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Citrus Greening: A Puzzle with Many Pieces

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Citrus Greening: A Puzzle With Many Pieces

Finding the solution to some crop diseases is like solving a jigsaw puzzle. The solution has many pieces, and fitting them together can be a challenge. Citrus greening, also known as "Huanglongbing" (HLB), is just such a disease. HLB is costing Florida citrus growers millions of dollars each year in lost revenue from unproductive trees. It continues to spread and is the most serious threat to the U.S. citrus industry in history. The disease was recently confirmed in commercial groves in Texas and in a homeowner's yard in California. Both states are important citrus producers, and if HLB spreads in these states the way it has throughout Florida, the economic consequences will be devastating.

The Agricultural Research Service is working aggressively with university and private-industry partners to help mitigate the threat posed by HLB. The goal is to keep the U.S. citrus industry sustainable and profitable and to preserve the nutritious and delicious array of fruits and juices that people have come to treasure.

Solving the HLB puzzle depends on developing a deeper understanding of its complicated nature. HLB is presumed to be caused by nonculturable, Gram-negative bacteria belonging to the genus *Candidatus* Liberibacter. So far, the species of bacteria associated with HLB in the United States is *Candidatus* Liberibacter asiaticus, which is transmitted by the Asian citrus psyllid, an insect.

The puzzle pieces are questions that constitute gaps in our knowledge: Do some types of citrus have a natural resistance that can be bred into commercial varieties? How can psyllid populations be effectively suppressed? Are there molecular tools for tapping into the genomes of the psyllid or bacterium in ways that would "disarm" them? How do we replant young, healthy trees and keep them free of HLB? Is there a cure for infected trees?

In this issue, you can read about some of ARS's efforts, including research in Fort Pierce, Florida, to exploit a fungal pathogen that keeps the psyllid in check and to help juice processors maintain their high standards (see page 4). We also explore investigations in Albany and Davis, California, to determine whether citrus amino acids hold clues to attack strategies used by the Liberibacter bacterium (see page 7).

Other ARS research includes disease modeling and tracking in Fort Pierce, which provides valuable guidance to state and federal regulatory agencies that use the research to make decisions designed to curb the spread of HLB and the psyllid.

The ARS National Clonal Germplasm Repository for Citrus and Dates in Riverside, California, maintains a diverse collection of citrus and its relatives in a disease-free environment. The repository is instrumental in ensuring that citrus trees provided to commercial operations are free of known pathogens. A team of ARS and university scientists there is screening citrus relatives for sources of natural resistance to the disease, the psyllid, or both.

In Fort Collins, Colorado, scientists are working on cryopreservation techniques that show promise for long-term storage of genetic materials and that also have potential for eliminating pathogens from propagative materials.

The psyllid genome has been sequenced and made publicly available by an ARS scientist in Fort Pierce, and researchers there are exploring ways to use RNA interference technology to silence genes critical to the psyllid's survival.

In Albany, scientists completed the genome sequence of Carrizo citrange, an important citrus rootstock, which will help in the search for genes that may be used to genetically improve citrus for HLB resistance.

In Parlier, California, a researcher is using genomic sequences of a wide range of Liberibacter isolates to develop diagnostics based on specific "DNA signatures," so that when HLB is detected in a citrus tree, it can be traced to its source. Such forensic abilities are in demand among scientists trying to track down sources of new infections in California and Texas, where the incidence of HLB is still low.

ARS scientists working in quarantine facilities in Beltsville and Fort Detrick, Maryland, maintain a collection of HLB isolates from around the world for comparative genetic analyses. Those at Fort Detrick have made progress in diagnosing and differentiating world isolates, and in Beltsville, they are using comparative genomics to identify genes and proteins that may provide an understanding of the role of Liberibacter in HLB disease development.

Currently, the only way to control HLB is to remove infected trees and suppress the psyllid vector. This approach presents difficult choices to growers because many are reluctant to destroy infected trees. A wide range of possible treatments and solutions is being explored for successful management in the future. Together, these efforts are moving us toward the ultimate goal of maintaining a profitable and competitive U.S. citrus industry and eliminating this global threat altogether.

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