Controlling Asian Citrus Psyllids; Sparing Biological Control

By Phil Stansly and Jawwad Qureshi

Old-timers around the industry will talk about the bad old days of the 1960s and 1970s when scale insects and other sucking pests had to be controlled with multiple sprays of broad spectrum insecticides. Introductions of parasitic wasps and other predaceous insects brought that era to a close, and growers enjoyed three decades of freedom from the necessity of spraying process fruit more than a couple of times with oil. This was fortunate as low prices during the latter half of this period would have allowed little else.

The arrival of new pests to our shores, such as the Diaprepes root weevil (1963), citrus leafminer (1993) and brown citrus aphid (1995), has challenged this low input pest management system, but none as much as the Asian citrus psyllid (ACP), *Diaphorina citri*. First detected in 1998, its true impact on Florida citrus is only now being realized due to rapid spread of greening disease vectored by the psyllid. Caused by *Candidatus Liberibacter asiaticus* and first detected in Florida in 2005, greening has spread throughout the state, especially in the south. An aggressive management program for psyllids now appears to be necessary. Can this be done without wiping out critical biological control?

Figure 1. Olla v-nigrum adult (A) and larva (B) feeding on an ACP numph.
Photo by Phil Stansly.

KEY BIOLOGICAL CONTROL AGENTS OF FLORIDA CITRUS PESTS

All citrus pests in Florida have natural enemies, although some are more effective than others. Scale insects are normally held in check by a complex of parasitic wasps, aided by a group of specialized ladybeetles. Mealybugs and whiteflies are suppressed by similar complexes, whereas biological control of aphids relies on a wider range of predaceous insects that includes lacewing and hoverfly larvae. Predators such as ants and spiders, aided by parasitic wasps, especially the introduced species *Ageniaspis citricola*, are usually effective against citrus leafminer. Numerous species of predaceous mites attack rust mites and spidermites, and tiny Stethorus ladybeetles also contribute to spidermite control. On the other hand, the most effective suppression of Diaprepes root weevils comes from native nematodes present in the soil. In addition, humid conditions in summer favor fungi such as species of *Hirsutella* (rust mites, psyllids), *Aschersonia* (whiteflies), *Beauvaria* (Diaprepes), *Neozygites* (aphids) and *Paeciliomyces*.

Our studies have shown that survival of ACP in the field from egg through adult emergence is generally less than 10 percent, and that most nymphs are consumed by predators, especially from ladybeetles such as the metallic blue ladybeetle *Curinus coeruleus*, Olla v-nigrum, (Figure 1) and the multicolored Asian ladybeetle, *Harmonia axyridis*, aided by lace-wings (Figure 2), hoverflies, spiders and the introduced parasitic wasp, *Tamarixia radiata*. The wasp is established throughout the citrus growing region, but generally adds little to ACP mortality, leading us to continue the search in Asia for more effective races and species of parasitoid.

Figure 2. Lacewing larva, Ceraeochrysa sp, feeding on young psyllids nymphs.
Photo by Phil Stansly.

ACP CONTROL

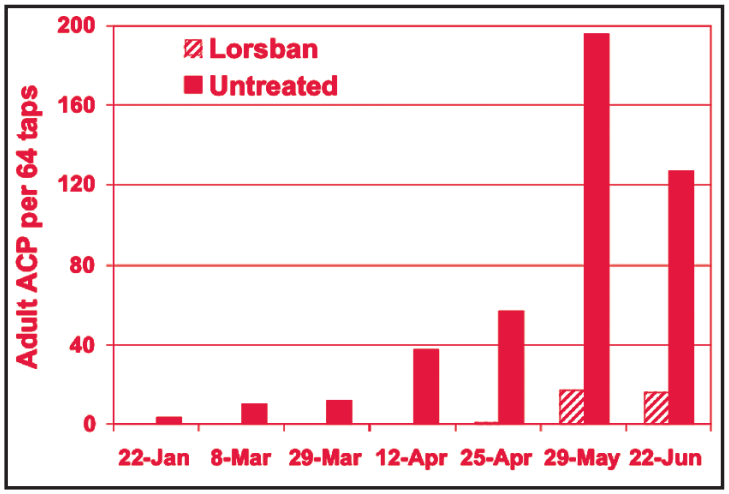
Unfortunately, there is no economic threshold for ACP; we don't know to what extent psyllids need to be suppressed to achieve the objective of remaining profitable in the face of greening. However, if there was a threshold, it would be lower for young trees. Young trees are at greatest risk for contracting greening and passing it on because they flush heavier and more often. They also succumb most quickly because the causative bacteria distributes rapidly through a small tree. Furthermore, their potential economic value is greatest. Thus, young trees need the most protection from greening.

