Classical Biological Control Of Asian Citrus Psylla

Release of Tamarixia radiata

By Marjorie A. Hoy, Ru Nguyen and A. Jeyaprakash

The Asian citrus psylla, Diaphorina citri, has successfully invaded Florida and is expected to colonize the entire state. By the time the pest was detected in June 1998 in Florida, D. citri had spread through a sufficiently large region of the southeastern citrus-growing area that it was not considered amenable to eradication efforts. Also, no effective eradication methods were known.

By June 1999, this pest had spread to 12 counties in Florida – Brevard, Broward, Collier, Dade, Hendry, Indian River, Martin, Monroe, Orange, Osceola, Palm Beach and St. Lucie. D. citri will likely colonize the rest of the citrus-growing region in Florida and could spread to Louisiana, Texas, Arizona and California citrus. In addition to commercial citrus, the ornamental plant orange jasmine, Murraya paniculata, is a suitable host for this pest.

Asian citrus psyllids cause economic damage to citrus in groves and nurseries by direct feeding and, potentially, by transmitting a serious citrus disease called greening.

Both adults and nymphs feed on young folias, depleting the sap and causing galling or curling of leaves. High populations feeding on a citrus shoot can kill the growing tip. On a recent field trip in south Florida, we found it easy to identify citrus flush infested with moderate numbers of psyllid nymphs because the shoots appeared distorted. The psyllids produce honeydew, which allows the growth of sooty mold.

More importantly, this psyllid is able to transmit a bacterium, Liberobacter asiaticum, that causes greening disease. The disease also is called Huanglongbing or yellow shoot in China, citrus Likubin (decline in Taiwan), dieback in India, or leaf mottle in the Philippines.

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Greening is considered the most serious disease of citrus in the world, causing reduced production and death of trees. Classical biological control of the psyllid vector should contribute to the suppression of psyllid populations. The resultant lower psyllid populations could reduce the rate of transmission of greening if the disease is confirmed to be present in Florida.

Asian citrus psylla nymph on citrus flush.

Our goal is to release two natural enemy species of the Asian citrus psyllid in Florida. The first natural enemy to be released is a parasitic wasp (= parasitoid), Tamarixia radiata (Waterston) (Hymenoptera: Eulophidae). This parasitoid was obtained from Taiwan and Vietnam and evaluated in the high security quarantine at the Division of Plant Industry, Department of Agriculture and Consumer Services, Gainesville, Fla., beginning in October 1998. No plant material or psyllid hosts were imported to reduce the chance that the parasitoids would be contaminated with the greening disease organism. In addition, parasitoids were cultured on psyllids reared on jasmine (which is considered an unsuitable host for greening disease). Permission to release T. radiata was obtained on July 12, 1999 and the first releases took place on July 15, 1999 near Ft. Pierce and Indiantown.

In quarantine, the parasitoids were tested during more than 12 generations with a molecular detection method called the Long polymerase chain reaction (Long-PCR), and all were negative for greening disease. In all tests conducted on the parasitoids, only the positive controls were positive and all negative controls were negative.

By contrast, our Long-PCR tests of foliage from several citrus trees in south Florida, where the psyllid has been found feeding, suggests that the greening disease organism's DNA already may be present in Florida

citrus, even though the trees do not show obvious symptoms of the disease. These positive Long-PCR results need to be confirmed because PCR tests (using different methods) conducted by scientists in the University of Florida's Institute of Food and Agricultural Sciences (IFAS) and the U.S. Department of Agriculture have been negative. Analysis of the sensitivity of the Long-PCR indicated that we could detect extremely low levels (as few as 100 copies of the greening disease DNA) of the greening bacterium DNA in either psyllids, parasitoids or citrus.

Additional research by plant pathologists is needed to confirm the presence or absence of the greening disease bacterium in Florida's citrus. Plant pathologists from the Florida Department of Agriculture and Consumer Services, IFAS and the USDA currently are investigating this. However, our negative Long-PCR results with the parasitoids indicate that release of T. radiata will not introduce greening disease into Florida because all T. radiata individuals tested were negative for greening DNA.

The parasitoids will be released throughout the areas of Florida that have Asian citrus psylla. Release sites should have abundant psyllid hosts and not be treated with toxic pesticides. Releases can include orange jasmine plants, door yard citrus and groves. Once releases are made, establishment and dispersal of the parasitoids will be monitored periodically. Releases will consist of 100-200 T. radiata per site.

Native natural enemies in Florida may help suppress Asian citrus psyllid, although we know little about which natural enemies attack this pest in Florida at present. In China, the lacewing Chrysopa boninensis is considered an important natural enemy of the psyllid, and fungal pathogens have been reported to reduce psyllid populations when the relative humidity is high. Spiders and other generalist predators could prey on the psyllids.

