Ladybeetles and lacewings for Asian citrus psyllid-focused citrus pest management

By Jawwad A. Qureshi, Azhar A. Khan and Philip A. Stansly

Citrus is attacked by several insect and mite pests, most of which are controlled by a wide range of natural enemies including specialist parasitic wasps and specialized or generalist predators. For example, scales, mealybugs, citrus blackflies and whiteflies are suppressed by a complex of parasitic wasps, and in some situations, are aided by specialized ladybeetles such as the vedalia beetle *Rodolia cardinalis* and the mealybug destroyer *Cryptolaemus montrouzieri*.

In contrast, biological control of aphids relies on a wider range of predaceous insects that includes ladybeetles, lacewings and hoverfly larvae. Citrus rust mites and spider mites are attacked by several species of naturally occurring predatory mites and also by tiny *Stethorus* ladybeetles.

The commercially available predatory mite *Amblyseius swirskii* is used in vegetables to control broad mite and whitefly and also feeds on Asian citrus psyllid (ACP) eggs and neonates.

Citrus leafminer (CLM) is suppressed by predators such as ants and spiders, aided by several species of native and introduced parasitoids.

Management of huanglongbing (HLB) or citrus greening disease spread by ACP depends largely on vector control. Biological control has always been an important component of citrus pest management in Florida and therefore a thorough understanding of its contribution and enhancement to the mortality of ACP and other pests is important. Like other currently available options to control ACP, biological control alone may not sufficiently mitigate the impact of HLB, but it does contribute significantly to ACP suppression in commercial groves as well as in other habitats such as urban settings where chemical control is not appropriate. Studies have shown significant contributions from several biological control agents to the mortality of ACP and other citrus pests in Florida.

NATURALLY OCCURRING BIOLOGICAL CONTROL OF ASIAN CITRUS PSYLLID

Studies conducted soon after the invasion of ACP in Florida reported a wide range of predators attacking ACP. Populations of the native southern two-spotted ladybeetle, *Olla v-nigrum*, were seen to increase on Florida citrus in response to early infestations of ACP. Other ladybeetle species that were found attacking ACP were multicolored Asian ladybeetle *Harmonia axyridis*, blood-red ladybeetle *Cycloneda sanguinea*, and little red ladybeetle *Exochomus childreni*. Additional contributions to the mortality of ACP were noted from predatory groups such as lacewings, spiders and hoverflies. Follow-up studies showed that a diet of ACP nymphs supported successful larval development of the metallic blue ladybeetle *Curinus coeruleus*, as well as *E. childreni*, *H. axyridis*, *O. v-nigrum* and *C. sanguine*, and that the adults of all but *C. sanguinea* reproduced on a diet of ACP nymphs.

We estimated a net reproductive

rate of ACP during 2006–2007 up to 27-fold; lower in colonies exposed to natural enemies compared to colonies protected from predation by sleeve cages. The ladybeetles *O. v-nigrum*, *C. coeruleus*, *H. axyridis* and *C. sanguinea*, the Asian cockroach *Blattella asahinai*, lacewings *Ceraeochrysa* sp. and *Chrysoperla* sp., and spiders were most often encountered visiting these colonies. However, incidence of attack by the specialized parasitoid *Tamarixia radiata* seen in these experiments and another statewide study was low in spring and summer, indicating a need to bolster populations of the wasp early in the season. A separate article focusing on augmentation and contribution of *T. radiata* to the mortality of ACP was published in the June 2012 issue of *Citrus Industry*.

Insecticide use to control ACP increased after the advent of HLB. Foliar sprays may depopulate the grove of beneficial non-targets responsible for control of several citrus pests. As a consequence, outbreaks of secondary pests such as mites, scales and CLM have become common. For example, *Ageniaspis citricola*, an introduced parasitic wasp specific to CLM and once abundant in Florida citrus, is now detectable only at very low levels. Similarly, abundance of *Tamarixia*, ladybeetles and lacewings had decreased from earlier estimates, possibly due to insecticide use. Unfortunately, these species are not available commercially to reinforce natural populations by mass release. Therefore, commercially available predators never tested before are also being evaluated against ACP to investigate their potential role in citrus pest management.

