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THE ASIATIC CITRUS PSYLLID, DIAPHORINA CITRI KUWAYAMA (HOMOPTERA:PSYLLIDAE)[1]

Frank W. Mead[2]

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 does not occur in North America or Hawaii but was reported in Brazil, by Costa Lima (1942; Rio de Janeiro) and Catling (1970). D. citri often has been referred to as "citrus psylla," but this is the same common name often applied to Trioza erytreae (Del Guercio), the psyllid pest of citrus in Africa. T. erytreae, to avoid confusion, should be referred to as the African citrus psyllid or the twospotted citrus psyllid (the latter name in reference to a pair of spots on the base of the abdomen in late stage nymphs). These 2 psyllids are the only known vectors of the etiologic agent of citrus greening disease and are the only economic species on citrus in the world. Three other species of Diaphorina have been reported on citrus (2 in Swaziland, 1 in India), but these are non-vector species of relatively little importance.

DESCRIPTION AND IDENTIFICATION: ADULTS (fig. 1) 3-4 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 2 small light brown spots on middle segments (nearly all black in T. erytreae); living insect covered with whitish, waxy secretion, making it appear dusty. NYMPHS (fig. 1) 0.25 mm long in 1st instar, 1.5-1.7 mm in last (5th) instar; color generally yellowish orange; no abdominal spots (advanced nymphs of T. erytreae with 2 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). EGGS (fig. 1) 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).

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. *Any psyllid colony found on citrus in the United States should be viewed with alarm and emergency action taken.*

DAMAGE: Injury caused by the 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 organism that causes 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 in Taiwan, and

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1/ Contribution No. 394, Bureau of Entomology.
2/ Taxonomic Entomologist, Div. Plant Ind., P. O. Box 1269, Gainesville, FL 32602.

yellow shoot in China.

CONTROL: 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, the chemicals monocrotophos, dimethoate, fenitrothion, fenthion, and endosulfan (0.05% each) were effective. Several other chemicals, including methyl demeton were promising. They wrote that dimethoate was preferable because it was less expensive and has a lower dermal toxicity with the exception of fenitrothion. Dimethoate, being a systemic insecticide, does less damage to non-target fauna and could prove fatal even to the nymphs and adults of the Asiatic citrus psyllid that escape direct spraying. Injection of trees with tetracycline antibiotics to control greening disease has been effective where the vector can be kept under control. A more lasting effect was obtained by injecting trees with a "new" chemotherapeutant produced in India called B.P.-101. 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 organism 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 chalcidoids, the most important of which is Tetrastichus radiatus Waterston.

HOSTS: Mainly Citrus spp., at least 2 species of Murraya, and at least 3 other genera all in Rutaceae.

LIFE HISTORY: 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 5 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).

DISTRIBUTION: D. citri ranges primarily in tropical and subtropical Asia and has been reported from the following geographical areas: China, India, Burma, Taiwan, Philippine Islands, Malaysia, Indonesia, Ceylon, Pakistan, Thailand, Nepal, Sikkim, Hong Kong, Ryukyu Islands, Afganistan, Saudi Arabia, Réunion, 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.

SURVEY AND DETECTION NOTES: Sooty mold on foliage indicates presence of Homoptera. Ground under heavily infested citrus may appear white from honeydew deposits. 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. Schwarz et al. (1974) listed 4 reasons why the symptoms of greening in Southeast Asia were often different from those in South Africa. These reasons included the more tropical climate of Asia keeping mature fruit green, citrus variety differences, differences in the heat tolerance of the vectors leading to different disease distribution in the grove, and differences in the virulence of the strains of the pathogen.

TRANSMISSION: 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 1 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.

QUARANTINE SUMMARY:

Florida Department of Agriculture Rules (provide legal basis for excluding citrus, except fruit, from entering Florida):

1. Plants, General, Chapter 5B-1.
2. Transit Inspection, Chapter 5B-4.
3. Fruit Flies and Other Dangerous Diseases, Chapter 5B-8.
4. Spiny Citrus Whitefly or Blackfly, Chapter 5B-9.
5. Citrus Canker and Other Citrus Diseases, 5B-10.

Federal Foreign Quarantine No. 19, Citrus Canker and Other Citrus Diseases (provides legal basis for excluding citrus, except fruit, from entering U.S.A.).

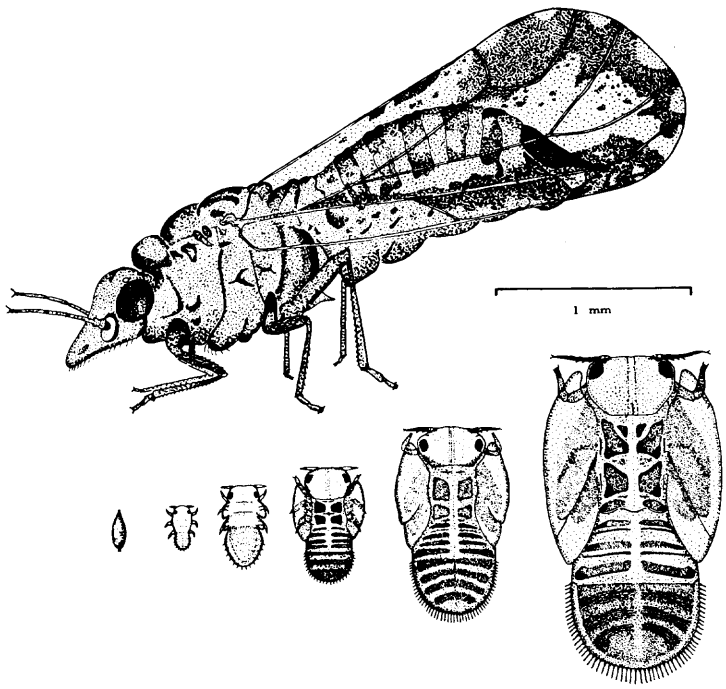

Fig. 1.
Egg, 5 nymphal instars and adult female of Diaphorina citri Kuwayama (from Catling, H. D. 1970).

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