

EPPO Datasheet: *Diaphorina citri*

Last updated: 2020-09-03

IDENTITY

Preferred name: *Diaphorina citri*

Authority: Kuwayama

Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta:
Hemiptera: Sternorrhyncha: Psyllidae

Other scientific names: *Euphalerus citri* (Kuwayama)

Common names: Asian citrus psyllid, citrus psylla, citrus psyllid
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EPPO Categorization: A1 list

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EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)

EPPO Code: DIAACI



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Notes on taxonomy and nomenclature

The taxonomic placement of the genus *Diaphorina* has been subject to several changes. It was moved from the family Psyllidae to the family Liviidae (Burckhardt & Ouvrard, 2012), but it was later proposed to place it back under Psyllidae (Burckhardt *et al.*, 2021).

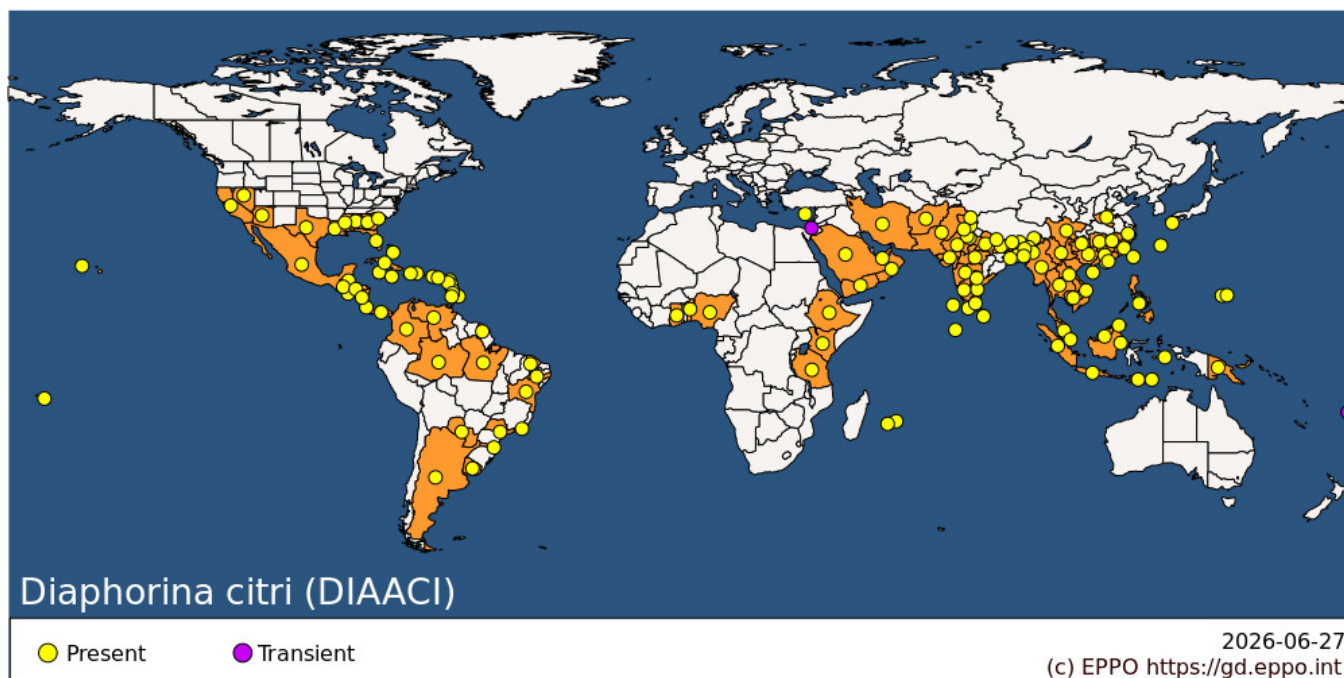
HOSTS

D. citri is confined to Rutaceae, occurring on wild hosts and on cultivated *Citrus*, especially grapefruit (*Citrus paradisi*), lemons (*C. limon*) and limes (*C. aurantiifolia*). *Murraya paniculata*, a rutaceous plant often used for hedges, is a preferred host. Within the EPPO region, host species are generally confined to countries surrounding the Mediterranean Sea.

