Final Report
Hawaii Invasive Species Council
Research and Technology Program
PCSU contract 54005

Project Title: Quarantine testing of an insect for biocontrol of *Miconia calvescens*

HISC Funds: $37,275

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Summary of project
The psyllid *Diclidophlebia lucens* for this project was imported from Costa Rica to the Volcano quarantine facility under USDA-APHIS-PPQ 526 permit #69048 between July and October 2005. A colony has been maintained on small potted *Miconia calvescens* and used for experimental studies of host specificity and susceptibility to natural enemies. The insect colony remains vigorous with no problems from disease or natural enemies over the past 2.5 years. Specificity tests of adult and larval *D. lucens*, completed in December 2007, indicate this insect's host range is restricted to the family Melastomataceae, members of which are all alien in Hawaii. Although *D. lucens* is probably acceptable for release for biocontrol based on this restricted host range, its further development is currently assigned a low priority. Potential impact of this agent on miconia appears limited, and its populations would likely be subject to control by psyllid enemies already present in Hawaii.

Timeline of this project was modified to accommodate hiring and training of quarantine personnel. Write-up of specificity testing and other studies will be incorporated in a manuscript for publication later in 2008. Specific accomplishments of this project through December 2007 are noted below.

Project Goals:
1) Obtain host specificity data for and evaluate the suitability of *Diclidophlebia lucens* for release in Hawaii for biocontrol of *Miconia calvescens*.
Accomplishment: A total of 28 plant species were tested, beginning with many of the naturalized melastomes found in Hawaii and including representatives of other related plant families (Myrtaceae, Lythraceae, Onagraceae, Combretaceae, Thymelaeaceae) and some unrelated species. All tests indicate that host range of this insect is restricted the family Melastomataceae (Figure 1). In particular, expected host range in Hawaii, based on ability of the insect to feed and reproduce under quarantine conditions, includes *Miconia calvescens, Tetrazygia bicolor* and *Heterocentron subtriplinervium*. Other melastomes may serve as hosts, but our tests suggest that their suitability is marginal. No plants outside the melastome

family would be expected to experience damage from this insect. Native and endemic plants appear very unlikely to experience direct adverse effects from *D. lucens*.

2) Carefully screen the colony of *Diclidophlebia* to eliminate parasitic and pathogenic hitch-hikers from Costa Rica.

Accomplishment: We initiated our lab colony with recently deposited eggs imported from a Costa Rican lab colony. Resulting nymphs and adult were transferred to fresh plant material in quarantine. No natural enemies have been encountered attacking eggs or nymphs of this insect in the field in Costa Rica. In particular, eggs held for possible emergence of tiny hymenopteran parasitoids in Costa Rica have yielded no enemies. Our initial shipments of *D. lucens* appeared to be enemy-free, and we are confident that the colony has remained so in Hawaii.

3) Test adult feeding and oviposition preference in choice (*M. calvescens* present) and no-choice (*M. calvescens* absent) situations.

Accomplishment: No-choice tests of feeding and egg-laying by mature adults indicate that the potential host range of this insect is entirely restricted to the melastome family in Hawaii (Figure 1). Since none of these host plants are highly valued in Hawaii (in fact, most are weedy invaders), host preference under choice conditions were not examined. No-choice tests are regarded as highly conservative from the standpoint of screening against possible non-target host use, since they tend to reveal the broadest possible host range, which typically is not realized in actual field settings.

4) Test host specificity of immatures by exposing first instar nymphs to non-target plants under no-choice.

Accomplishment: Testing of first instars proved unfeasible due to the fragility of eggs and young nymphs of this species. Therefore testing was conducted with third instars. Results paralleled those of the adult tests (Figure 1): species most suitable for development of immature *D. lucens* are *Miconia calvescens, Tetrazygia bicolor* and *Heterocentron subtriplinervium.*

5) Replicate all tests a minimum of four times.

Accomplishment: This objective has been met in all tests and appears to be a suitable level of replication.

6) Evaluate the susceptibility of Diclidophlebia to known psyllid enemies in Hawaii (e.g. *Curinus coeruleus, Cryptolaemus montrouzieri*) in quarantine under close confinement in petri dishes, as well as in cages on potted plants.

Accomplishment: Immature and adult *Curinus coeruleus* fed on eggs and nymphs of *D. lucens* in quarantine tests. Lady beetles of this species did not attack adult psyllids, which are more mobile than immature stages. *Curinus coeruleus* are widespread in Hawaii and are considered a primary constraint on outbreaks of the leucaena psyllid (*Heteropsylla cubana*), which severely impacted leucaena (haole koa) prior to *Curinus*. Susceptibility of *D. lucens* to parasitoids in Hawaii has not been evaluated, however its susceptibility to this predatory lady beetle alone could prove a major barrier to biocontrol of miconia by this agent.

7) Summarize data from quarantine tests and combine them with results of biological studies completed in Costa Rica in a petition for release of Diclidophlebia in Hawaii.

8) Incorporate data on host specificity of Diclidophlebia and its susceptibility to natural enemies into a formal petition for release.

9) Submit a formal petition for release to the Hawaii Department of Agriculture and USDA-APHIS within one month of completion of tests in quarantine.

