FARM BUREAU
OF VENTURA COUNTY
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Notes from the CEO

By John Krist

About 500 scientists, citrus industry representatives and regulatory staff from 22 nations gathered in Florida in early February for the fourth International Research Conference on Huanglongbing. The five-day agenda featured more than 200 presentations and posters on a wide range of issues, as the global research community strives to better understand and develop improved tools for dealing with this deadly citrus disease and the pest that vectors it, the Asian citrus psyllid.

Much of the news from Florida, Brazil and other hotbeds of ACP-HLB research was grim. The best that can be said is that several promising lines of inquiry have been identified. Some might eventually lead to improved ability to manage the pest and the epidemic it spreads.

I wish I could report a breakthrough, that a sure-fire method of halting the transmission of the HLB-causing bacterium had been found or that an HLB cure or disease-resistant rootstock had been identified. Even a foolproof means of killing ACP without costly and repetitive pesticide applications would have been welcome. But breakthroughs were in very short supply.

In fact, much of the news from Florida, Brazil and other hotbeds of ACP-HLB research was grim. The best that can be said is that several promising lines of inquiry have been identified. Some might eventually lead to improved ability to manage the pest and the epidemic it spreads. Other presentations documented how difficult it is to control this disease – and how dire are the consequences of failure.

The bleakest picture comes from Florida, where the HLB epidemic has been raging for a decade.

In 2005, when HLB was first detected in Florida, the state produced 169 million boxes of citrus fruit. This year's forecast is 90 million boxes, a decline of more than 60 percent. The disease is present in every commercial grove in the state, and many growers are no longer removing symptomatic trees. Statewide, about 3.1 million trees are currently being lost each year to HLB, and only about 2.1 million are being replaced.

Production costs have doubled, largely due to the cost of enhanced nutritional programs that help extend the productive life of infected trees, and the nearly monthly applications of pesticides required to suppress the ACP population. Yet even with all that investment, the average per-tree yield has declined 40 percent. One consequence of this has been an unprecedented abandonment of no-longer-profitable groves, nearly 33,000 acres in all. Another 43,000 acres have been bulldozed.

Last year, about a third of the crop was lost to early fruit drop before harvest. The forecast is for a similar drop this year. This is a relatively recent phenomenon, possibly related to the increasing toll HLB takes on a tree as the infection progresses over time. One of the research projects described at the conference determined that within two to three months after initial infection with HLB, even symptomless trees have lost 30 to 50 percent of their root systems. By the time canopy thinning becomes apparent, 70 to 80 percent of the infected tree's root system has been destroyed. With their ability to transport water and nutrients into the canopy severely compromised, these older trees find it difficult to sustain fruit until maturity.

Other investigators have been trying to understand how the disease epidemic spreads so fast. In the Mexican lime-producing state of Colima, for example, the number of trees known to be infected with HLB went from one to 5 million in just three years.

One research team has determined that when an HLB-infected female ACP alights on a previously uninfected tree to deposit eggs, she also feeds at the egg-laying site, introducing the bacteria into the new flush. When the eggs hatch, the nymphs feed and almost immediately acquire the bacteria themselves, a phenomenon the research team dubbed an "infectious colonization event." As soon as the nymphs mature and fly off, they're capable of infecting other trees, even though the tree where they hatched displays no symptoms and in fact may not test positive for the presence of bacterial DNA for months or even years.

This swiftness of spread makes controlling the epidemic fiendishly difficult, akin to managing an Ebola epidemic in a densely populated urban environment. Keeping the HLB infection rate low enough for growers to remain economically viable means mounting a nearly perfect campaign to suppress ACP, identify and immediately remove newly infected trees, and replant with clean trees reared in ACP-excluding hothouses.

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What's Inside?

Hansen Center expands education programs

By Susana Bruzzone-Miller

Winter is a time to plan and prepare for the busy education year ahead. The crops – sugar snap peas, beets, lettuce, kale and more – are planted and growing well. Before we know it, yellow school buses will arrive, a welcome sight at the UC Hansen Agricultural Research and Extension Center (UC HAREC).

