A closer look at the VECTOR

Controlling the Asian citrus psyllid is a key to managing citrus greening.

By David Hall

The Asian citrus psyllid, Diaphorina citri Kuwayama, was first found in Florida in June 1998 and is now established throughout the entire citrus-growing region. The primary concern is that it spreads the bacterium Candidatus Liberibacter asiaticus that causes citrus greening disease (huanglongbing). citrus greening, one of the world’s most serious diseases of citrus, was first found in Florida in late August. Trees infected with the disease may only live five to eight years, during which time they produce misshapen, inedible fruit.

Early finds of trees infected by greening in late August and early September were in dooryard situations in the general area of Miami, but subsequent surveys have found the disease further north and northwest, including in commercial citrus groves. The state’s citrus industry is now urgently working with regulatory and research agencies to determine what can be done about the disease. The presence of the psyllid in Florida sets the stage for spread of the disease throughout Florida citrus and into other citrus-producing areas in North America.

Now that the disease and vector are in Florida, and particularly in the event that the disease cannot be eradicated, growers will need to implement programs to manage the disease. Such programs will include strategies aimed at the psyllid.

Vector-disease interactions
The greening disease pathogen can be acquired by an adult psyllid within a 30-minute feeding period and transmitted during a five- to seven-hour feeding period.

The pathogen multiplies in the vector. Consequently, after acquiring the pathogen, adults remain infective throughout their life. Late-stage nymphs
Adult Asian citrus psyllids may be found resting or feeding on leaves with their heads at the leaf surface and their bodies held at a 30- to 45-degree angle from the leaf surface.

The psyllid’s life cycle includes an egg stage and five nymphal instars. The eggs are elongated (0.31 mm long) and oval in shape, light yellow when freshly deposited and bright orange with two distinct red eye spots at maturity. The egg is anchored to plant tissue on one end generally in an upright position, and large numbers of eggs may be found on a single flush shoot.

Nymphs are small (0.3–1.7 mm long) and generally green to yellowish-orange. Nymphs produce white, waxy excretions as they develop. At 77 degrees F (25 C), the developmental period is 17 days from egg to adult. New adults reach reproductive maturity within 15 to 17 days. Therefore, the mean population generation time is 32 to 34 days.

Adults have been reported to live an average of 40 to 48 days, during which females will continuously lay eggs if young leaves are present. Adult females have been observed during their lifetime to lay an average of 858 eggs on grapefruit. Population fluctuations of the psyllid are closely correlated with the occurrence of new, young flush because eggs are laid exclusively on young flush and nymphs develop exclusively on flush.

A report from China indicated flight activity by adult psyllids may occur all day long; however, it was pronounced during warm, windless, sunny afternoons between 4 and 6 p.m. Speculations were that flying psyllids could be transported by wind drifts over a 0.5 to 1 km distance depending on wind speed and duration of sustained flight.

Detection and monitoring

A pest management program for the Asian citrus psyllid may require regular monitoring of citrus in order to enact time management strategies such as insecticide applications. Visual surveys by persons trained to recognize the different life stages of the psyllid may be the fastest way to detect an infestation.

The presence of adult psyllids in a planting of citrus or orange jasmine also can be determined using yellow sticky traps. Sticky traps can be placed on stakes or hung directly in citrus trees.

Some information on sampling to estimate infestation densities is available for citrus and orange jasmine, but no commercial sampling recommendations are available. With respect to traps for adults, there is no attractant currently available for survey purposes.

Control strategies

A management program for citrus greening will include specific strategies for the pathogen and specific strategies for the vector. An integrated pest management program for the psyllid will be based on biological and chemical controls. The psyllid in Florida is subjected to natural control by ladybeetles, syphid flies, lacewings, spiders and one parasitoid species, Tamarixia radiata (Waterston).

In a classical biological control project, T. radiata was obtained from Taiwan and Vietnam and released in Florida in an attempt to boost biological control of the psyllid. Prior to releases, laboratory assays on the parasitoids in quarantine indicated that none were contaminated with the pathogen. T. radiata is now established although it is unclear of its current distribution in Florida and impact on psyllid infestation levels.

Notable infestations of the pest continue to occur, and significant spread of greening is expected. Foreign exploration to discover new natural enemies of the psyllid could be fruitful with respect to boosting biological control.

Growers can reduce infestations of the psyllid using insecticide treatments, although care should be taken not to disrupt natural enemies of the psyllid or of other insect pests. Applying insecticides at critical flushing periods may be effective to some degree in reducing spread of greening. Insecticides, such as Admire Pro, Danitol 2.4EC and Provado 1.6F, are registered for citrus and have been shown to be effective for psyllid control. Legal controls on the movement of plants infested by psyllids are the first line of defense in preventing spread of the psyllid and citrus greening. CVM

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also can transmit the pathogen, and they retain the pathogen after reaching the adult stage.

Because there can be a long latency period before visual symptoms of the disease appear in an infected tree, spread of the disease in an area will be much further than indicated by trees with visual symptoms. Plant pathologists and vector entomologists will be studying vector-disease relationships in search of strategies for managing citrus greening.

**Host plants**

The Asian citrus psyllid has a restricted range of host plants which includes citrus, orange jasmine, Chinese boxthorn and related species of Rutaceae (citrus plant family). Since plants such as orange jasmine and Chinese boxthorn are grown as ornamental plants, regulatory efforts to limit spread of the disease includes these plants and is thus negatively affecting the ornamental plant industry in Florida. Continuous shoot flushes produced by orange jasmine in the vicinity of citrus could play an important role in population levels of the psyllid when new citrus flushes are not available.

Although orange jasmine has not been considered a host of the Asiatic strain of the greening pathogen, recent reports in Brazil indicate this plant may be susceptible at least to a strain of greening disease in Brazil, *Candidatus Liberibacter americanus*.

**Life cycle and biology**

An applied management program for citrus greening may require that citrus growers be able to identify adults or other life stages of the psyllid and have some knowledge about the psyllid’s biology as it relates to citrus.

Adult Asian citrus psyllids are small (2.7 to 3.3mm long) with mottled brown wings. The adults are active, jumping/flying insects and can readily fly short distances when disturbed. Adults may be found resting or feeding on leaves with their heads at the leaf surface and their bodies held at a 30- to 45-degree angle from the leaf surface. The psyllid is a sucking insect and thus inserts its mouthparts into plant tissue to feed.

**TOP:** Eggs of the Asian citrus psyllid are elongated and oval in shape, light yellow when freshly deposited and bright orange with two distinct red eye spots at maturity. Large numbers of eggs may be found on a single flush shoot.

**MIDDLE:** Nymphs are small and generally green to yellowish-orange.

**BOTTOM:** As they develop, nymphs produce white, waxy secretions.

**OPPOSITE PAGE:** Adult Asian citrus psyllids are small with mottled brown wings. The insect inserts its mouthparts into plant tissue to feed.