RESEARCH SNAPSHOTS

Progress toward HLB-tolerant citrus from conventional plant breeding

DISEASE MANAGEMENT

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What is the technique?

The USDA citrus breeding program has been underway since 1893 and numerous cultivated varieties have been released. USDA-produced varieties are represented in more than 75% of US- grown citrus trees. Like most fruit trees, citrus trees have a fruit-producing part (the scion), which is grafted onto a mostly underground part (the rootstock). The USDA team of Dr. Ed Stover focuses on developing new scions using conventional breeding approaches that involve crossing two complementary parents by transferring the pollen of one parent into the flowers of another parent. The resulting fruit produces seeds that, when mature, germinate and give unique new citrus types. The seedlings that result from crosses are then grown for a number of years until their fruit quality, productivity, disease resistance, and other traits can be assessed.

How does creating new varieties through breeding improve HLB management?

All *Citrus* cultivars tested so far are susceptible to huanglongbing (HLB), but they are not equally susceptible. Some are able to grow and produce a fairly normal crop, despite supporting high populations of the HLB-associated bacterial pathogen and developing leaf symptoms. The primary goal of the USDA scion-breeding program is to identify and develop HLB-tolerant citrus of major market types, such as mandarins, oranges, and grapefruit. Tolerance to HLB is measured by the ability of infected trees to produce sufficient numbers of attractive and flavorful fruit. That way, growers of such tolerant citrus varieties maintain profitable businesses and backyard growers are happy with their trees' performance.

Currently, the most important goal for California citrus growers is preventing the disease from becoming established in the state. In Florida, despite using aggressive treatments to sustain HLB-affected trees, citrus production per acre has declined by ~40% and fruit quality has diminished. In addition, backyard citrus trees have essentially disappeared. In Florida, where HLB is endemic, tolerant citrus types will be immediately useful. In California, growers may choose to plant HLB-tolerant types as insurance against future losses, when HLB becomes established.

Who is working on the Project?

Citrus breeders and their research teams are collaborating with scientists from related disciplines throughout the U.S. to develop HLB-tolerant citrus. At the USDA/ARS in Florida, Ed Stover, Randy Driggers, Greg McCollum, David Hall, Liz Baldwin, Jinhe Bai and Anne Plotto collaborate to create, identify, and validate HLB-tolerant types producing high quality fruit. Colleagues at the University of California-Riverside, Mikeal Roose and Chandrika Ramadugu, and the University of Florida, Fred Gmitter, Ming Huang, and Qibin Yu, have collaborated with the USDA to identify gene markers associated with HLB-tolerance in USDA populations. These collaborations benefit from exchange of plant material, research results, techniques and ideas. UC Riverside and the University of Florida also have individual projects to develop HLB-tolerant citrus.

What are the challenges and opportunities?

The best sources of HLB tolerance include some mandarin types, citron, and the citrus relative *Poncirus trifoliata*. Unfortunately for Florida growers, the two most widely-grown mandarin varieties before HLB, Murcott and Sunburst, are highly susceptible and have been removed. A California mandarin (Tango), and a few minor Florida varieties (e.g. Sugar Belle and Bower), show some tolerance to bacterial strains present in Florida. A few advanced, high-quality mandarin hybrids in the USDA program have good HLB tolerance and are being evaluated for release.

SunDragon fruit on the tree

HLB tolerance associated with citron parentage is likely good news for lemon growers, but up until now, citron has been a parent only to acid citrus fruit types, like lemons and limes. We have initiated crosses between citron hybrids and other citrus types, like mandarins, oranges, and grapefruit. The USDA citrus breeding program has worked for over a century on hybrids between the foul-tasting *Poncirus* and the tasty *Citrus* types. Hybrids between *Poncirus* and *Citrus* have yielded many rootstocks over the years, and we have now developed more advanced hybrids that are acceptable scion types. The first such scion variety, 'US SunDragon', was recently released and it has shown remarkable tolerance to HLB. There is great promise for identification and development of HLB-tolerant citrus, but time and exposure to more diverse bacterial pathogen strains will be needed to prove their value.

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