



The “dog days of summer” are from July 3 to August 11, a time of particularly hot and humid weather. This period coincides with the early morning rising of Sirius, known as the “Dog Star,” the brightest star in the night sky. Sirius’ early rising was believed by many in ancient Greece, Egypt, and Rome to contribute to the extreme weather of the season.

This period is also a slower time of the year, but rest assured that CRDF has many research projects underway that will help you in your production practices, none more important than the work we are doing to maximize the efficacy of injecting oxytetracycline (OTC). Hundreds of thousands – perhaps millions – of trees were treated this past winter and spring. Most growers are seeing a response in tree health, which should translate into higher yields with better quality this season. Even though the full benefit of this therapy will likely take several years to realize, I’m confident we have begun the climb back to industry sustainability and growth. Here are a few of the projects regarding OTC that we have underway:

1. A project with Dr. Lukasz Stelinski and Dr. Kirsten Pelz-Stelinski, UF/IFAS, is measuring 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 consume enough OTC that it kills the *Candidatus Liberibacter asiaticus* (CLas) in its gut, which would prevent the spread of CLas when the ACP feeds on other trees. Wouldn’t it be something if fewer trees became infected over time, reducing spread of HLB, because fewer psyllids were “hot?”
2. A project with Dr. Ute Albrecht, UF/IFAS, is testing one of the approved OTC injectable products at different dosages. One treatment is at 75% each year for two years, one is at 50% each year for two years, and one is at 150% for just one year. Our thinking is if less of the product can be used and the same result realized, it seems like good policy to do so, and with the higher dose, if we could get two years of control with one treatment and still stay beneath federal residue thresholds, it would cut the cost of the treatment in half.
3. A project with Dr. John Curtis, Better Crops, LLC, to evaluate the impact on root growth from OTC. It stands to reason that roots will grow if less CLas is in the tree, but this is a trial that will attempt to quantify response. Syngenta has been doing a tremendous amount of root monitoring over the years, so it will be interesting to see what they find, as well.
4. Dr. Curtis is also testing to see if there is a difference between trees injected with OTC and those injected with OTC and treated with Gibberellic acid and 2-4,D.
5. CRDF is funding work which experiments with injecting OTC in different parts of the tree. While insertion just below or above the bud union is how growers are applying product and is likely the best, if

we can quantify movement throughout the tree from insertions in larger branches, for example, it could be easier and less costly for growers.

6. Following grower concerns expressed to CRDF, Dr. Henry Yonce, Biotech Agriculture USA, and Dr. Swadesh Santra, UCF, have teamed up to test how long OTC stays viable in the tank (up to three days) after being mixed according to label instructions, and whether there is a chemical, biological, or physical change to the solution.

7. Dr. Yonce is also doing a side-by-side test of trees injected with OTC and those not injected. CRAFT will be able to answer this question more fully, but CRDF wanted to get a trial started as soon as the OTC product was approved.

8. In 2015, CRDF planted three rootstock trials. The trees are now eight years old, so Dr. Ute Albrecht, UF/IFAS, is injecting those trees for us, leaving untreated trees in the middle of each plot as controls. Each plot had equal injections in the rootstock and the scion, so we will see if there is a difference. With the trees coming into their most productive years, this will be a project that should answer the question of whether there is a difference between an insertion in the rootstock and one in the scion.

We have also invited full proposals on three projects that are quite interesting. While I can't get into specifics at this point, they use OTC in combination with other antimicrobials and a pesticide, and test these antimicrobials as standalone products, too. Our thinking is that there will possibly come a time when resistance to OTC builds up, so unless a tree that is sufficiently HLB resistant or tolerant is with us and available to growers, we will need something else to take the place of OTC.

