Citrus Greening, Not If These Scientists Can Help It

By Stephanie Yao, USDA-ARS

(See Alpha Scents mention page 3)

In the Rio Grande Valley of southern Texas, scores of citrus trees cover the landscape. Texas is the third largest producer of citrus fruit in the United States, the majority of which is grown in the Rio Grande Valley. Here, grapefruit is king, but orange, tangerine, tangelo, and Meyer lemon are also grown.

A couple of years ago, growers in this region started seeing a new insect on their citrus trees: the Asian citrus psyllid. This tiny pest is responsible for transmitting the deadly citrus greening disease, also known as Huanglongbing, which devastated the Florida citrus industry in 2005.

Fearing they would have an outbreak of the same magnitude, the Texas growers approached ARS scientists in at the Kika de la Garza Subtropical Agricultural Research Center in Weslaco, Texas, to help them prepare for an outbreak.

"We have yet to see the citrus greening in our area, but the presence of the Asian citrus psyllid indicates it may only be a matter of time until trees start becoming infected," explains Robert Mangan, research leader of the Crop Quality and Fruit Insects Research Unit at Kika de la Garza and project manager. "That's why our scientists are working closely with federal and university collaborators to develop an area-wide approach to control the infection and spread of the disease."

Understanding Psyllid Habits

Every week, entomologist Donald Thomas, with the Crop Quality and Fruit Insects Research Unit, visits citrus groves to collect samples of psyllids and potential predators. Using a small, modified hand-held vacuum and sticky traps attached to trees, Thomas has monitored psyllid populations in the area over the past year. As expected, he found that psyllid populations fluctuate depending on the amount of rain in the area. After heavy rains, psyllid numbers increase as new growth on citrus trees, called flush, appear. That's because the psyllid relies entirely on flushing shoots for reproduction and development.

Thomas also found that psyllid populations tend to decrease during the winter, when the citrus trees are not flushing because of the cool temperatures. During this time, he found the psyllids living in other trees surrounding citrus groves, such as torchwood, persimmon, and mesquite. Thankfully, the psyllids don't seem to be reproducing on these trees, but further testing to determine this is underway. Thomas was also surprised to discover that psyllids were more abundant in abandoned citrus groves and urban areas where citrus trees are planted in backyards, indicating the need to also develop management tools for use in urban areas.

With help from colleagues in Texas and Florida, Thomas has identified at least six psyllid species present in south Texas citrus groves. Some of these psyllids are native to the Rio Grande Valley while others, like the Asian citrus psyllid, are not. The scientists are examining each

species' life cycle to see whether other psyllid species besides the Asian citrus psyllid can also spread citrus greening. This is important in helping determine which species to target.

Thomas is also working with Mexican and federal cooperators to examine potential biological control agents that could be used to control the psyllid population. A tiny wasp called *Tamarixia radiata* has shown the most promise during observational and preliminary testing. Lacewings, beetles, spiders, and predatory mites are also on the list of candidates.

Genetically Identifying the Psyllid

In a related project that compliments the area-wide project, molecular biologist Jesse de Leon, with the Beneficial Insects Research Unit, and colleagues from North and South America are using molecular tools to genetically characterize the Asian citrus psyllid. This will help scientists determine where to collect pre-adapted, natural enemies of the insect for a biological control program.

The researchers found there are two groups of Asian citrus psyllid in the Americas—one prevalent in South America, the other in North America. Through molecular testing, de Leon found the two psyllid groups to be genetically distinct. This suggests that the Asian citrus psyllid in North America did not come from South America; rather, each continent was probably invaded by insects from different countries in Asia. So, scientists may need to collect natural enemies from different Asian countries for each sub-continent.

de Leon's team is also studying *T. radiata*, one of the psyllid's natural enemies. The scientists are trying to determine whether *T. radiata* in the Americas exists as a single species or if the various populations are genetically distinct. So far, the scientists have identified four groups of *T. radiata* in the Americas. The next step is to use molecular tools to determine whether these groups of *T. radiata* represent a single species or whether they could represent cryptic or very closely related species. Accurately identifying *T. radiata* will help the scientists develop a successful biological control program.