Host list: *Aegle marmelos*, *Afraegle paniculata*, *Archidendron lucidum*, *Atalantia buxifolia*, *Atalantia*, *Balsamocitrus dawei*, *Casimiroa edulis*, *Citroncirus webberi*, *Citroncirus*, *Citrus australasica*, *Citrus australis*, *Citrus glauca*, *Citrus halimii*, *Citrus hassaku*, *Citrus hystrix*, *Citrus inodora*, *Citrus latipes*, *Citrus maxima*, *Citrus medica*, *Citrus reshni*, *Citrus reticulata*, *Citrus sunki*, *Citrus taiwanica*, *Citrus trifoliata*, *Citrus webberi*, *Citrus x amblycarpa*, *Citrus x aurantiifolia* var. *macrophylla*, *Citrus x aurantiifolia*, *Citrus x aurantium* var. *paradisi*, *Citrus x aurantium* var. *sinensis*, *Citrus x aurantium*, *Citrus x limon* var. *limettioides*, *Citrus x limon*, *Citrus x limonia* var. *jambhiri*, *Citrus x limonia* var. *volkameriana*, *Citrus x limonia*, *Citrus x nobilis*, *Citrus*, *Clausena anisum-olens*, *Clausena excavata*, *Clausena harmandiana*, *Clausena indica*, *Clausena lansium*, *Cordia myxa*, *Ficus carica*, *Fortunella japonica*, *Fortunella* sp., *Fortunella*, *Glycosmis pentaphylla*, *Limonia acidissima*, *Merrillia caloxylon*, *Murraya koenigii*, *Murraya paniculata*, *Rutaceae*, *Swinglea glutinosa*, *Triphasia trifolia*, *Vepris lanceolata*, *Zanthoxylum ailanthoides*, *Zanthoxylum asiaticum*, *x Citrofortunella microcarpa*, *x Citrofortunella* sp.

GEOGRAPHICAL DISTRIBUTION

The distribution of *D. citri* is wider than that of the causal agent of citrus huanglongbing (HLB) disease originally associated with this vector, '*Candidatus Liberibacter asiaticus*'. *D. citri* occurs in Afghanistan, some states of Brazil, Macau, Myanmar, and Singapore, where the associated bacterium has not yet been recorded.



EPPO Region: Cyprus, Israel

Africa: Benin, Ethiopia, Ghana, Kenya, Mauritius, Nigeria, Reunion, Tanzania, United Republic of

Asia: Afghanistan, Bangladesh, Bhutan, Cambodia, China (Aomen (Macau), Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hunan, Jiangxi, Sichuan, Xianggang (Hong Kong), Yunnan, Zhejiang), East Timor, India (Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, West Bengal), Indonesia (Java, Kalimantan, Maluku, Nusa Tenggara, Sumatra), Iran, Islamic Republic of, Israel, Japan (Kyushu, Ryukyu Archipelago), Lao People's Democratic Republic, Malaysia (Sabah, Sarawak, West), Maldives, Myanmar, Nepal, Oman, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam, Yemen

North America: Mexico, United States of America (Alabama, Arizona, California, Florida, Georgia, Hawaii, Louisiana, Mississippi, Nevada, South Carolina, Texas)

Central America and Caribbean: Antigua and Barbuda, Bahamas, Barbados, Belize, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Montserrat, Nicaragua, Panama, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Virgin Islands (US)

South America: Argentina, Brazil (Amazonas, Bahia, Ceara, Para, Pernambuco, Rio de Janeiro, Santa Catarina, Sao Paulo), Colombia, French Guiana, Paraguay, Uruguay, Venezuela

