

INTEGRATED PEST MANAGEMENT ANALYSIS OF ALTERNATIVE TREATMENT METHODS FOR CONTROL OF THE ASIAN CITRUS PSYLLID AND HUANGLONGBING

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The treatment program used by the California Department of Food and Agriculture (CDFA) for control of the Asian citrus psyllid (ACP), *Diaphorina citri* (Hemiptera: Psyllidae), and the disease it transmits, namely Huanglongbing, *Candidatus* Liberibacter asiaticus, targets multiple life stages. A contact insecticide is used for an immediate control of ACP adults in order to prevent spread, and a systemic insecticide is used to control developing ACP nymphs and to give the plant long term protection from re-infestation. The contact insecticide preferentially used contains the synthetic pyrethroid cyfluthrin, while the systemic insecticide contains the synthetic neonicotinoid imidacloprid. Both products have been shown to be effective against ACP elsewhere, particularly in Florida. In addition, HLB-infected plants are removed in their entirety and destroyed, in order to remove a reservoir for the disease. The California Huanglongbing Task Force, a joint government, university, and industry group formed in 2007 to provide guidance to the CDFA on matters pertaining to ACP and HLB has endorsed the use of these chemicals in the CDFA's treatment program.

Below is an evaluation of alternative treatment methods to control ACP and HLB which have been considered for treatment programs in California.

A. PHYSICAL CONTROL

Mass Trapping. Mass trapping of adults involves placing a high density of traps in an area in an attempt to physically remove them before they can reproduce. The current available trapping system for ACP relies on short distance visual stimulus, and is not considered effective enough to use in a mass trapping program.

Active Psyllid Removal. Adult ACPs are mobile daytime fliers, and adults could theoretically be netted or collected off of foliage. However, due to their ability to fly when disturbed, and the laborious and time-prohibitive task of collecting minute insects from several properties by hand, it would be highly unlikely that all adults could be captured and removed. Nymphs attach themselves to developing leaves and stems via their proboscis. Therefore, physical removal of the nymphs would entail removal of the growing shoots which will stunt the tree and reduce fruit production. For these reasons, mechanical control is not considered to be an effective alternative.

Host Removal. Removal of host plants for ACP would involve the large-scale destruction of plants and their roots by either physical removal or phytotoxic herbicides. Additionally, host removal could promote dispersal of female psyllids in search of hosts outside of the treatment area, thus spreading the infestation. For these reasons, host removal is considered inefficient and too intrusive to use over the entirety of the treatment areas used for ACP. However, physical host removal of HLB-infected plants in their entirety is used for HLB control, because it is limited in scope to just the infected tree and it is effective at eliminating the disease reservoir, thereby preventing further spread of the disease by ACP.

B. CULTURAL CONTROL

Cultural Control. Cultural controls involve the manipulation of cultivation practices to reduce the prevalence of pest populations. These include crop rotation, using pest-resistant varieties, and intercropping with pest-repellent plants. None of these options are applicable for ACP control in an urban environment, and may only serve to drive the psyllids outside the treatment area, thus spreading the infestation.

C. BIOLOGICAL CONTROL

Microorganisms. No single-celled microorganisms, such as bacteria, are currently available to control ACP.

Nematodes. Entomopathogenic nematodes can be effective for control of some soil-inhabiting insects, but are not effective, nor are they used, against above ground insects such as psyllids.

Parasites and Predators. There have been two parasites released in Florida against ACP, but only one of these are considered somewhat successful there, namely *Tamarixia radiata* (Hymenoptera: Eulophidae). This insect has been released into the environment in southern California. The CDFA is working with the citrus industry to pursue options for incorporating this parasite into treatment programs statewide. In addition, a second wasp has been recently released by the University of California Riverside, *Diaphorencyrtus aligarhensis*.

Sterile Insect Technique (SIT). SIT involves the release of reproductively sterile insects which then mate with the wild population, resulting in the production of infertile eggs. SIT has neither been researched nor developed for ACP, nor has it been developed for any species of psyllids, and is therefore unavailable.

D. CHEMICAL CONTROL

Foliar Treatment. A number of contact insecticides have been researched for use against ACP elsewhere, particularly in Florida. Contact insecticides are more effective against adult ACPs than the sedentary nymphs because adults actively move around on plants, thereby coming into contact with residues, whereas nymphs have to be directly sprayed in order for them to come into contact. The following product has been identified for use by the CDFA, based on a combination of effectiveness against ACP, worker and environmental safety, and California registration status.

Tempo® SC Ultra is a formulation of cyfluthrin which is applied to the foliage of all host plants. Tempo® SC Ultra is a broad-spectrum synthetic pyrethroid insecticide which kills insects on contact. Tempo® SC Ultra has no preharvest interval, which makes it compatible with residential fruit-growing practices.

Soil Treatment. A number of systemic insecticides have been researched for use against ACP elsewhere, particularly in Florida. Systemic insecticides are particularly effective against psyllid nymphs because nymphs spend much of their time feeding, thereby acquiring a lethal dose. The following products have been identified for use by the CDFA, based on a combination of effectiveness against ACP, worker and environmental safety, and California registration status.

Merit® 2F is a formulation of imidacloprid which is applied to the root system of all host plants via a soil drench. Imidacloprid is a synthetic neonicotinoid insecticide which controls a number of other phloem feeding pests such as psyllids, aphids, mealybugs, etc.

CoreTect™ is a formulation of imidacloprid which is applied to the root system of all host plants via insertion of a tablet into the soil, followed by watering. It is used in place of Merit® 2F in situations where there are environmental concerns about soil surface runoff of the liquid Merit® 2F formulation, such as host plants growing next to ponds and other environmentally sensitive areas.

E. RESOURCES

- Grafton-Cardwell, E. E. and M. P. Daugherty. 2013. Asian citrus psyllid and huanglongbing disease. Pest Notes Publication 74155. University of California, Division of Agriculture and Natural Resources Publication 8205. 5 pp.
<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnasiancitruspsyllid.pdf>.
- Grafton-Cardwell, E. E., J. G. Morse, N. V. O'Connell, P. A. Phillips, C. E. Kallsen, and D. R. Haviland. 2013. UC IPM Management Guidelines: Citrus. Asian Citrus Psyllid. Pest Notes Publication 74155. University of California, Division of Agriculture and Natural Resources. <http://www.ipm.ucdavis.edu/PMG/r107304411.html>.
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