Diaphorina citri

Introduction

The Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama, is widely distributed in southern Asia. It is an important pest of citrus in several countries, particularly India, where there has been a serious decline of citrus in recent years. This psyllid [did not occur in North America or Hawaii but]was reported in Brazil, by Costa Lima (1942; Rio de Janeiro) and Catling (1970) and in June 1998, the insect was detected in Florida, distributed along Highway 1 on the east coast of Florida, from Broward to St. Lucie counties and was apparently limited to dooryard host plantings at the time of its discovery. By September 2000, this pest had spread to 31 counties in Florida (Halbert 2001). *D. citri*, and one of its parasites, is also present in the Rio Grande Valley of Texas. Both species appear to have been accidentally introduced in the spring of 2001 on potted *Murraya* originating in Florida (Michaud).

D. citri and *Trioza erytreae* (Del Guercio) are the only two known vectors of the etiologic agent of citrus greening disease and are the only economic species on citrus in the world.

Identification

Authority	: Kuwayama
Classification	
Kingdom	: Animalia
Phylum	: Arthropoda
Class	: Insecta
Order	: Homoptera
Family	: psyllid
Genus	: *Diaphorina*
Species	: *citri*
Synonyms	:
Common Names	: Citrus Psylla, Asian Citrus Psyllid
Role	:Pest

Signs & Symptoms

Injury caused by psyllids results from the withdrawal of large quantities of sap from the foliage, heavy development of sooty mold on honeydew-covered leaves, and transmission of the organisms that cause greening disease. The once flourishing citrus industry in India is slowly being wiped out by dieback. This dieback has multiple causes but primarily it is due to greening disease. What is now generally accepted as greening disease has been called citrus chlorosis in Java, leaf-mottling and leaf-mottle yellows in the Philippines, likubin (rapid decline) in Taiwan, and huang long bing (yellow dragon disease) in China.

Nymphs, which are always found on new growth, move in a slow, steady manner when disturbed.

The **adults** leap when disturbed and may fly a short distance. They are usually found in large numbers on the lower sides of the leaves with heads almost touching the surface and the body raised almost to a 30 degree angle. The period of greatest activity of the psyllid corresponds with the periods of new growth of citrus. There are no galls or pits formed on the leaves as caused by many other kinds of psyllids; the nymphs are completely exposed (the nymphs of *T. erytreae* are partially enclosed in a pit). Citrus trees in advanced stages of decline are somewhat similar to those affected by tristeza. Field recognition of greening in Asia from symptoms alone is often difficult. Very similar leaf symptoms may be caused by a wide variety of factors varying from nutritional disorders to the presence of other diseases such as root rots and gummosis, tristeza, and exocortis.

Capoor et al. (1974) described **greening symptoms** of citrus as trees showing stunted growth, sparsely foliated branches, unseasonal bloom, leaf and fruit drop, and twig dieback. Young leaves are chlorotic, with green banding along the major veins. Mature leaves have yellowish-green patches between veins, and midribs are yellow. In severe cases, leaves become chlorotic and have scattered spots of green. Fruits on greened trees are small, generally lopsided, underdeveloped, unevenly colored, hard, and poor in juice. The columella was found to be almost always curved in sweet orange fruits and apparently the most reliable diagnostic symptom of greening. Most seeds in diseased fruits are small and dark colored.

Figure 1. Feeding damage caused by the Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama, to citrus foliage.

Morphology

Adults-3 to 4 mm long; body brown mottled; head light brown (black in *Trioza erytreae*); forewing broadest apical half, mottled, and with brown band extending around periphery of outer half of wing, the band slightly interrupted near apex (broadest at middle, unspotted, and transparent in *T. erytreae*); antennae with black tip and two small light brown spots on middle segments (nearly all black in *T. erytreae*); living insect covered with whitish, waxy secretion, making it appear dusty.

Figure 2. Adult Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama.

Nymphs

0.25 mm long in 1st instar, 1.5 to 1.7 mm in last (5th) instar; color generally yellowish orange; no abdominal spots (advanced nymphs of *T. erytreae* with two basal dark abdominal spots); wing pads massive (small pads in *T. erytreae*); large filaments confined to apical plate of abdomen (*T. erytreae* with fringe of fine white filaments around whole body, including head).

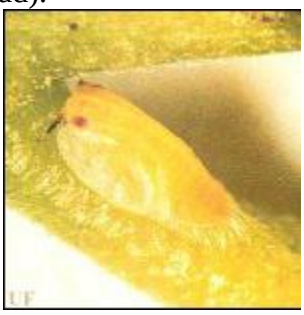

Figure 3. Nymph of the Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama.
CREDITS: University of Florida

Figure 4. The white waxy excretions of the nymphs are an indicator of the Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama.
CREDITS: Douglas L. Caldwell, University of Florida

Eggs

Approximately 0.3 mm long, elongate, almond-shaped, thicker at base, and tapering toward distal end; fresh eggs pale, but then turning yellow and finally orange at time of hatching; eggs placed on plant tissue with long axis vertical to surface (long axis horizontal to surface in *T. erytreae*).

