Arnold Schumann, a professor of soil fertility and water quality with the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS), led the effort to study the effectiveness of citrus under protective screen (CUPS) in protecting trees from HLB. The work resulted in growers having confidence in the practice. Today, Florida CUPS plantings are closing in on 1,000 commercial acres. Schumann discusses his research in the following Q&A.
Q: What got you interested in CUPS and how long have you been studying it?
A: The research has been conducted over nearly nine years. We built our CUPS at the UF/IFAS Citrus Research and Education Center in early 2014 and planted the first trees in summer 2014. The proven ability of screen houses to exclude citrus canker and Asian citrus psyllid from citrus nurseries in Florida was an incentive to try growing mature trees for fruit production under similar screen in larger structures.

Q: What rootstocks and varieties have performed the best in CUPS?
A: Semi-dwarfing rootstocks are a good choice for scions with the capacity to grow large trees in order to avoid excessive hedging and topping, which could adversely affect yields. Due to the relatively high planting density and the CUPS roof, available space for tree canopies is limited. US-897 is a good match for red grapefruit in CUPS. We are observing that sour orange at 10 feet by 5 feet high density spacing is running out of space after eight years when compared with the US-897 rootstock.

Ray Ruby, Ruby Red and Flame grapefruit, Dancy, Murcott, W. Murcott, Kinnow, Early Pride, Temple, Minneola, Sugar Belle, Persian lime and Eureka lemon varieties have all performed well in the CUPS. Grapefruit are the most consistent, reliable yielding varieties in CUPS.

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Q: What are your thoughts on producing CUPS in pots or in the ground?
A: Pots are a good choice for testing varieties at very high densities with hydroponics, such as for our research spacing of 8 feet by 4 feet. They require trellises to support the trees, and the cost of pots and media is high. Weed control with an herbicide boom is not practical, and herbicide has to be hand-applied. Fruit production from in-ground plantings has exceeded expectations and is the best option.

Q: What has your research shown on planting density?
A: Research experience has shown that planting densities in CUPS can be greater than conventional guidelines would recommend, because the sunlight passing through the screen is diffracted and refracted at many angles. This causes tree canopies to be better illuminated than without screen and mitigates shading effects from high densities.

Q: How has production trended since trees were planted in CUPS?
A: Grapefruit yields have averaged about 800 boxes/acre for six out of eight years at 10 feet by 5 feet spacing in the ground. The cumulative yield for eight years of the grapefruit at 8 feet by 4 feet spacing in pots is 7,329 boxes/acre, and yields have peaked twice at 1,400 boxes/acre/year.

Q: What are the yields now that some of these trees are mature?
A: Yields stabilized as trees fully matured. For grapefruit trees, there is little year-to-year variation. Other varieties like Murcott and Kinnow have major alternate-bearing patterns year to year. The internal quality of fruit from mature trees is top-notch, and external quality depends on how well the peel blemishes caused by rust mites, greasy spot and melanoose can be controlled. Packout is nearly 100% most years for grapefruit.

Q: How successful has your CUPS been in protecting against the psyllid and HLB?
A: Psyllids have entered and spread in the CUPS after the screen was breached from storm damage or repairs. The HLB bacteria titer in sampled psyllids was undetectable. Candidatus Liberibacter titer in psyllids is rapidly diluted over a few generations of feeding on uninfected trees and with no new inoculum being added from outside groves. After 8.5 years, the HLB incidence is just over 0.5%.

Q: Are there other pest concerns with CUPS?
A: Citrus canker doesn’t survive in CUPS. Greasy spot and melanoose can be controlled with conventional copper, strobilurin fungicides or Bacillus-based biofungicides. Spider mites, rust mites, mealybugs and thrips are controlled with appropriately timed pesticide sprays supported by regular scouting.
OTC Is a Priority
By Rick Dantzler, CRDF chief operating officer

Delivering oxytetracycline (OTC) through systemic delivery devices has brought hope for higher fruit yields and better quality, so the Citrus Research and Development Foundation (CRDF) is working hard to maximize the efficacy of this therapy. In just the last two months, CRDF has funded eight projects on OTC and is considering seven preproposals that test other antimicrobials used in conjunction with OTC.

For example, one project measures the impact on the Asian citrus psyllid (ACP) from feeding on trees that have been treated in such a manner. Our hope is that the ACP will ingest enough OTC that it kills the Candidatus Liberibacter asiaticus (CLas) in its gut, preventing the spread of CLas to other trees when the ACP feeds on them. Wouldn’t it be something if fewer trees became infected over time because fewer psyllids were “hot?”

A second project tests ReMedium T1 at lower than the recommended doses, as well as one experiment that tests the product at 150% of the recommended dose every other year. If we could get the need for treatment down to every other year while still staying beneath federal residue thresholds, it would cut the cost of the treatment in half, which would be huge.

On other subjects, CRDF funded the next two years of yield and tree health data from an ILB Multi-Agency Coordination Group rootstock and grapefruit trial on the East Coast that had run out of money. The trees had reached fruiting age, so it didn’t make sense not to get production data.

With leftover funds, CRDF approved giving the Citrus Research and Field Trial Foundation $750,000 to jumpstart the new iteration of the program. This will help growers get OTC in mature trees and test other therapies on a large scale.

CRDF also agreed to fund more testing of the finger lime peptide if the testing takes place in Florida. The environment here is different, and we felt that we needed to see evidence of it working here before putting more money into it.

Finally, we invited Ron Bransky, a University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) professor emeritus, to give us a full proposal on the cause of blight and its triggers. We know that ILB is our primary threat, but a combination of ILB and blight ends the tree’s productive life even sooner. Bransky has made good progress on isolating the cause and triggers.

CRDF is also focusing on next steps for plant improvement since most agree this is the long-term answer to ILB. John Chater of UF/IFAS and Matthew Mattia of the U.S. Department of Agriculture’s Agricultural Research Service have recently inventoried all field trials in Florida and are working with citrus breeders to identify the best germplasm for further evaluation. More on this later, but the next steps on plant breeding, especially CRISPR and GMO editing, will surely be a focus for CRDF as OTC and other therapies buy us time to develop a sufficiently ILB-tolerant or -resistant tree.

Q: How much fertilizer is used in CUPS?
A: The amount of fertilizer used per box of fruit produced is only a fraction of that used in HLB groves because the trees in CUPS grow twice as fast, with healthy roots to absorb the nutrients and healthy trees to utilize them optimally.

Q: What are you hearing from growers about CUPS adoption and how their structures are working?
A: There is growing interest in CUPS in Florida (~650 acres and growing to over 1,000 acres soon) and in other states like Texas, Louisiana and California. In 2022, Florida CUPS growers observed that the screen house structures completely protected the trees from hurricane damage and fruit drop. Fruit drop is already very low in CUPS. It seems that the added value of storm protection is important given that a conventional grove can take up to five years to recover from hurricanes.

Column sponsored by the Citrus Research and Development Foundation