Education outreach is an important part of the UC HAREC mission. The 4-H Youth Development Programs at the Center offer unique opportunities for Ventura County youth. Access to a working farm allows children to observe food growing and connect with the land. Engaging hands-on activities facilitate learning and support what is taught in the classroom. Agricultural literacy, nutrition, and sustainability concepts are the foundation of the youth programs. More than 4,400 Ventura County youth are served each year.

Through collaborations and new programs, the education team has increased offerings at the center and extended the ages reached. In addition to the popular kindergarten and third-grade field trips and classroom outreach, fifth-graders now have an opportunity to visit the farm. The new program, "From Watersheds to Planter Beds," supports learning about one of the most important natural resources – water. Hands-on activities aligned to Common Core Standards engage youth as they investigate how water moves through plants, learn about watersheds, conservation and much more.

Additionally, the 4-H Student Farm was established at the center in collaboration with Ventura Unified School District and Food Corps. Seventh- and eighth-graders from Balboa Middle School participate weekly throughout the school year. Led by Chris Massa, Food Corps member, students learn the nuts and bolts of farming. Eager young farmers tackle irrigation, planting and harvesting while also learning plant biology, nutrition, food safety and cooking. The students produced more than 800 pounds of food in 2014. Some was used in the school cafeteria, the rest was donated to Food Share.

Last summer, the Center piloted the 4-H Sustainable You! Summer Camp curriculum created by Utah State University Extension sustainability specialist Roz Brain. Sustainable You! Summer Camp was designed to help youth understand what it means to be sustainable through fun, interactive activities based around the major areas of sustainability: land, air, food, energy, and water. The five-day camp proved to be appropriate for fourth- to sixth-graders. The education team will partner with the City of Ventura to deliver this exciting program again at the center in June.

Through collaborations and support from the UC Hansen Fund, programs at the Center are offered free of charge to Ventura County youth. Programs are delivered by staff and specially trained and dedicated volunteers. For more information, visit the UC HAREC website: http://ucharec.ucanr.edu.

— Susana Bruzzone-Miller is the education outreach coordinator for the UC Hansen Agricultural Research and Extension Center. Contact her at sbmiller@ucanr.edu.

Notes from the CEO

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One of the case studies described at the conference involved a 1,000-acre citrus plantation in Brazil, where management initially reduced the HLB infection rate to an "acceptable" 1 percent of the trees each year through frequent pesticide applications (two or three time a month, and again if ACP is observed), frequent HLB scouting and tree removal (four times a year) and aggressive replanting.

However, even this "success" story revealed how easily even the best management strategy can unravel. After initially declining, the HLB infection rate inexplicably began climbing again within the Brazilian plantation. Managers didn't understand why until they looked outside their grove. Within six miles they found about 500 backyard trees infected with HLB and infested with ACP. Constant reinfection from this reservoir of 500 unmanaged trees was undoing an otherwise textbook-perfect strategy for 200,000 plantation trees. The grove owners were able to regain control over the epidemic only after they received permission from the homeowners to remove about 400 of the backyard trees and extend their ACP pesticide program to the remainder.

More hopeful news came from several projects searching for tolerance of, or even resistance to, infection by the bacteria that causes HLB. Several complex hybrids of existing rootstocks show good five-year resistance to symptoms of HLB …

Several presenters referred to this as the "bad neighbor" effect, and it underscores how a large-scale suppression and management program can be undone by seemingly trivial gaps that leave pockets of disease and vectors – urban plantings, abandoned groves, even organic or no-spray commercial groves – in or near the managed plantings.

Several presenters used epidemiological computer models to simulate the spread of an HLB infection throughout a citrus management area. If at least 99 percent of the growers participate in a robust management program, the modeling showed, it appears possible to keep HLB at bay and eradicate it from the control area. At 95 percent participation, it becomes impossible to eliminate the infection and the epidemic begins to spread, albeit slowly. At 80 percent participation, the infection rate swiftly reaches 100 percent and management is futile.