Figure 5. Eggs of the Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama.
CREDITS: Douglas L. Caldwell, University of Florida

Identifications having regulatory significance should be made by taxonomists with adequate reference materials. Psyllids as a group are most likely to be confused with aphids. Aphids are common on tender citrus leaves; aphids are sluggish but adult psyllids are active jumping insects; aphids usually have 4-6 segmented antennae, while psyllids usually have 10; most aphids have cornicles on the abdomen, which the psyllids lack.

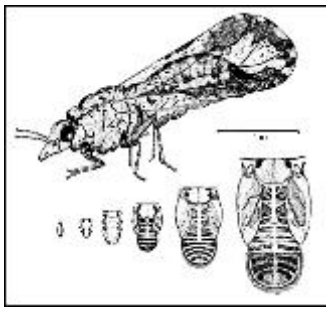

Figure 6. Adult female and nymphal instars of Asiatic citrus psyllid.
CREDITS: Douglas L. Caldwell, University of Florida

Biology & Ecology

Eggs are laid on tips of growing shoots on and between unfurling leaves. Females may lay more than 800 eggs during their lives. Nymphs pass through five instars. Total life cycle requires from 15 to 47 days, depending upon the season. Adults may live for several months. There is no diapause but populations are low in winter (the dry season). There are 9 to 10 generations a year; 16 have been observed in field cages. Numerous papers have appeared containing life history information, among them the following: Atwal et al. (1970), Capoor et al. (1974), Catling (1970), Husain & Nath (1927), Mangat (1961), Mathur (1975), Pande (1971), USDA, ARS (1959), and Wooler et al. (1974).

Dispersal & Vectors

Capoor et al. (1974) reported a high percentage of transmission by tissue grafts. They found that 4th and 5th instar nymphs and adults could effect transmission. *D. citri* requires an incubation period of about 21 days in which to transmit the pathogen, which it retains for life following a short access feeding (15-30 minutes) on a diseased plant. It is unnecessary for adult psyllids arising from infectious nymphs to have access feeding on diseased shoots in order to become vectors. Adult psyllids were able to transmit greening in a minimum infection feeding of 15 minutes but the percentage of transmission was low. One hundred percent infection was obtained when the psyllids fed for one hour or more. Capoor et al. (1974) strongly indicated that the pathogen multiplied in the body of the psyllid and that there was an absence of transovarial transmission. They summarized differences between *D. citri* and *Trioza erytreae* in various aspects of greening transmission. Moll and van Vuuren (1977, p. 38) concluded that the greening causal agent most closely resembles a gram-negative bacterium under the electron microscope. They designated the pathogen as a bacterium-like organism.

Figure 7. Symptoms of greening disease, *Liberobacter* spp, on citrus.
CREDITS: University of Florida

Management

Many workers in India have reported that *D. citri* can be controlled effectively with a wide range of modern insecticides. Bindra et al. (1974) reported that for overall effectiveness against nymphs and adults at different intervals after spraying several chemicals were effective. Injection of trees with tetracycline antibiotics to control greening disease has been effective where the vector can be kept under control. In countries where greening has spread over long distances, it has occurred because of the movement of infected and infested nursery stock; only clean and healthy plants should be transported. In areas of low incidence of greening, the relatively few infected trees should be removed to prevent them from being reservoirs of the pathogen. Tests in India by Raychaudhuri et al. (1974) showed that the greening organisms of infected budwood could be deactivated by either hot (moist) air, hot water, or 21 days in the heat therapy chamber.

Natural enemies of *D. citri* include syrphids, chrysopids, at least 12 species of coccinellids, and several species of parasitic wasps, the most important of which is *Tamarixia radiata* (Waterston). *T. radiata* was introduced in Florida (intentionally) and the Rio Grande Valley of Texas (accidentally) (Michaud).

Figure 8. Nymphs of the Asiatic or oriental citrus psyllid, *Diaphorina citri*, Kuwayama, killed by the ectoparasitoid wasp *Tamarixia radiata*.
CREDITS: University of Florida

Host Notes

Mainly *Citrus* spp., at least two species of *Murraya*, and at least three other genera all in Rutaceae.

Distribution

D. citri ranges primarily in tropical and subtropical Asia and has been reported from the following geographical areas: China, India, Myanmar, Taiwan, Philippine Islands, Malaysia, Indonesia, Sri Lanka, Pakistan, Thailand, Nepal, Cecum, Hong Kong, Ryukyu Islands, Afghanistan, Saudi Arabia, Reunion, Mauritius, and Brazil. The discovery of *D. citri* in Saudi Arabia (Wooler et al., 1974) is the first record from the Near East. *T. erytreae* also occurs in Saudi Arabia, preferring the eastern and highland areas where the extremes of climate are present, whereas *D. citri* is widespread in the western, more equitable coastal areas.

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