Oceania: American Samoa, Fiji, Guam, Northern Mariana Islands, Papua New Guinea

BIOLOGY

D. citri has a short life cycle and high fecundity. Its optimal developmental temperature ranges from 25-28°C (Liu and Tsai, 2000), and it is, therefore, best adapted to tropical and subtropical conditions, although mean temperatures above 30°C reduce its survival and fertility. Pairing starts soon after emergence, the insects being most active in spring and summer, once mean temperatures are above 12°C (Udell *et al.*, 2017). Eggs are laid inside half-folded leaves in buds, in leaf axils or other suitable places on the young tender parts of the tree (shoots or flushes). Females have a pre-oviposition period of about 10 days at their optimal temperature, and can lay up to 800 eggs during their lifetime (Liu and Tsai, 2000). Eggs hatch within 3-10 days (3 days at 28°C and 10 days at 15°C) and nymphs pass through five instars in 11-40 days. The complete life cycle takes 14-50 days, with up to 9-14 overlapping generations per year at mean temperatures of 20-25°C. However, as the eggs are laid exclusively on young flushes and nymphs can only develop on tender plant tissue, the number of generations per year is limited by the sprouting activity of citrus trees, and population fluctuations are closely correlated with tree phenology during the growing season (Udell *et al.*, 2017). *D. citri* overwinters as an adult, which can live for up to six months. Adults are highly active and jump at the slightest disturbance. Nymphs will move away when disturbed, but normally lead a sedentary existence, clustered in groups.

D. citri is known to be the most efficient vector of 'Ca. Liberibacter asiaticus', the most aggressive causal agent of huanglongbing disease. Together, these two organisms constitute the most destructive citrus pathosystem worldwide (Gottwald, 2010). *D. citri* can also transmit 'Candidatus Liberibacter africanus' and 'Candidatus Liberibacter americanus'. In areas in which these three bacteria species coexist, *D. citri* can transmit them indiscriminately (Ajene *et al.*, 2020; Gottwald, 2010).

DETECTION AND IDENTIFICATION

Symptoms

High densities of *D. citri* nymphs feeding on tender shoots can stunt and twist them. Lateral leaf notching is a characteristic form of damage associated with this insect (Aubert, 1987). However, at low insect densities, this symptom may go unnoticed. Both adults and immature insects secrete a semi-solid honeydew. Sooty mold may occur in the presence of high psyllid densities and humid environmental conditions.

Morphology

Eggs

Yellow, almond-shaped and tapering at the distal end; length approx. 0.31, width 0.15 mm.

Nymph

Light-yellow to dark-brown or green, bearing well-developed wing pods.

Adult

Adults are about 2-4 mm long, with a yellowish-brown body, greenish-brown or pinkish-brown abdomen, and greyish-brown legs. Males are smaller than females. The wings are transparent, mottled with white and brown spots and a broad, beige, band is present at the periphery of the distal part, slightly interrupted near the apex. The terminal segments of the antennae are black. Two darker segments are also found in the middle of the antennae.

The EPPO Diagnostic Protocol on *D. citri* provides guidance on how to detect and identify the pest (EPPO Standard PM 7/52).

Detection and inspection methods

Several sampling methods have been proposed and tested for the detection and monitoring of *D. citri*. The sampling methods recommended depend on the goals of the monitoring program. For early detection, suction sampling devices for the capture of adults, and yellow sticky traps are mostly recommended. For regular *D. citri* management actions, the stem tap sampling of adults provides reliable information rapidly. The visual sampling of nymphs in tender shoots during the major citrus sprouting periods of the tree growing season is recommended for determinations of the number of *D. citri* generations (Monzo and Stansly, 2020). Detailed protocols for surveillance, sampling and detection are indicated in the EPPO Standard PM 9/27 (2020) and in the EFSA pest survey card (EFSA, 2019).

PATHWAYS FOR MOVEMENT

D. citri has a substantial flight capacity. It can disperse locally over distances of at least 2 km, within 12 days, when food and oviposition resources (tender citrus shoots) are scarce (Lewis-Rosenblum *et al.*, 2015). Eggs and nymphs can be carried over longer distances on citrus material (budwood, grafted trees, rootstock seedlings) from infected areas. Trailers transporting oranges from groves to packing houses have also been recognized as a source of adult vector dispersal (Halbert *et al.* 2010). Adults and, 5th or 6th-instar nymphs can transmit 'Ca. Liberibacter asiaticus' to citrus plants. However, cleaned fruit, that has been washed and is without leaves at the end of the packing process is

not considered to pose a risk. The rutaceous plant *Murraya paniculata*, frequently used as an ornamental bush or hedge, is one of the preferred hosts of *D. citri*. This plant can carry *D. citri* eggs or nymphs, and its introduction into disease- and vector-free regions creates a risk of introduction of huanglongbing or its vector.

