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AN INTRODUCED INSECT BIOLOGICAL CONTROL AGENT PREYS ON AN INTRODUCED WEED BIOLOGICAL CONTROL AGENT

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Biotic interference, especially by generalist predators, has been implicated in preventing establishment or limiting the impact of introduced weed biological control agents (Goeden & Louda 1976). *Boreioglycaspis melaleuca*e Moore (Homoptera: Psyllidae) was released into Florida in 2002 as part of a classical biological control program targeting the ecological weed *Melaleuca quinquenervia* (Cav.) S. T. Blake ('melaleuca') and is now established and contributing to the suppression of melaleuca (Tipping et al. 2008). The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) was introduced numerous times into the U.S. starting in 1916 as a biological control agent of Homoptera (Gordon 1985). Chapin & Brou (1991) first documented established populations in 1988 in Louisiana and Georgia. It appeared in Florida in the early 1990s where it feeds on soft scales, mealybugs, psyllids, whitefly larvae, and the eggs of Coleoptera and Lepidoptera (Michaud 2002).

In 2007, we observed large populations of *H. axyridis* adults and larvae on melaleuca infested with *B. melaleucae* in our research plots at the USDA-ARS Invasive Plant Research Laboratory (IPRL) in Ft. Lauderdale, Florida (N 26°05' W 80°14'). Although other predacious coccinellids were present including *Brachiacantha decora* Casey, *Coleophora inaequalis* (F.), and *Olla v-nigrum* (Mulsant), *H. axyridis* is considered a dominant intraguild species and has outcompeted many coccinellid species (Pervez & Omkar 2006). Our objective was to determine if *H. axyridis* would attack and sustain itself on *B. melaleucae* under laboratory conditions.

Adult *H. axyridis* were collected from melaleuca growing at IPRL and provisioned with *B. melaleucae* nymphs in the laboratory until they oviposited. Individual egg masses were incubated at 27°C until larval emergence. First instars (n = 27) were confined in individual plastic containers (30 mL) with plastic snap lids along with a single melaleuca leaf containing various numbers of small (instars 1-3) and large (instars 4-5) of *B. melaleucae in situ*. This was done in lieu of transferring exact numbers because the nymphs are extremely delicate and easily injured or killed when handled. We strove to find leaves with similar numbers of small and large psyllids whose numbers we increased steadily as the *H. axyridis* larvae grew. For example, an average of 3 small and 1.5 large nymphs were added daily for first instar *H. axyridis* while fourth instars received 30.5 small and 14 large nymphs daily. Increases in provisioning were guided by the presence of surviving nymphs, which indicated that prey numbers were not limiting. Moisture was supplied with a moistened dental wick placed in the bottom of the container.

Dead or missing nymphs were tallied every 1-3 d and a fresh leaf with their associated nymphs was added. Missing nymphs were assumed to have been consumed. Larval testing ended when *H. axyridis* died or pupated. Adult feeding trials were conducted for 7 d in the same manner with 12 adults that eclosed successfully from the larval feeding trials.

Larvae and adults fed readily on *B. melaleucae* (Table 1). However, the mean (±SE) larval development time was 23.0 ± 0.6 d, which may indicate that the psyllid is not an optimal food source when compared to other prey. For example, *H. axyridis* completed larval development in 11.2 d when fed fresh eggs of *Sitotroga cerealella* (Olivier) (Abdel-Salam & Abdel-Baky 2001), 10.5 d when fed *Myzus persicae* (Sulzer) (Lanzoni et al. 2004), and 9.6 d when fed *Aphis pisum* Harris (Specty et al. 2003).

SUMMARY

Adults and larvae of the generalist predator *H. axyridis* were found in close association with the melaleuca biological control agent *B. melaleucae*

TABLE 1. MEAN (±SE) OF SMALL AND LARGE *BOREIOGLYCASPIS MELALEUCAE* NYMPHS CONSUMED BY LARVAE AND ADULTS OF *HARMONIA AXYRIDIS* IN LABORATORY TESTS.

Variable	*H. axyridis* larvae	*H. axyridis* adults
Total small nymphs	169.1 ± 11.7	168.7 ± 20.4
Total large nymphs	140.7 ± 9.3	90.0 ± 12.8
Total nymphs	309.9 ± 18.6	258.7 ± 30.9
Small nymphs day^{-1}	—	20.3 ± 1.1
Large nymphs day^{-1}	—	10.9 ± 0.7
All nymphs day^{-1}	—	31.3 ± 1.2

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on melaleuca in the field. Larvae and adults readily accepted the psyllid as prey in laboratory studies with larvae consuming an average total of 309.9 nymphs while adults consumed an average of 31.3 nymphs per day. However, *H. axyridis* larval development time was more than twice as long as those reported in other studies that used different prey, indicating that the psyllid may be a lower quality prey item for *H. axyridis*. Field level studies are needed to evaluate any biotic interference by *H. axyridis* with the biological control activities of *B. melaleucae*.

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