Asian Citrus Psyllid and Huanglongbing Disease

Integrated Pest Management for Home Gardeners and Landscape Professionals

The Asian citrus psyllid (ACP), *Diaphorina citri*, a tiny, mottled-brown insect about the size of an aphid, poses a serious threat to California's citrus trees, including those grown in home gardens and on farms. The psyllid feeds on all varieties of citrus (e.g., oranges, grapefruit, lemons, and mandarins) and a few very closely related ornamental plants in the family Rutaceae (e.g., calamondin, box orange, Indian curry leaf, and orange jessamine or orange jasmine).

This psyllid damages citrus directly by feeding on new leaf growth (flush), which twists and curls the young leaves, as well as killing or burning back new shoots. The more serious damage to citrus occurs indirectly because the insect can carry and transmit (vector) the bacterium *Candidatus* Liberibacter asiaticus, which causes the fatal citrus disease Huanglongbing (HLB), also called citrus greening disease. The psyllid takes the bacteria into its body when it feeds on an HLB-infected plant. The disease spreads when the bacteria-carrying psyllid flies to a healthy plant and injects bacteria as it feeds.

HLB can kill a citrus tree within three to five years, and there is no known cure. Once a tree is infected, the only method for preventing spread of the disease is to remove and destroy the infected tree.

Currently the Asian citrus psyllid has been found only in Southern California counties, but it is likely to spread northward up the coast and into the Central Valley. HLB was found in March 2012 in a yard in Los Angeles County, which means it is now even more important to keep the psyllid populations low so they don't find infected trees like this one and spread the disease.

BACKGROUND

The Asian citrus psyllid and Huanglongbing disease spread from Asia and India to other areas of the world where citrus is grown. The Asian citrus psyllid was first found in the United States in June 1998 in Palm Beach County, Fla., on backyard plantings of orange jessamine, *Murraya paniculata*. By 2001 the psyllid had spread to 31 counties in Florida, primarily due to the movement of infested nursery plants. Agriculture officials believe HLB was present in Florida in backyard citrus trees, and the psyllid rapidly spread the disease within the state to other backyards and commercial citrus not long after the psyllid arrived.

In 2001, the psyllid spread to the Rio Grande Valley in Texas on nursery stock (orange jessamine); it also was detected in Louisiana. The insect subsequently spread to other states and now is found in Alabama, Georgia, Mississippi, South Carolina, Arizona, California, and Hawaii as well as Mexico.

In 2008, the Asian citrus psyllid expanded its range from Mexico to Southern California, where it was first detected in San Diego County. The California Department of Food and Agriculture (CDFA) established quarantine areas around psyllid find sites and treated infested trees to control the pest and limit its spread. Later, the quarantine areas were expanded to include areas of Imperial, Orange, Los Angeles, Riverside, San Bernadino, and Ventura counties when the psyllid was found in or near those counties.

Figure 1. Brownish adult, yellow nymphs, and white wax of Asian citrus psyllids.

Because HLB has now been found in California, there is major concern that the disease will spread further in California through the movement of infected plants or infected psyllids. The establishment of HLB in California would severely damage both backyard citrus trees and commercial citrus production. To protect the state's citrus from HLB, it is important to control the psyllid, prevent the accidental introduction of any infected host plant, and detect and remove any infected plants found in California as soon as possible. The job of detecting infected trees is made difficult by the fact that it takes one to two years for symptoms of HLB to begin to show in the trees.

IDENTIFICATION AND LIFE STAGES OF THE PSYLLID

The adult Asian citrus psyllid is a small, brownish, winged insect about the size of an aphid (Figure 1). Its body is 1/6 to 1/8 inch long with a pointed front end, red eyes, and short antennae. The wings are mottled brown around the outer edge except where a clear stripe breaks up the pattern. The adults may have greenish, yellow, or orange abdomens depending on the time of year and the host plant they have been feeding on.

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The adult psyllid feeds with its head down, almost touching the leaf, and the rest of its body raised from the surface at about a 45-degree angle with its tail end in the air. No other insect pest of citrus positions its body this way while feeding. Adults typically live one to two months. Females lay very tiny yellow-orange almond-shaped eggs in the folds of the tiny, newly developing feather flush leaves of citrus. Each female can lay several hundred eggs during its life span.

The eggs hatch into nymphs that are flattened, yellow or orange to brownish, and 1/100 to 1/14 inch long (Figure 2). Nymphs molt four times and increase in size with each nymphal stage (instar) before maturing into adult psyllids. The nymphs can feed only on soft, young leaf tissue and are found on immature leaves and stems of flush growth on citrus (Figure 3). The nymphs remove sap from plant tissue when they feed and excrete a large quantity of sugary liquid (honeydew). Each nymph also produces a waxy tubule to help clear the sugary waste product away from its body. The tubule's shape—a curly tube with a bulb at the end—is unique to the Asian citrus psyllid and can be used to identify the insect.

