

WHAT PROGRESS ARE WE MAKING ON HLB?

During the HLB Research Summit held at the University of California, Davis, September 9-10, 2015, several well-known research experts were asked their thoughts on "What progress are we making on huanglongbing (HLB)?"

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The confirmation of '*Candidatus Liberibacter asiaticus*' (CLAs) in the state has been a real wake-up call. HLB has been found in two different locations in California. There is evidence that the problem is spreading, which means that action needs to be taken sooner rather than later.

HLB is an enemy, but once the enemy has been identified, you can begin the battle. A lot of novel, very interesting work is being done on detection technologies that are alternatives to PCR. They hold great promise if we can get closer to whole tree detection, rather than a very small fraction of tree detection. To prevent or slow the development of an HLB epidemic, it is essential to confirm infections as early as possible and take action immediately. Because trees can be infected with CLAs for a lengthy time prior to the appearance of HLB symptoms, detection of the pathogen is challenging. Although PCR is very reliable in detecting CLAs, if trees are not symptomatic, it is difficult to determine where to collect diagnostic samples. Early detection means that infections can be found prior to trees developing visible symptoms. That is crucial if HLB is to be controlled in California.

In Florida, the situation got out of control because symptoms were not apparent. As soon as a single tree was found and testing for CLAs began, we found the pathogen was everywhere. California is ahead of the curve on that and hopefully can stay that way. I wish there was a significant breakthrough in therapeutics or control in general, but we are not there yet. Currently, the standard three-pronged approach (controlling psyllids, removing infected trees and only planting clean nursery stock) is still the most important management strategy.

DISEASE CONTROL STRATEGIES

Breeding and transgenic (introduction of DNA from another source) approaches really are going to be the ultimate

solutions. I lean more toward transgenics than conventional breeding simply because of the time factor. We know it is feasible with transgenics to develop trees that will likely be resistant to a host of different diseases. Conventional breeding is attractive. We've had a breeding program at the ARS for more than 100 years, and new varieties have come out of that program. It is a very slow process that takes about 30 years from hybridization to a variety being released. A rootstock is a bit faster proposition. The advantage is that you maintain the same scion, but impart resistance through the rootstock, which would be a great benefit. Some rootstocks that have been evaluated in Florida appear to have a less rapid rate of decline than others, which holds some promise.

FLORIDA EXPERIENCE

The number one lesson is be vigilant; you must constantly seek symptoms and constantly assay as many samples as possible. It is really a numbers game. The public must be educated. It is amazing that with the extent of HLB in Florida, I have seen people who have lived there their whole lives who are not even aware of the problem. The outreach efforts I have seen here in this meeting are really important, especially with the huge number of residential trees in California. Ensuring that the public is aware of this problem, educating them as to what they can do to help solve it and encouraging them to do so will go a long way.

BIOLOGICAL CONTROL

In Florida, before HLB, pests were managed almost exclusively through biocontrol. Minimal use of insecticides and the interactions among various pests resulted in good biocontrol. If you do not have enough of the pest that you are trying to control, the population of biocontrol organisms will decline, so there is a cyclic nature. With residential trees, people will be much more amenable to releasing wasps in their backyard than commercial insecticide spraying.

FUNDING RESEARCH AREAS

New detection technologies could provide a real advantage over PCR, though none have been validated. Therapeutics of any kind would be of tremendous value, however, we do not have any promising ones at the moment.

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One of the main challenges with HLB management has been that it takes citrus trees a long time to show disease symptoms after they become infected. If not removed, the infected trees serve as new sources of inoculum for disease spread in the following years.

There have been significant areas of progress on HLB in recent years; one of which is developing a range of early detection technologies that we hope will soon be available for regulators and growers to begin folding into monitoring programs. Earlier detection of infected trees is critical to narrowing the potential for pathogen acquisition and spread during the asymptomatic phase.

Another area of progress is that we are getting a much better handle on how the vector and the HLB-associated *Liberibacter* spread in the landscape, what drives their movement and what aspects of local landscape and environmental conditions influence whether the psyllid is likely to be there. This information feeds into risk modeling that provides a better picture of where to look for not only the ACP, but also the disease. By refining how we identify early cases of disease, we can hopefully mitigate some impacts. That process has been going on for years, but it is becoming more defined.