PEST SIGNIFICANCE

Economic impact

The economic impact of *D. citri* results principally from its role as a vector of huanglongbing, the most damaging citrus disease in the world (Gottwald, 2010). The presence of this pathosystem systematically drastically affects the citrus industry (Hodges and Spreens, 2012), and significantly impairs integrated pest management strategies (Grafton-Cardwell *et al.*, 2013). This pathosystem greatly decreases tree productivity, increases management costs considerably, and may also have deleterious effects on fruit quality (Tansey *et al.*, 2017). Intensive management programs for this pathosystem also have a negative impact on biological control processes for this crop, with important economic consequences (Monzo and Stansly, 2020a). In addition, direct feeding by *D. citri* causes leaf curling and notching. Under heavy infestations, sprouting shoots die, resulting in blossom and fruitlet drop.

Control

There are no curative treatments for huanglongbing, and there are no tolerant or resistant plants. The management of this pathosystem is therefore entirely dependent on efficient vector control (Grafton-Cardwell *et al.*, 2013). Insecticide-based strategies are the most effective, but must be compatible with biological control (Monzo *et al.*, 2014; Qureshi *et al.*, 2009). Broad-spectrum insecticide use in the winter is recommended, as only adult psyllids are found on citrus plants at this time of the year (Qureshi and Stansly, 2010). More selective active ingredients must be used during the tree growing season, when biological control is more relevant (Monzo *et al.*, 2014; Qureshi and Stansly, 2009). Due to the high frequency of insecticide applications against this vector in huanglongbing management programs, the rotation of modes of action is essential, to reduce the risk of resistance (Tiwari *et al.*, 2011). Economic thresholds have also been proposed, for spraying based on *D. citri* abundance, as a means of reducing the number of applications (Monzo and Stansly 2017). Biological control alone is not sufficient to prevent the spread of huanglongbing, but it can help to reduce the frequency of applications in commercial groves and is the most efficient management strategy for citrus trees in non-commercial citrus growing areas, such as those in urban gardens (Kistner *et al.* 2016; Monzo and Stansly, 2020a). The parasitoid *Tamarixia radiata* has been introduced into several citrus-growing regions worldwide, with various degrees of success (Chen and Stansly, 2014). Conservation biological control of naturally occurring predators can also greatly reduce the size of *D. citri* populations during the citrus growing season (Qureshi and Stansly, 2009; Monzo *et al.* 2014).

Phytosanitary risk

D. citri could probably establish itself and spread in Mediterranean countries without difficulty. The presence of *D. citri* would greatly increase the risk of introduction and spread of huanglongbing. However, in addition to its role in spreading huanglongbing, this psyllid has a significant potential for damage in its own right. Biological control may be possible, but there is no guarantee that it could keep populations at sufficiently low levels to prevent transmission of huanglongbing.

PHYTOSANITARY MEASURES

Considering the severity of huanglongbing, EPPO has recommended to prohibit the importation of citrus plants for planting and cut branches or buds of citrus from areas or countries where citrus huanglongbing (or either of its vectors) are present. In the EU territory, it is also forbidden to import fruit from third countries with their peduncles and leaves. In disease free countries as those of the Mediterranean area, awareness, monitoring, surveillance, pest risk assessment, quarantine measures and action plans are advised (Duran-Vila *et al.*, 2014; Siverio *et al.*, 2017). Procedures for official control with the aim of detecting, containing and eradicating huanglongbing and its vectors are provided in the EPPO Standard PM 9/27 (EPPO, 2020). As surveys should be carried out in all the EU member countries, a pest survey card was prepared by the European Food Safety Authority (EFSA, 2019) to assist EU Member States in planning their huanglongbing annual survey activities.

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1988 and revised in the two editions of 'Quarantine Pests

for Europe' in 1992 and 1997 as well as in 2020. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1992/1997) *Quarantine Pests for Europe (1st and 2nd edition)*. CABI, Wallingford (GB).

EPPO (1988) Data sheets on quarantine organisms No. 151, Citrus greening bacterium and its vectors *Diaphorina citri* & *Trioza erytreae*. *Bulletin OEPP/EPPO Bulletin* 18, 497-507.



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