Tamarixia radiata previously was introduced into the islands of Reunion, Mauritius and Taiwan, where it has performed well as a natural enemy of the Asian citrus psyllid. T. Radiata appears to be a very effective natural enemy, producing nearly two generations for each pest generation. T. radiata females live 12 to 24 days and deposit 166 to 330 eggs. Females deposit eggs on the psyllid nymph between the thorax and abdomen. The newly hatched parasitoid larva sucks fluid from the site where it is attached to the host, eventually killing it. By the time the T. radiata larva has matured, it has sucked out the contents of the psyllid and the psyllid has become "mummified" and turns a dark brown color. The adult parasitoid emerges from the top of the thorax, leaving a distinctive emergence hole.

T. radiata females also kill all stages of psyllids by host feeding (which means females insert their ovipositor into the psyllid to make a hole and then suck up the liquid that oozes out). Host feeding provides a source of protein that helps the female parasitoid produce more eggs. T. radiata females also feed on honeydew excreted by the psyllids. A single T. radiata female is able to kill over 500 psyllids by a combination of host feeding and parasitism.

While T. radiata has a short generation time and high reproductive rate in the laboratory, its effectiveness in suppressing psyllid populations under field conditions needs further analysis, especially under Florida's conditions. In Taiwan, T. radiata performed best in relatively stable habitats (orange jasmine plantings with no pesticides and little large-scale pruning); under these conditions T. radiata and another parasitoid, D. aligarhensis, were able to

maintain psyllids at low levels. In a less stable habitat (when orange jasmine was pruned every three to four months and pesticides were applied occasionally), psyllid densities were higher and parasitism was lower. In the most disturbed habitat (if citrus trees were treated with methomyl), the parasitoids were unable to persist.

T. radiata is expected to establish in Florida but it could take a year or two to confirm its establishment, overwintering success, and ability to spread. For additional information about Asian citrus psyllid, the parasitoids, and greening disease, consult the following websites:

http://www.ifas.ufl.edu/~entweb/DCITRI.htm

http://extlab1.entnem.ufl.edu/PestAlert/hoy-0615.htm

http://www.ifas.ufl.edu/~insect/CITRUS/acpsyllid.htm

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Two Cents Worth

Citrus: The way it was

By Fred McDowell

The first association I had with the citrus business was about 1935. My home was about one city block from the docks on Lake Crescent, located at Crescent City in Putnam County. The lake was and still is connected by a deep channel to the St. Johns River, a direct route to Jacksonville.

Packed citrus was trucked to the docks and loaded on a large boat to be shipped to Jacksonville for delivery to New York City or other points in the east. The boat was the last used for lake traffic of citrus. It was called the Mac. I would guess the length to be about 100 feet.

In 1935 there were six packinghouses in Crescent City – the Florida Citrus Exchange, Chase & Co. and others.

On the lake, one of the old loading docks still remains. It does not look as large as it did 65 years ago.

In two other areas of Lake Crescent, loading docks were used to load fruit from the groves around the lake. At that time, there were no roads to the groves; the only access was by boat. The fruit was placed on rails on the docks, then loaded on the boats, moved to the city docks, unloaded and moved to the packinghouses. Remains of the old pilings still stand.

LARGE TREES

How large do citrus trees grow? The largest I recall grew in Polk County, in the Lakeland-Highland area (the Strickland Grove). The tree from a distance resembled a large oak tree. The trunk at about four feet from the ground was approximately four feet in diameter. The size of the tree, which grew alone in a large grove, would have covered a quarter of an acre. The limbs came to the ground. The grove manager picked 60 boxes of oranges from the tree. The height of this tree and others in the area was about 45 feet.

The harvesting department of the citrus company I worked for used many 40-foot ladders to harvest fruit. It also had one set of 44-foot ladders to pick a grove at the Lake Thonotosassa area of Hillsborough County, the Stebbins grove. Some limbs went beyond the 44-foot mark, possibly 45-50 feet.

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Until the freezes of the 1980s there were many old seedling groves in the state. Many were in excess of 150 years old. My family owned one for 50 years, until the cold. It was bearing fruit during the Civil War. The trees were very large when killed to the ground in 1895. There were probably hundreds or more of these groves in the state.

I was familiar with an old grove in Hastings, which was killed in the 1950s by cold. I have been told of a grapefruit tree in Hardee County many years ago that picked 100 boxes of fruit.

Before the freezes starting in the 1950s, there were many old groves with huge trees in the Citra and Orange Lake area. DeLand had 40 acres or more of orange trees with heights averaging 35-40 feet.

Some of the numbers may seem large – they are not. It is the way it was before the cold, insects and diseases of today.

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