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The Asian citrus psyllid

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Introduction

The Asian citrus psyllid (ACP), *Diaphorina citri*, is a vector of the destructive citrus disease Huanglongbing (HLB, also known as citrus greening) in the Asia-Pacific region and the Americas. HLB-infected trees gradually lose productivity and eventually die (Figure 1 and Figure 2). In poorly managed orchards, trees can die within five years of planting.

Fruit from HLB-infected trees tends to be smaller than normal. When cut open, the fruit appears asymmetrical about the fruit axis (lopsidedness) and sometimes small, brownish–black aborted seeds are present. Leaves on HLB-infected trees usually have an asymmetric blotchy mottle pattern (Figure 3), which is a key field diagnostic feature.

All commercial citrus varieties are susceptible to HLB and currently there is no cure. The disease is present in many countries including Australia's northern neighbours Indonesia and Papua New Guinea, but is currently absent from Australia. Preventing the disease and its vector from coming into Australia and developing preparedness for any future incursions is a priority for the Australian citrus industry.

Early detection is the key to maintaining Australia's HLB-free status. Government and industry partners undertake awareness, surveillance and trapping activities across Australia to increase the chance of early detection; this will be enhanced by active participation from citrus growers and the wider community.

This Primefact intends to facilitate such participation by providing information about ACP identification, alternative hosts, and its biology and ecology.

Figure 1. A huanglongbing-infected citrus tree with yellowing leaves. Photo: JM Bove, INRA Centre Des Recherches.

Figure 2. A huanglongbing-infected mandarin orchard in Bhutan showing sparse foliage and tree decline.

Figure 3. Asymmetric blotchy mottle on leaves from a huanglongbing-infected tree.

Identification

Adult ACP are 3–4 mm long. The forewings appear widest at the apex, with mottled brown patches (Figure 4). The eyes are red. The antennae are short and pale brown with black tips. When resting or feeding, the body of the adult and the plant surface form a roughly 45° angle (Figure 5).

ACP nymphs are yellowish-orange and have prominent wing pads, especially in the later instars (Figure 6). They produce copious amounts of white and string-like honeydew (Figure 7) that may melt to form droplets when the temperature is greater than 36°C.

ACP eggs are approximately 0.3 mm long, elongated, almond-shaped, and tapered toward the distal end (Figure 8). They are laid in groups on young flush. Newly laid eggs are pale, but then turn yellow and finally orange before hatching.

Figure 4. Asian citrus psyllid adult.
Photo: M Rogers, University of California.

Figure 5. Asian citrus psyllid adults on a leaf.

Figure 6. Asian citrus psyllid nymphs have prominent wing pads. Photo: Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org.

Figure 7. Asian citrus psyllid nymphs produce copious amounts of white and string-like honeydew.

Figure 8. Asian citrus psyllid eggs. Photo: David Hall, USDA Agricultural Research Service, Bugwood.org.

No other insects found in Australian citrus resemble ACP adults. However, aphids also feed in groups (Figure 9 to Figure 11) on young foliage. Some aphid nymphs look superficially similar to ACP nymphs, but they do not have wing pads, nor do they produce string-like honeydew. Most aphids have a pair of upright, tube-like appendages (cornicles or siphunculi) on the back of their abdomen, while ACP nymphs do not.

Australia has many native psyllids, mostly living on native vegetation such as eucalypt and wattle trees. These native species can be blown by the wind onto nearby citrus trees. Most native psyllids have transparent wings, in contrast to the almost opaque wings of ACP. Interestingly, one native psyllid, the spotted gum psyllid (*Eucalyptolyma maideni*) has a similar resting-feeding posture as the ACP (Figure 12). However, adults of this psyllid are bright green to yellow, in contrast to the mottled brown colour of ACP adults. Of the psyllids found in horticultural crops in Australia, the recently arrived tomato potato psyllid (*Bactericera cockerelli*) is cicada-like with transparent wings (Figure 13). The adult of the Australian solanum psyllid (*Acizzia solanicola*) also has transparent wings and resembles a winged adult aphid with a prominent black head and thorax (Figure 14).

Figure 9. Black citrus aphid (*Toxoptera aurant*). Photo: www.infuentialpoints.com.

Figure 10. Melon aphid (*Aphis gossypii*). Photo: www.infuentialpoints.com.

Figure 11. Spiraea aphid (*Aphis spiraecola*). Photo: www.infuentialpoints.com.

Figure 12. Spotted gum psyllid (*Eucalyptolyma maideni*). Photo: www.bugguide.net.

Figure 13. Tomato potato psyllid (*Bactericera cockerelli*. Photo: www.abc.net.au.

Figure 14. Australian solanum psyllid (*Acizzia solanicola*). Photo: Nicholas A Martin, Plant and Food Research.

Hosts

ACP can exploit many host plants, especially species of the family Rutaceae. Among the main hosts in this family are orange jasmine *Murraya exotica* L. (a synonym for *Murraya paniculata* [L.] Jacquin) and species and varieties of the genus *Citrus*. Although adults can feed on many species of Rutaceae, ACP cannot complete its development on all of them.

Distribution

According to the 'Invasive Species Compendium' data downloaded from CABI (https://www.cabi.org/isc/datasheet/18615) on 23 July 2020, ACP is currently present in the following countries and regions:

Africa: Kenya, Mauritius, Réunion and Tanzania.