CONVERGENT LADYBEETLE *HIPPODAMIA CONVERGENS*

This native ladybeetle is abundant in many parts of the United States and is collected in the mountains of California where it hibernates en mass. The cost is low, but the hungry beetles coming out of hibernation are programed to disperse and do not seem to like staying in citrus groves. Nevertheless, they can develop and reproduce successfully on diets of ACP, as well as brown citrus aphid and green citrus aphid.

TWO-SPOTTED LADYBEETLE *ADALIA BIPUNCTATA*

This species (Figure 1) is distributed throughout Asia, Europe and North America and is being used in many countries to control aphids, but

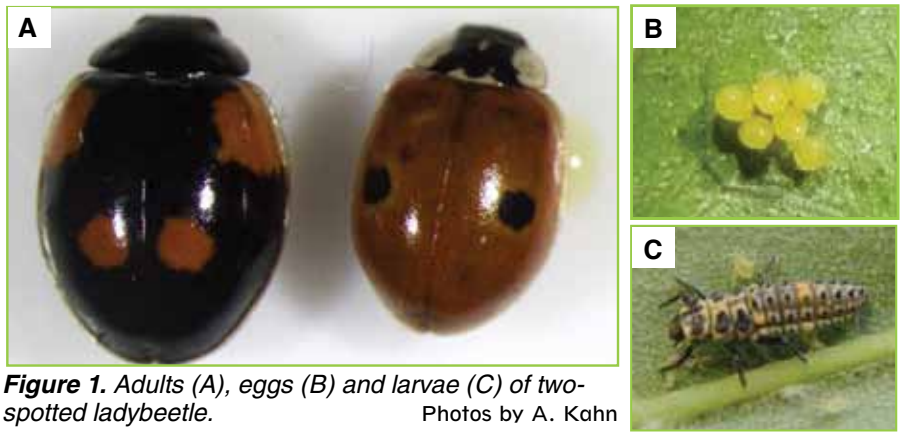

Figure 1. *Adults (A), eggs (B) and larvae (C) of two-spotted ladybeetle.* Photos by A. Kahn

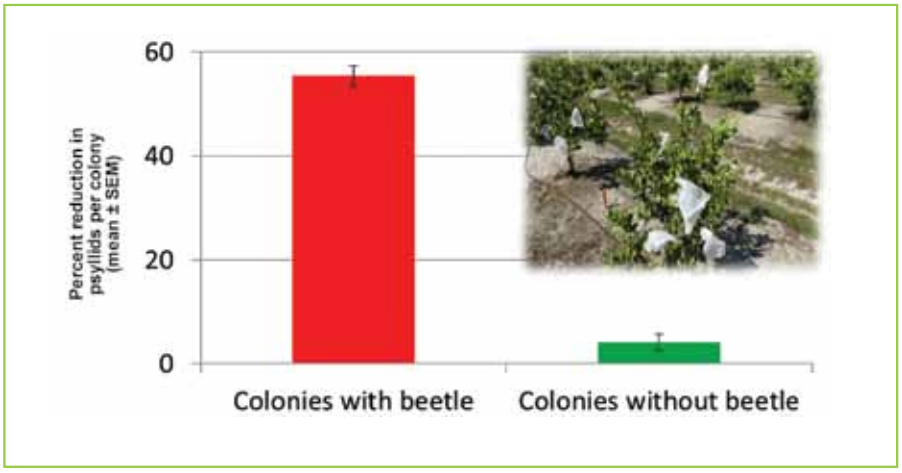

Figure 2. *Reduction of ACP nymphs in the colonies with and without two-spotted ladybeetles (SEM stands for standard error of the mean).*