What's that Smell?

These days, entomologist Joseph Patt's laboratory smells more like a perfumery than an actual laboratory. That's because Patt, who is also with the Beneficial Insects Research Unit, is experimenting with petite grain oils—essential oils used as perfume bases—to see which works best in mimicking flushing shoots that attract the Asian citrus psyllid. The plant volatiles emitted from these shoots may play an important role in helping the psyllids find suitable host plants on which to reproduce. This is a key aspect of developing a management system for the psyllid, to find an attractant that can be used to trap and kill or bait the psyllids.

The psyllid is commonly found on orange jessamine, a popular ornamental plant related to citrus. Analyzing the volatiles that make up the plant's scent, Patt was able to formulate a synthetic mixture based on orange jessamine. Testing in the greenhouse showed the synthetic mixture is attractive to the psyllids.

The Asian citrus psyllid relies on both sight and scent to find food. Patt tested petite grain oils with yellowish-green colored cards developed by Alpha Scents, Inc., to monitor the insect. Greenhouse studies showed that cards scented with petite grain oils attracted more psyllids than the unscented cards. In the future, the scented, colored cards could be used in urban areas, where wide spraying of pesticides is forbidden, to disseminate biological control agents like fungi that will only affect the psyllid.

While Patt's results are promising, he must still confirm his findings in the field and conduct optimization studies of his scent formula.

Inducing Flushing All Year Long

Currently, researchers seeking to better understand the Asian citrus psyllid's interaction with citrus plants must schedule their studies around when the plant flushes. In the race to develop solutions to control citrus greening before it reaches southern Texas, the researchers cannot afford any lost time.

Plant physiologist Nasir Malik, with the Integrated Farming Research Unit, is coming to their aid. His goal: to induce flushing in citrus trees to allow scientists to conduct year-round testing.

Malik has developed growth chambers that can manipulate the air temperature in which the citrus plants are growing. He placed replicate grapefruit trees in the low-air-temperature chambers for different time periods. The plants were then transferred to the greenhouse where air temperature was higher.

The results were outstanding. Malik was able to induce some flushing in the trees that stayed in the growth chambers for 2 weeks, but longer treatments induced more flushing. The trees that spent 10 weeks in the growth chambers flowered almost immediately after being transferred to the greenhouse.

Thanks to Malik, scientists can produce new flushes at will, speeding up testing. Malik plans to expand his testing to longer intervals to see if he can achieve 100 percent flowering on the trees. He has also successfully induced branching or new flush in a variety of trees such as guava, pomegranate, and chapote, a native small tree related to citrus, thus demonstrating the utility of the technique for the nursery industry in general.

Need Something Now? Just Look Online

Growers looking for ways to currently control the psyllid population in their citrus groves have a new tool they can use: an online national database of approved pesticides for psyllid control.

Compiled by post-graduate student Deanna Chapa and university, private industry, and government cooperators, the database is the first organized collection of label information that growers and researchers can use to quickly find out which pesticides are effective in their area or on their crop.

Users can set up queries based on the criteria they select or enter. And if categories need to be added, just contact Chapa, who will continue working on this database when she joins ARS as a full-time scientist.

With the help of ARS researchers and collaborators, citrus growers and enthusiasts in the Rio Grande Valley will be well prepared to handle a citrus greening outbreak.—**By Stephanie Yao,** ARS.

This research is part of Crop Protection and Quarantine (#304) and Methyl Bromide Alternatives (#308), two ARS national programs described at www.nps.ars.usda.gov.

Robert Mangan, Donald Thomas, Jesse de Leon, Joseph Patt, Nasir Malik, and Deanna Chapa are with the USDA-ARS Kika de la Garza Subtropical Agricultural Research Center, 2413 East Highway 83, Weslaco, TX 78596