Castle and U. Albrecht. 2021. Field Performance of 'Hamlin' Orange trees on Various Rootstocks in Huanglongbing-endemic Conditions. HortScience 56:244-253.

Forner-Giner, M.A., Continella, A., and Grosser, J.W. 2020. Citrus Rootstock Breeding and Selection. In: (A. Gentile, Ed.) The Citrus Genome. Springer-Nature.

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Cohort 1	Cohort 2	Cohort 3	Cohort 4
A+VolkxOr19-11-8	Murcott+Rubidoux	S10xS15-12-25	LB8-9 (SugarBelle)xS10-15-9
Afghan sour orange	A+VolkxOr19-11-8	LB-9-14	LB8-9 (SugarBelle)xS13-15-16
46x20-04-6	Cleopatra+Carrizo	US-802 (Bowman)	UFR-2
2247x2075-02-26	2247x2075-01-2	US-942 (Bowman)	UFR-14 (Gmitter) <i>difficult to propagate</i>
2247x6070-02-2	UFR-6	US-812 (Bowman)	A+HBJL-2B
Milam+HBPxOr1 4-9-10	UFR-5	SuperSour 2 (Bowman)	S11z x 50-7-16-6
UFR-1 clone #55	UFR-4	US-1516 (Bowman)	S10xX639-12-32
UFR-1 clone #28	UFR-7 (Gmitter)	US-897 (Bowman)	S11z x 50-7-16-4
UFR-1 clone #02	UFR-8 (Gmitter)	SuperSour 3 (Bowman)	LB8-9 (SugarBelle)xS13-15-15
UFR-1 original clone	UFR-9 (Gmitter)	UFR-10 (Gmitter)	LB8-9 (SugarBelle)xS10-15-18
UFR-6 clone #1	UFR-15	UFR-13 (Gmitter)	S11z x 50-7-16-12
SG-2-P	UFR-16	Blue 1	A+HBPxCH+50-7-12-39
SG-6-50	UFR-17	White 1	A+HBPxCH+White 1-12-29
A+VolkxOr19-11-31	2247x6070-02-2	Orange 14	S10xS15-12-34
	A+HBPx6058x2071-2-8-16	Orange 16	Milam+HBPxOrange 4
	Green 6 x Orange 14-9-6	US-1279 (Bowman)	UFR-17 super-root mutant
	A+HBPxOrange14-9-16	US-1280 (Bowman, requires Material Transfer Agreement)	
	Farr Trifoliolate	US-1281 (Bowman)	
	46x20-04-S15	US-1282 (Bowman)	
	46x20-04-29	US-1283 (Bowman)	
	2247x2075-02-7	US-1284 (Bowman)	

Table 1 Rootstocks for the Tri-State Project (Note: Cohort 1 and Cohort 2 trees have been planted, planting of Cohort 3 is underway, and propagation of Cohort 4 rootstocks is underway).

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