PUBLIC AWARENESS

As an extension specialist, another area of progress I should note is increased awareness of this problem. There are so many people in California affected one way or another by the psyllid or the disease. We're lucky to have a very large network of people at UC, in industry and at state and federal agencies tackling different aspects of increasing public and stakeholder education. Such education programs are critical to promoting early disease and insect finds and widespread adoption of control measures. For areas like the Central Valley, hopefully by the time HLB does arrive, growers and the general public will be in a much better position to adopt coordinated and aggressive control measures during the early phase when eradication is most feasible.

BIOLOGICAL CONTROL

Disease in urban neighborhoods in Southern California is incredibly challenging to manage effectively, let alone to try to eradicate. We absolutely are relying on biocontrol as an important strategy in these areas. We're learning more about how to increase its chances of successfully slowing disease spread. This will likely involve coordinating with homeowner education programs, emphasizing the need to manage a variety of species, including Argentine ants, to maximize the effectiveness of biocontrol agents.

FLORIDA EXPERIENCE

We've learned a lot from the HLB situation in Florida. One of the most important lessons for us early on was the role of human transportation in the spread of psyllids and disease. This lesson led directly to steps being taken in California, including the establishment of quarantines, to ensure that people are not moving around infested or infected plant material. Similarly, regulations were put in place in California to make sure that nursery plants are not sources of HLB spread. I am fairly confident that these measures (although they've proven burdensome for certain people and industries) are at least part of the reason that the pace of the ACP and HLB situation in California has to date been very different from Florida.

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The California citrus industry is concerned about recent finds of HLB-positive citrus trees reported in some residential areas of Los Angeles County. At this time, containment and eradication are our main goals in Southern California. Early detection of '*Candidatus Liberibacter asiaticus*' (CLas) in psyllids and affected trees, in addition to effective

eradication of compromised citrus trees, can help prevent this devastating disease from spreading in California.

EARLY DETECTION TECHNOLOGIES

In order to achieve this goal, the Citrus Research Board is currently funding research projects on early detection technologies. With funding from the USDA National Institute of Food and Agriculture, our group is trying to develop technologies that can facilitate detection of HLB through encouraging field-testing by growers, extension agents and any public members interested in monitoring the disease. The rationale is that if a single laboratory is expected to conduct all the required tests, the task will be onerous. Involving the public sector in this process will enable the state to focus its resources on high-risk areas. Large-scale testing by many will facilitate early detection leading to exclusion and eventual suppression of the disease.

DISEASE CONTROL STRATEGIES

A long-term solution to control HLB is to develop cultivars with resistance to the disease. Currently, two approaches are being pursued – transgenic and conventional breeding. We have chosen a non-transgenic approach because of the ease associated with field-testing and the release of promising disease-resistant cultivars to the citrus community. Approval by the FDA and EPA will not be needed since the hybrids are a result of natural breeding. Even though the approach is time consuming initially, the advantages associated with conventional breeding are appealing.

FLORIDA EXPERIENCE

The lessons learned from Florida's HLB experience have been useful in defining the regulatory process required for HLB suppression. Since 2005, we have been developing methodologies to conduct psyllid testing for the presence of CLas. This is now used as an early indicator for the existence of HLB. Testing the psyllid vector would give us a lead-time of two to four years prior to the appearance of HLB symptoms in the plants.

Big box retail stores in Florida marketing ornamental citrus trees contributed to the quick spread of HLB throughout the state. California has regulations in place to avoid such incidences. In Florida, it was demonstrated that trucks transporting citrus acted as carriers of disease-spreading psyllids. Groves along the highway were the first to be affected by HLB. At present, California has strict regulations for trucks transporting processed or unprocessed citrus. Numerous guidelines were established based on Florida's HLB experiences. This has helped slow the spread of HLB in California. Additionally, our outreach program seems to be working efficiently in disseminating information and educating the public regarding HLB-related issues. 🌱

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