There are other psyllids such as Eucalyptus psyllids, tomato psyllids, and Eugenia psyllids that can be found in home gardens. The Asian citrus psyllid is easily distinguished from these in its adult stage by the brown band along the edge of its wing with a clear area; its characteristic body tilt; and, in the nymph stage, the shape of the waxy tubules it produces.

IDENTIFICATION OF THE HLB DISEASE

In March 2012, Huanglongbing was found in a citrus tree in Southern California, and this tree was destroyed to prevent the spread of this disease. Everyone's assistance is needed to watch for additional infected trees. The disease may have already spread from this initial infection in Los Angeles in the bodies of psyllids to other citrus trees, or it may come into the state in an infected citrus tree or other host plant, illegally imported or smuggled into the state. It could also arrive in the body of an infected psyllid that flies into California from Mexico. The tree that was found with HLB in Los Angeles is believed to have been infected through grafting a bud (taking plant tissue from one tree and inserting it into another to form a new branch) from another infected tree.

An early symptom of HLB on citrus is the yellowing of leaves on an individual limb or in one sector of a tree's canopy. Citrus leaves can yellow for many reasons, and often discolor from deficiencies of zinc or other nutrients. The pattern of yellowing caused by nutrient deficiencies typically occurs symmetrically between or along leaf veins. Leaves that turn yellow from HLB will show an asymmetrical pattern of blotchy yellowing or mottling of the leaf, with patches of green on one side of the leaf and yellow on the other side (Figure 4).

As the disease progresses, the fruit size becomes smaller, and the juice turns bitter. The fruit might remain partially green, which is why the disease is also called citrus greening. The fruit become lopsided, have dark aborted seeds, and tend to drop prematurely. Chronically infected trees are sparsely foliated with small leaves that point upward, and the trees have extensive twig and limb dieback. Eventually, the tree stops bearing fruit and dies. These symptoms might not appear for two to three years after the bacteria infect a tree.

DAMAGE

The Asian citrus psyllid damages citrus when its nymphs feed on new shoots and leaves (flush growth). They remove sap from the plant tissue and inject a salivary toxin as they feed. This deforms new leaves by twisting and curling them and inhibits or kills new shoots by burning them back. There are many other insect pests that can cause twisting of leaves such as aphids, citrus leafminer, and citrus thrips. The twisting of leaves doesn't harm trees and can be tolerated, but the burning back of new flush will retard the growth of young trees that are not yet five years old.

Figure 2. Yellowish psyllid nymphs with red eyes and white waxy tubules.

Figure 3. Asian citrus psyllid nymphs producing waxy tubules and being tended by ants.

Figure 4. Huanglongbing caused asymmetrical yellow mottling of the leaves and an odd shape and greening of the fruit.

Excess sap, or honeydew, that the nymphs excrete accumulates on leaf surfaces, which promotes the growth of sooty mold that is unsightly but not harmful. Other insect pests of cit-

rus also excrete honeydew, including aphids, whiteflies, and soft scales.

Most importantly, the Asian citrus psyllid can kill citrus trees through its feeding activity if the insect infects the tree with the bacterium that causes Huanglongbing.

MANAGEMENT

The Asian citrus psyllid hasn't been detected in most California counties. If you see the pest or disease, you need to contact your county agricultural commissioner or the CDFA hotline to alert them to its presence so that regulatory and control actions can be taken. If you live in one of the areas where the Asian citrus psyllid is already established, you can treat your citrus plants to prevent infestation unless the Department of Food and Agriculture has already treated for you as part of its eradication program.

Psyllid Detection and Quarantine

Governmental agencies are monitoring citrus trees to detect new Asian citrus psyllid infestations. Citrus trees are visually examined to find the psyllid, and yellow sticky cards are hung in trees to capture adults. When a psyllid is found, a quarantine area is established that extends 20 miles from the find site. Plants and fruit that could be hosts of the psyllid (i.e., citrus and close relatives) can't be taken out of the quarantine area. This quarantine helps prevent psyllids from being moved to uninfested areas of California.

Whether you are inside or outside of a quarantine area, it is very important to assist with the effort to detect and eradicate the Asian citrus psyllid. Your efforts will reduce the potential for this psyllid to spread Huanglongbing and will provide more time for scientists to work on finding a cure for the disease. For maps and information on the quarantine areas, see the CDFA Web site, http://www.cdfa.ca.gov/plant/pe/interiorexclusion/acp_quarantine.html.

