11.11 Managing Asian Citrus Psyllid *Diaphorina citri* with Soil and Foliar Applications of Insecticides

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Diaphorina citri Kuwayama, a worldwide pest of citrus, vectors the bacterium *Candidatus* Liberibacter asiaticus, the causal organism of the "huanglongbing" or Asian form of citrus greening disease. The introduction of *D. citri* in 1998 and advent of citrus greening disease in 2005 has elevated the psyllid vector to key pest status in Florida. Insecticides are widely used to reduce the incidence of the pest and the disease although several native and introduced biological control agents can also impart considerable mortality (1-8).

Therefore, insecticides should be used judiciously to conserve natural enemy diversity and ecological stability. Toward this end we evaluated systemic and foliar applications of several recommended and experimental insecticides against feral populations of *D. citri* and some of its natural enemies on young and mature citrus trees in experimental and commercial citrus groves. Experiments were arranged in randomized complete block designs. Treated and untreated trees were examined for *D. citri* and its natural enemies. A tap sampling method was used to evaluate treatment effects on psyllid adults and their natural enemies (2). This sample consisted of 22 × 28 cm white paper sheet (on a clipboard) held under branches selected at random that were tapped three times with hand or stick. Psyllid adults and predators falling on the paper were counted. Additional evaluations included examination of citrus shoots for infestation with *D. citri* immatures and presence of predators.

Drench applications made using EZE-DOSE (Model CCI DO 35) applicator were evaluated in 5-6 years old 'Valencia' orange trees on 'Swingle' rootstock planted on double-row raised beds at a density of 326 trees/ha. Trees were pruned to induce shoot growth and encourage psyllid infestation. Imidacloprid and another neonicotinoid systemic thiamethoxam were very effective in controlling *D. citri* for two to three months (2, 8). However, similar application of the carbamate, oxamyl was not effective. Populations of predatory coccinellids, *Curinus coeruleus*, *Olla v-nigrum*, *Harmonia axyridis*, and *Cycloneda sanguinea* were significantly reduced on treated trees compared to the untreated trees. Another carbamate, aldicarb was evaluated at 3 rates, 2 placements and 3 timings to control *D. citri* in 8-12 years old citrus trees planted at 373 trees/ha on double-row raised beds (3). Trees were 'Valencia' orange on 'Swingle' rootstock in rate and timing experiments and 'Hamlin' on 'sour orange' in a rate x placement experiment and followed natural flush cycle. A modified Gandy granular applicator provisioned with two double coulters to open a furrow, and a metering wheel to control release from a single hopper was adjusted for different application rates. A PTO-powered blower delivered granules to the furrows through a maximum of three tubes to each coulter, and a following press wheel closed the furrows set at approximately 2 and 3 ft from the tree trunk for the proximal and distal bands respectively. Application of aldicarb at 5.6, 2.8 and 1.4 kg ai/ha in March 2006 reduced *D. citri* adults 58-66% to 45-46% and 25-37% respectively compared to untreated trees in two separate experiments. No difference was observed in placement (one vs. two sides of the tree) or tree size (8 vs. 12 yr old). Application at 5.6 kg ai/ha in January 2007 reduced adults

by 86% and shoot infestation by 77% in spring, and was generally better than the November 2006 and especially February 2007 applications. More adults were negatively impacted when caged on treated trees for 25 days in March 2007. Spiders and ladybeetles were equally abundant in treated and untreated trees.

Foliar applications of several insecticides alone or with adjuvants were evaluated during growing season in 12-14 year old 'Valencia' orange trees planted on double-row raised beds at a density of 326 trees/ha. Trees were pruned on bed or swale sides to induce shoot growth and encourage psyllid infestation. Applications were made using tractor mounted hydraulic or Durand Wayland 3P-10C-32 air blast sprayer. Most of these insecticides reduced psyllid populations for 2-3 weeks and negatively impacted ladybeetles populations. In contrast, foliar applications of insecticides made during the period of tree dormancy before spring flush reduced psyllid populations for up to six months with minimal impact on natural enemies. These applications were effective because they targeted adult psyllids when little flush was present to harbor immature or psyllid predators (7).

Findings from these experiments suggest that soil applications of aldicarb at 5.6 kg/ha to mature citrus trees 2–3 months before spring growth can suppress *D. citri* through spring with minimum direct effect on principal psyllid natural enemies. Foliar applications during the dormant winter period are also effective by controlling adults when few nymphs or natural enemies are present. Few adults then survive to infest the spring flush whereas natural enemies migrate in and are available to feed on psyllid immatures. In contrast, foliar sprays during the growing season were less effective, should be based on scouting and made prior to anticipated flush to effectively target adults. Drench applications of imidacloprid controlled psyllids for 2-3 months on young trees and are best applied to the soil when trees are active and rainfall moderate to avoid leaching. In Florida, aldicarb must be applied between 15 November and 30 April in conformance with the label. Thus, frequent foliar sprays may be necessary at other times to provide needed protection for frequent flushes on young trees.

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