For all the same reasons, mature trees are at lower risk from greening and will survive longer if infected. However, infected trees of whatever size or age will serve as sources of greening inoculum. Nevertheless, considering just risk of infection, susceptibility and potential loss, mature trees require less protection. Furthermore, mature trees when sprayed less intensively will serve as refuges for natural enemies that can recolonize more intensively managed young blocks. Therefore, careful use of insecticides on mature trees is warranted.

Insecticides must be selectively targeted and sprayed only when necessary in order to control ACP efficiently and still spare beneficials. Insecticides can be targeted to the pest by employing selective materials, application methods, or timing. Good timing requires understanding the ecology of the pest, its natural enemies, and regular scouting to track pest and beneficial populations.

SELECTIVE INSECTICIDES

To be considered selective or "soft," an insecticide should kill significantly more pests than natural enemies. Non-selective or broad spectrum insecticides include the organo-phosphates (chlorpyrifos, malathion, dimethoate), carbamates (carbaryl, oxamyl), and pyrethroids (fenpropathrin, bifenthrin). Many broad spectrum insecticides control adult psyllids, but all are "hard" on beneficials. Most other chemistries



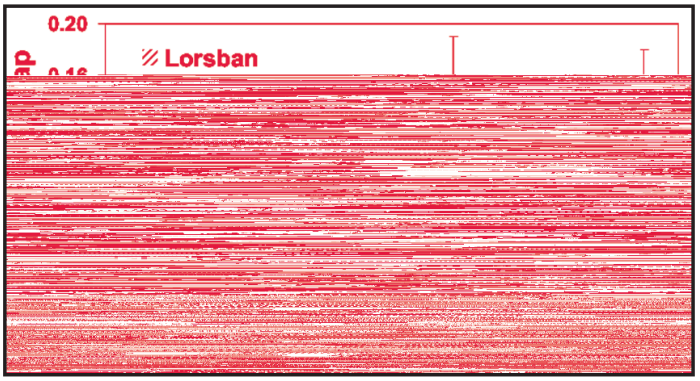


Figure 3. Adult psyllids (A) and ladybeetles (B) observed on trees in two 15-acre blocks of Valencia orange of mixed age sprayed with Lorsban 4E at 6 pts/acre on Jan. 15, 2007, or two adjacent 45-acre unsprayed blocks in a commercial citrus grove in southwest Florida.

such as oils, insect growth regulators (diflubenzuron, pyriproxyfen), imidacloprid and various miticides are more selective, although effects on specific natural enemies are poorly understood. Unfortunately, sprays of "soft" insecticides are either ineffective against ACP or effective only against the immature stages (nymphs) found exclusively on young flush. However, control of nymphs with foliar applications is temporary at best, due to the continual growth of new flush. Thus, we really have nothing we can spray directly on flush to provide good psyllid control while sparing beneficials.

SOIL APPLICATION

Soil application of systemic insecticides can provide long-term control while avoiding direct contact with beneficial organisms. Two such insecticides labeled for Florida citrus have proved effective in controlling ACP: imidacloprid and aldicarb (Temik). Both are systemic and able to translocate from roots to foliage. Temik is a restricted-use granular material applied as a side dressing by professional applicators. The product can only be used from Nov. 15 through April 30 and is most effective against ACP when applied before February in time to activate with moisture and move into the spring flush. Imidacloprid is sold as a liquid, applied as a drench, and can protect from ACP, other sucking insects and citrus leafminer for two months or more. However, its use is limited by rate restrictions to one or two applications on young trees less than six feet in height. Thus, soil applied systemic insecticides are relatively innocuous to natural enemies and an important tool for controlling ACP. Unfortunately, they only provide a partial solution due to the limited number of materials available and restrictions on their use.