When psyllids are found in a backyard, the citrus trees at that location (the find site) and usually the neighboring yards are treated to control the infestation. Two insecticides are applied; a foliar insecticide is used to kill adult psyllids, and a systemic (ground drench) insecticide is used to kill the nymphs. This treatment combination is very effective against the psyllids for 9 to 12 months, and no additional treatments are needed.

How You Can Help

Homeowners can help government agencies combat the psyllid by inspecting their citrus trees and reporting infestations of the Asian citrus psyllid. The best way to detect the psyllid is by looking at tiny new leaves (feather flush growth) on citrus trees on a monthly basis, especially from spring to fall. Slowly walk around each tree and inspect the flush growth. Look for signs of psyllid feeding and damage, including twisted leaves, waxy deposits (Figure 3), honeydew, and sooty mold and adult psyllids (Figure 5).

If you think psyllids are present, use a hand lens to look for small yellow eggs, psyllid nymphs with their waxy tubules, and adults. Immature stages (eggs and nymphs) are limited to tender new leaves and they don't fly, so monitoring efforts are most effective when directed toward these stages on feather flush.

If you think you have found the Asian citrus psyllid, immediately contact your county agricultural commissioner's office, or call the CDFA Exotic Pest Hotline at 1-800-491-1899. Personnel from CDFA will inspect plants for the presence of this psyllid and send insect specimens to diagnostic laboratories for identification and testing for the presence of Huanglongbing. If the insect is identified as an Asian citrus psyllid, then the quarantine will expand to include that location, and citrus and other Asian citrus psyllid host plants will be treated to control the psyllid.

Homeowners can also help by monitoring their citrus trees for symptoms of HLB and reporting if a tree appears to have the disease. If the tree is determined to be infected with HLB, it will need to be removed to prevent spread to other trees. Diligent scouting for the pest and disease will help save backyard citrus trees and protect commercial citrus orchards. For additional photos of the Asian citrus psyllid and HLB symptoms, visit http://www.CaliforniaCitrusThreat.org or, for a version in Spanish, http://www.PeligranCitricosEnCalifornia.com.

Figure 5. Asian citrus psyllid adults and nymphs attacking young growth on citrus.

Biological Control

Several predators and parasites feed on different life stages of the psyllid. The nymphs are killed by tiny parasitic wasps and various predators including lady beetles and their alligator-shaped larvae, syrphid fly larvae, lacewing larvae, and minute pirate bugs. Some spiders, birds, and other general predators also feed on adult psyllids.

Because the Asian citrus psyllid recently arrived in California, it doesn't yet have a full complement of natural enemies to help control its populations. Biological control will improve as the psyllid's natural enemies increase, but this won't eliminate the pest or prevent it from transmitting the disease.

Chemical control is currently the most effective method to control the Asian citrus psyllid, especially if the purpose of control is to prevent spread of the psyllid to new areas of California. In other areas of the world where Huanglongbing is present, natural enemies aren't effective enough against the psyllid to keep the disease from spreading, and insecticide treatments are needed to protect citrus trees.

Chemical Control

If CDFA personnel haven't already treated your citrus trees for the Asian citrus psyllid and you live in an area where the pest has been detected, you can protect your citrus from infestation by treating trees with an insecticide when new leaf flush begins to appear. Mature citrus trees typically produce most of their new growth in the spring and fall, but young trees tend to produce flushes of new growth periodically during warm weather.

The insecticide carbaryl (Sevin), applied as a foliar spray, is effective against adult psyllids. The nymphs are often harder to kill with an insecticide spray, because they are tucked inside the small leaves of new flush growth, which protects them. Carbaryl is very toxic to honey bees and to natural enemies of other citrus pests, so don't apply this material unless you are certain you have an infestation.

The systemic insecticide imidacloprid (Bayer Advanced Fruit, Citrus, and Vegetable Insect Control) provides the best control of psyllid nymphs. It is applied to the ground at the base of citrus trees and is taken up into new leaf tissue where the nymphs feed. The insecticide is retained in the plant for about six months but is most effective against psyllids for one to three months. Imidacloprid should be applied only once a year and in summer or early fall to protect those periods of leaf flush. The insecticide takes one to two weeks to move from the roots to the leaves, so it should be applied before or as soon as tiny new flush begins to appear.

Imidacloprid is best taken up by the tree during the warm months of June through September. Applying imidacloprid in early fall, just before leaf flush, poses less hazard to honey bees, which can be injured if they collect nectar from recently treated trees, because there is no bloom present at that time.

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