More-hopeful news came from several projects searching for tolerance of, or even resistance to, infection by the bacteria that causes HLB. Several complex hybrids of existing rootstocks show good five-year resistance to symptoms of HLB, or continue to test negative for the bacteria despite having been inoculated with it and exposed to infected psyllids. Other projects involving various grafted combinations of rootstocks and scions have also yielded trees that become infected, but in which the bacteria reproduces less well and plant growth is not as reduced. These results suggest there is more variability in the citrus genome than previously appreciated, and that production of tolerant or resistant varieties might be achieved through sophisticated conventional breeding – not just trans-spe-

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cies genetic modification of the sort that might alarm GMO-averse consumers.

There were also hopeful results in the search for more effective, less risky methods for killing ACP. Several research projects involved the use of customized molecules, designed to be ingested by psyllids, that suppress genes responsible for triggering production of digestive enzymes or juvenile growth hormones. In the lab, at least, these techniques significantly heightened ACP mortality, holding out promise for a species-specific, nontoxic suppression method that avoids the risk of pesticide resistance and mortality among non-target species, such as pollinators and other beneficial insects.

What does all this mean for Ventura County and its current battle against ACP?

First of all, it underscores the critical nature of the area-wide management strategy we have implemented in the Santa Clara River Valley (and will likely extend to other areas later this year). Although HLB has not yet been detected here, it inevitably will be. We have to perfect our suppression program before that; the data from Florida, Brazil and elsewhere demonstrate the futility of an HLB exclusion or management strategy that does not maintain ACP populations below detectable levels most of the time across a broad area.

We also need to address our "bad neighbor" problem, by securing removal of abandoned or no longer maintained trees regardless of whether they're in orchards, median strips, parks or urban yards.

And we probably don't have as long as we think to get our house in order. Although HLB has "officially" been detected only in a single tree in California – and not in any ACP samples collected during the HLB-detection surveying that was begun more than two years ago – one of the studies described in Florida casts doubt on this reassuring interpretation of the data.

When psyllids are collected for the HLB survey, they're tested to determine whether they contain fragments of genetic material from the HLB-causing bacteria. This requires subjecting the minute quantities in each sample to a series of 40 amplification cycles, intended to generate sufficient copies of the DNA fragments to be detectable. If the number of cycles required to generate a "positive" exceeds 36, the state deems it inconclusive – the result of lab errors, sample contamination or just random noise in the data.

If that were true, the spatial distribution of locations where survey crews collected those borderline ACP – those that indicated a "positive" HLB detection after 37 to 39 cycles –also would be random. David Bartels, an entomologist at the U.S. Department of Agriculture's Center for Plant Health Science & Technology in Texas, decided to test that.

What he found instead was that the "inconclusive" ACP collected throughout Southern California clustered in specific locations – more than a dozen of them, in San Diego, San Bernardino, Riverside and Los Angeles counties. Most of the clusters were in the vicinity of the Hacienda Heights HLB detection from 2012, but others were scattered across the LA basin, including one on the eastern end of the San Fernando Valley.

According to Dr. Bartels, data collected in Texas indicates that ACP showing similar borderline evidence of HLB infection tend to cluster around trees that conventional DNA testing has conclusively determined to be infected. The logical conclusion to be drawn from his spatial analysis, therefore, is that there are multiple probable HLB infection sites throughout Southern California. One of them is a short freeway drive from Ventura County; others are in areas where fruit loads headed for local packinghouses – loads that often transport ACP as hitchhikers – originate.

So those are the major takeaways of the Florida conference. Any solution for HLB remains years away. The disease is probably closer than we think. The odds of controlling the epidemic are worse than we anticipated. And the consequences of failure are devastating.

— John Krist is chief executive officer of the Farm Bureau of Ventura County. Contact him at john@farmbureauvc.com.

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