Accomplishment: A formal petition for release of *D. lucens* will not be submitted at this time. Evaluation of current data suggests that *D. lucens* should be assigned a low priority for release because its potential for impact on miconia appears limited, and its populations may be subject to control by psyllid enemies already present in Hawaii. Because other agents under consideration appear to have greater potential impacts on miconia, they will be developed ahead of *D. lucens*. These include a stem boring weevil and several species that attack flowers and fruit.

10) Submit host specificity and other biological data for publication in a peer-reviewed journal such as "Biological Control."

Accomplishment: A manuscript describing host specificity and other biological data for *D. lucens* is in preparation and is expected to be submitted later this year. A description and basic biology of this species was published in 2005:

Burckhardt, D., P. Hanson and L. Madrigal. 2005. *Diclidophlebia lucens*, n. sp. (Hemiptera: Psyllidae) from Costa Rica, a potential control agent of *Miconia calvescens* (Melastomataceae) in Hawaii. Proceedings of the Entomological Society of Washington 107: 741–749.

Figure 1.
Survival and egg-laying of *Diclidophlebia lucens* occurred only on melastomes in no-choice host specificity tests in quarantine. Adult survival and egg-laying was scored after 2 weeks exposure. Survival of nymphs to adulthood was scored within one month of placement of third instars on test plants. On most non-melastomes, adult and immature psyllids died within a few days. Data represent means and standard errors of a minimum of 4 replicate tests.

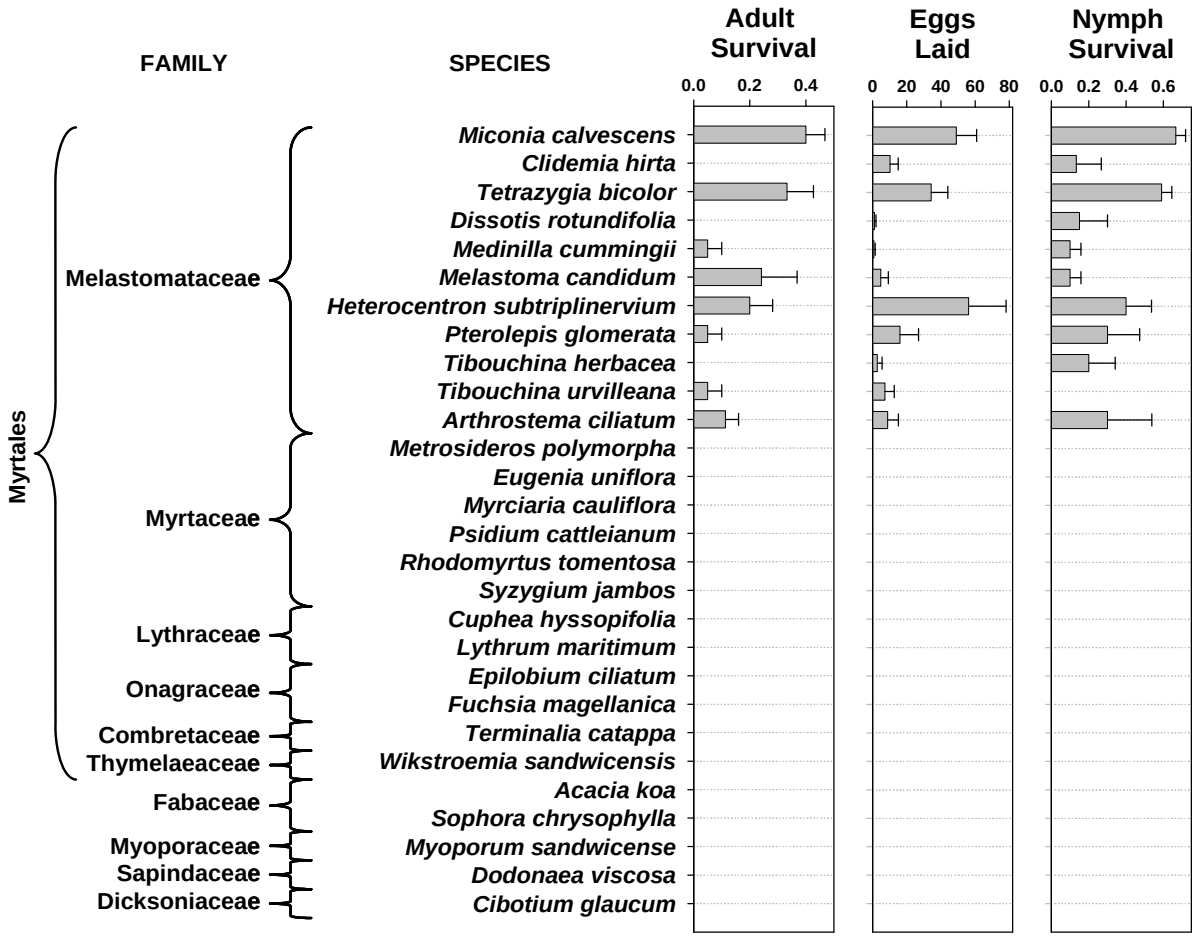

Figure 2. *Diclidophlebia lucens* attains high density of adults (orange) and nymphs (covered by wax filaments) when confined on miconia plants. Attacked shoots are stunted but not killed. (Photos by Kenji Nishida)

Figure 3.
Tests in quarantine of susceptibility of *Diclidophlebia lucens* to *Curinus coeruleus* lady beetles conducted by student intern Brenner Wai.