Asia: Afghanistan, Bangladesh, Bhutan, Cambodia, China, Hong Kong, India, Indonesia, Iran, Japan, Laos, Macau, Malaysia, Maldives, Myanmar, Nepal, Oman, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam and Yemen.

North America: Antigua and Barbuda, Bahamas, Barbados, Belize, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, Guadeloupe, Haiti, Jamaica, Martinique, Mexico, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, US Virgin Islands and the United States.

Oceania: American Samoa, Guam, Northern Mariana Islands, Papua New Guinea and Timor-Leste.

South America: Argentina, Brazil, Colombia, Paraguay, Uruguay and Venezuela.

Life cycle

ACP eggs hatch into nymphs, which pass through five instars before becoming adults (Figure 15). The total life cycle requires 15 to 47 days depending upon the region and season. Adults can live for several months. There is no diapause and there are up to 10 generations a year, however 16 generations have been observed in field cages.

Biology and ecology

Adults start mating soon after emergence. Females oviposit in the terminal tissue in leaf folds and on petioles, axillary buds, and the upper and lower surfaces of young leaves and tender stems. First and second instar nymphs mostly aggregate and feed inside the folded leaves, on the terminal stem and between the axillary bud and the stem of tender shoots.

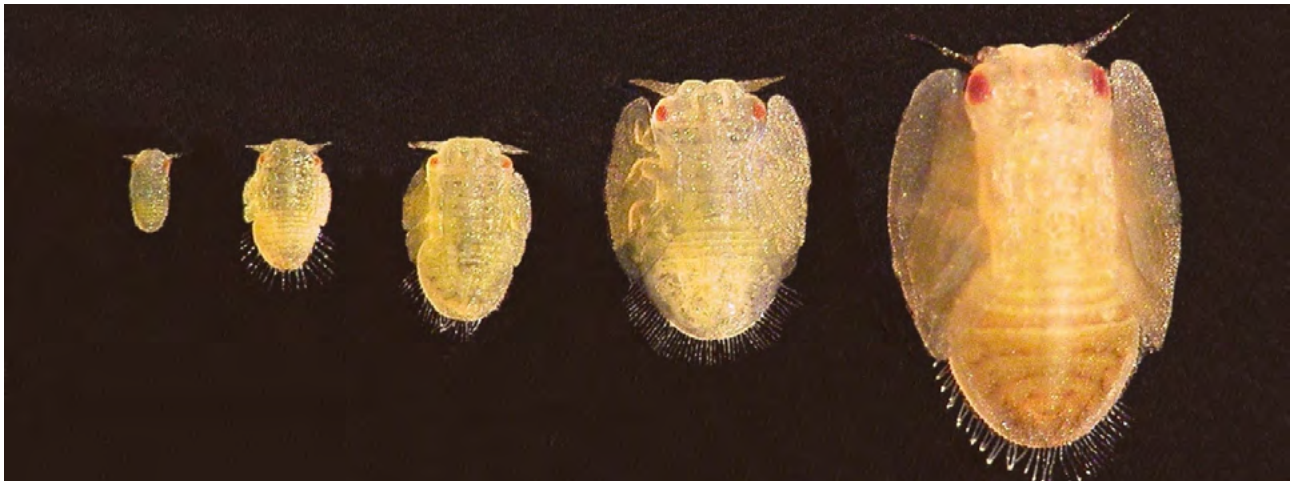

Figure 15. Asian citrus psyllid developmental stages. Photo: David Hall, USDA Agricultural Research Service, Bugwood.org.

Young nymphs are docile and move only when disturbed or over-crowded. Adults are often found resting on the terminal portion of the plant, especially on the lower side of the leaves. When disturbed they readily take flight for a short distance. The females only oviposit on the young and softer plant material. In the absence of suitable host tissue, oviposition ceases temporarily.

ACP spreads locally by natural dispersal. Long-distance spread occurs by movement of host materials such as budwood, grafted trees and rootstock seedlings and by the psyllid 'hitch-hiking' on harvested fruit along transport routes or on non-host materials.

ACP acquires HLB during its nymphal stages and late instar nymphs and adults are capable of transmitting the disease.

Natural enemies

In its native range in southern Asia, ACP is suppressed by a complex of parasitoids including *Tamarixia radiata* (Figure 16) and *Diaphorencyrtus* species. *Tamarixia radiata* was introduced into Réunion Island in 1978 and later into Mauritius and provided satisfactory control of the pest and suppressed HLB transmission. Predatory ladybirds and pirate bugs are also recorded in Asia, but most of them have little effect, although *Chilocorus nigritus* is beneficial in supplementing the action of parasitoids. Also, several entomopathogenic fungi have been reported to infect ACP.

Figure 16. A *Tamarixia radiata* wasp attacks an Asian citrus psyllid nymph. Photo: http://www.ucanr.org.

Management

In addition to using HLB-free seedlings and removing infected trees, controlling the psyllid vector is the key to effectively managing HLB.

Synthetic insecticides are the main tool for ACP control, however, frequent sprays have led to serious ACP resistance to many registered insecticides. Some alternative treatments such as mineral oils and kaolin have provided similar levels of ACP control to insecticides.

Biological control of ACP with *Tamarixia* wasps and entomopathogens has had limited success and the results have been highly variable.

Integrated approaches using a combination of cultural, biological and chemical options are needed to effectively and sustainably manage ACP.

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Unless otherwise stated, the images in this guide have been sourced from the NSW Department of Primary Industries.