The Tree of the Future:

Speaking of sufficiently HLB resistant or tolerant trees, CRDF funded projects with Dr. John Chater, UF/IFAS, and Dr. Matt Mattia, USDA/ARS, to fly drones over all field trials that are in the inventories of their respective institutions. Their final reports are due in September. With these inventories in hand, CRDF's Committee on Plant Improvement, meeting with breeders who will provide input, intends to identify the best germplasm for further evaluation in last-stage field trialing or mass propagation. There are outstanding prospects created by the breeders we have funded that seem to be holding up to HLB well, but which haven't been tested on a large scale, and until enough data is gathered to give growers confidence to plant new creations it is unlikely that much will get planted.

Genetically engineered trees have received support of late, too. Since a breeding solution is the most likely way of getting the problem of HLB behind us once and for all, nothing should be excluded. For that reason, CRDF is aggressively pursuing breeding solutions involving trees edited by CRISPR technology, as well as those which would be considered genetically modified (GMOs). Since it is possible to edit trees by CRISPR in ways that result in both non-GMO trees and GMO trees, we hope that the non-GMO varieties work. However, if they don't, we should continue working with GMO varieties since that may be what is required. CRDF is funding work on all these options and is committed to doing more as required.



CRDF is also funding two years of yield and tree health data from an HLB 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.

Plant Growth Regulators (PGRs):

With CRDF funding, Dr. Swadesh Santra, UCF, and Dr. Fernando Alferez, UF/IFAS, have teamed up to evaluate novel zinc products that could significantly help with preharvest fruit drop. Another CRDF project with Dr. Alferez is finetuning brassinosteroid use to enhance fruit quality by more than a full Brix point. Finally, Dr. John Curtis has tested Gibberellic acid and 2-4,D in novel ways to help reduce preharvest fruit drop. Results of this trial were well summarized by CRDF's Brandon Page and can be found on the CRDF website.

Potential Game Changer:

CRDF funded Dr. Robert Turgeon of Cornell University, considered by some to be the world's foremost expert on phloem physiology, to continue his groundbreaking ways to use antibodies to arrest CLAs, preventing the bacteria from moving throughout the phloem. The board agreed to fund him for a year to test his theory on greenhouse trees and to make scions in the UF/IFAS mature tissue transformation laboratory so that we could have mature scions to test if the greenhouse trials work. This is not short-term research so there is a limit to how many of these projects CRDF can fund, but if this one works, it will be a game changer.

Non-HLB work:

While most of CRDF's research portfolio is devoted to eradicating HLB or making it functionally irrelevant, we are not a one-trick pony. We exist to research other serious maladies of the citrus industry, and one of those is Diaprepes. We are funding work with Drs. Laura Diepenbrock and Larry Duncan, UF/IFAS, to determine the most efficacious ways of killing them or interrupting their life cycles and are in discussions with other researchers regarding solving the problem the way other commodities such as corn have, and that is by inserting BT toxins into the genome, which kills the larvae when they feed on the plant. This would result in a transgenic rootstock, but regulatory processes should be easy enough given the experience of other commodities. In my view, this is the most likely way of ending our Diaprepes problem for good.

CRDF also took a shot at making progress on blight by funding a project with Dr. Ron Brlansky, UF/IFAS. Dr. Brlansky and his team have discovered a pararetrovirus which evidence suggests is the causative agent of blight. If this can be confirmed, the next question is what causes the virus to begin expressing the disease since it is not active until something triggers it. If these "triggers" can then be identified, it may be that the triggers can be eliminated, and the disease never manifests itself.

Closing thoughts:



This industry is clawing its way back to higher levels of production. It started last season but then the darn hurricane put half the crop on the ground. Nevertheless, therapies are working. And financial assistance is coming from all quarters. Our state legislature provided CRAFT with a tremendous amount of funding – and CRDF contributed \$1.2 million to CRAFT – to assist growers with getting these therapies into their trees, and I believe Uncle Sam is going to provide relief from the hurricanes. All of this helps build critical industry mass, which is what the industry needs now more than ever.

At the recent FCM Grower Conference this summer at Bonita Springs, I detected new optimism on the part of growers, and for good reason: things are looking better. Until recently, the disease had the upper hand, but no more. Therapies are working, and as the weather cools and football season kicks off, you will see the fruit of your labor as we move into this harvest season.