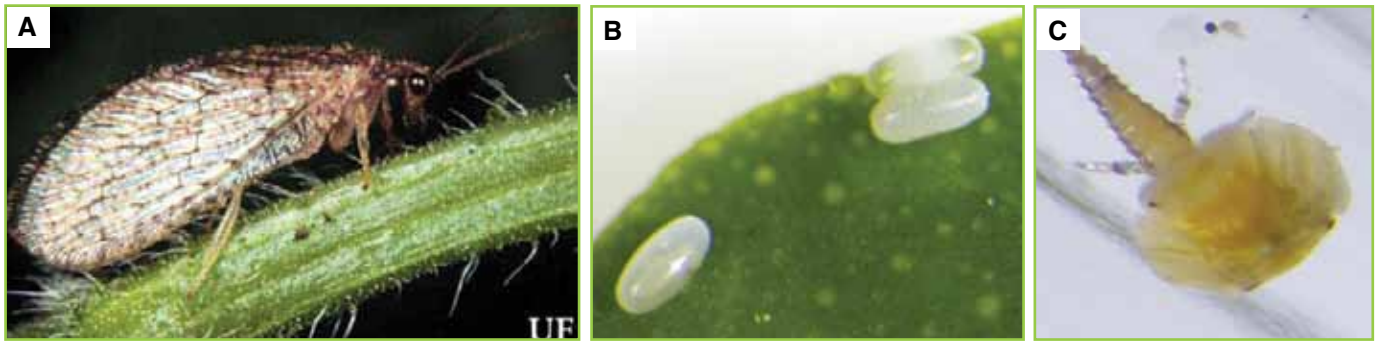

Figure 3. *Adult (A) and eggs (B) of brown lacewing and larvae (C) feeding on ACP nymphs.*
Photo (A) by University of Florida; photos (B) and (C) by A. Khan

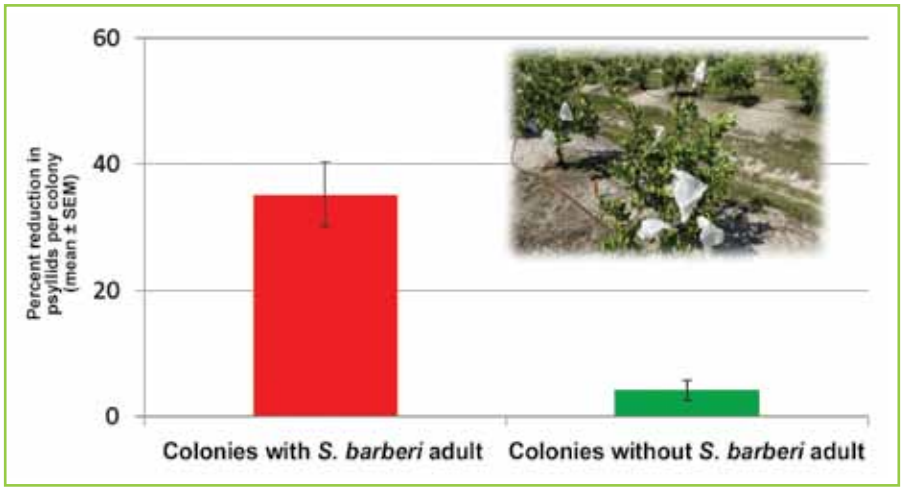

Figure 4. *Reduction of ACP nymphs in the colonies with and without brown lacewing (SEM stands for standard error of the mean).*

was never before tested against ACP. Beetle larvae developed successfully on ACP nymphs as well as on corn leaf aphid *Rhopalosiphum maidis* and frozen eggs of the flour moth *Ephestia kuehniella*, with 93 percent to 100 percent surviving to emerge as adults. Reproduction and egg hatch was as good on ACP as on eggs of *Ephestia*. ACP colonies were reduced by 56 percent when caged with the beetles on citrus in the field (Figure 2, previous page), indicating potential usefulness for control.

BROWN LACEWING *SYMPHEROBIUS BARBERI*

Brown lacewings (Figure 3) have been used as natural enemies of several insect pests in classical biological control. *Sympherobius barberi* is commercially available and reported as an important predator of several insect pests from Asia, Europe and America, but was never tested against ACP. Again, *S. barberi* consumed equal numbers of eggs or nymphs of *D. citri* as *Ephestia* eggs under either light or dark conditions, and both diets were suitable for the development and reproduction of *S. barberi*. Although reproduction was not as great as observed for *A. bipunctata*, we expect it to improve under field conditions where more oviposition sites are available. Also, the lacewings caged with nymphal colonies reduced ACP by 35 percent in the field (Figure 4), indicating they could contribute to ACP control while also helping manage aphids. While costs and benefits have yet to be assessed, these results indicate the potential for augmentation of natural enemies as a tool for ACP management.

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