DORMANT SPRAYS

Another way to achieve selectivity is by applying insecticides when pests are present, but natural enemies are either absent or somehow sheltered. Ladybeetles, lacewings and hover flies are predators of psyllids and other pests and are attracted to young flush where the immature stages of their prey are feeding. Adults of these beneficial insects are highly mobile and able to leave the grove when flush is not available. Psyllid adults are also mobile, but tend to remain on the tree, feeding on mature foliage in the absence of flush. Thus, adult ACP are best targeted with broad spectrum insecticides when flush is unavailable, especially during winter dormancy when psyllid populations decline and natural enemies are largely absent. This practice can greatly reduce the number of psyllids that eventually enter the spring flush where an unlimited food supply would otherwise allow populations to explode.

Ladybeetles and other psyllid predators also colonize the spring flush to feed on aphids and whatever psyllids are available. The effectiveness of the dormant spray against adults, combined with continued predation by natural enemies in the spring flush, explains why citrus researchers have been able to see up to six months of psyllid suppression from a single application with no discernable effect on ladybeetles (Figure 3).

SCOUTING FOR PSYLLIDS

Continuous monitoring of pest and beneficial insects in order to use pesticides efficiently and selectively is necessary. Young trees are constantly flushing and must be checked frequently for psyllid activity. Use a hand lens to look inside the smallest feather flush for eggs and young nymphs. Estimate the percentage of flush infested and the density of flush per tree or standardized area of canopy to arrive at a full picture of the extent of the infestation. Photographs and descriptions of psyllid stages can be found in Rogers M.E. and P.A. Stansly. 2006. "Biology and Management of the Asian Citrus Psyllid, Diaphorina citri Kuwayama, in Florida Citrus." http://edis.ifas.ufl.edu/IN668#copy and more on scouting citrus in Stansly, P.A. 2007. "Scouting for pests and beneficials in Florida citrus." Citrus Industry 88(2):14-17.

Attempting to control immature psyllids on the sporadic flush of mature trees is counterproductive; therefore, adult psyllids are the target. Adults can be monitored by placing a piece of 8 x 11 white paper on a clipboard under a branch which is then tapped three times. Psyllids as well as ladybeetles, spiders and lacewings are counted as they fall onto the paper. One hundred such "tap" samples every week should be sufficient to make spray decisions targeting adults in a 10-acre block of mature trees. Yellow sticky traps placed in the tree canopy at one per acre are also a good but labor intensive way to monitor for adults. If psyllid numbers remain low and do not increase significantly with either evaluation method, a spray is not necessary unless a flush is anticipated following hedging or topping.

RECOMMENDED PROGRAM

Rely as much as possible on long-lasting soil-applied systemic insecticides to control immature ACP. Aldicarb can be applied in late fall or early winter to trees of all sizes. Imidacloprid should be applied on young trees to the extent permitted by the label — once or twice in blocks depending on age, and as frequently as necessary to achieve year-round control on resets. Additional psyllid control will be necessary in most young blocks. Spray decisions should be

based on scouting, but sprays may be needed with sufficient frequency in young blocks to effectively employ soft chemistry including oil.

The winter dormant period is the time to make one or two sprays of broad spectrum insecticides on all trees to kill adults when they are fewest and most vulnerable, most natural enemies are absent, or in the case of many parasitoids, protected inside their hosts. Additional sprays of broad spectrum insecticides on mature trees during the growing season should only be made when justified by scouting and prior to anticipated flushes.

THE FUTURE

The rapid spread of greening in south Florida is indicating that growers may not be able to halt the spread of the disease within and among groves. Rather, learning to live with greening by adopting new horticultural or curative practices may be the best option. Regardless of what future programs look like, they will always include a psyllid control component to slow the inoculation rate of the causative bacteria. The program recommended here is designed to provide optimal psyllid suppression while not trading one problem for the many that would be unleashed by breaking the bonds of biological control.

Phil Stansly is professor of entomology and Jawwad Qureshi is assistant research professor of entomology, both with the University of Florida-IFAS, Southwest Florida Research and Education Center, Immokalee.