Final Report FY2018
Hawaii Invasive Species Council
Project Title: Melastome Biocontrol
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Project Overview

Following on surveys for natural enemies in Costa Rica and Brazil in the early 2000s, our biocontrol program has focused on developing selected agents which appear to hold the greatest promise for impacting miconia and other weedy melastomes. Initial studies by teams of students and post-docs in the native range generated a wealth of information on biology, host range and impact of agents on miconia. As resources and knowledge of each species' biology have allowed, agents have been brought to Hawaii for evaluation in quarantine facilities managed by the Forest Service or the Hawaii Department of Agriculture. So far four species have been evaluated in quarantine. Host specificity tests were completed for a miconia psyllid from Costa Rica, but this agent has been placed on hold because others appear to offer greater impact on plant growth. A stem boring weevil, whose ability to kill stems of young miconia was promising, but after extensive testing did not demonstrate a sufficiently narrow host range. We completed testing a butterfly species that appears to hold the most promise among leaf-feeding enemies of miconia. Finally we have been facilitating work at Hawaii Department of Agriculture with logistical support, and Clemson University, through a co-authored USDA grant, to develop a nematode that severely galls *Miconia* species and related melastomes in the native range. Our overall strategy for miconia biocontrol is to develop a suite of agents that attack different parts of the plant, with the goal of damaging miconia in multiple ways to lower its overall fitness.

Another invasive melastome of major importance in Hawaii, *Clidemia hirta*, has been a target of biocontrol efforts since the 1970s, but remains poorly controlled in Hawaiian forests. Our project with Clemson evaluates the shoot galling nematode, *Ditylenchus gallaeformans*, that also attacks miconia. We also are studying of a fruit galling wasp discovered in 2015 in the course of studies of a related wasp (discovered on *Miconia calvescens* in 2007 by a HISC-funded post-doc). In 2017, we successfully reared and began specificity testing with the Clidemia wasp. These little known wasps (*Allorhogas* spp.) open a new opportunity for managing a critical life stage of invasive melastomes – their bird-dispersed seeds.

In 2018 we aimed to conclude evaluation of Allorhogas on *Clidemia hirta*. All testing so far confirms expectations that this insect is narrowly host-specific. Its galling severely deforms each fruit and disrupts normal seed production, with potential to significantly reduce the spread. A similar agent has been under study for miconia, but has been technically challenging to rear

because it requires fruiting trees, which are difficult to grow in quarantine. In contrast, we have been able to rear the clidemia wasp on potted clidemia. Successful rearing and testing of this species is expected to yield important insights that will help with the miconia wasp. We also plan to maintain quarantine populations of a miconia stem weevil, through the last stages of its host specificity testing, as well as the tibouchina flea beetle, pending its release. All of this work is dependent on having sufficient staff to maintain insects and their hosts and test plants in quarantine. Continuing HISC support through 2018 enabled us to pursue multiple ongoing projects.

HISC funds also facilitate continuing development of the nematode gall-former *Ditylenchus gallaeformans*, which has great potential for controlling *Clidemia hirta* within Hawaii's wet forests (it also can attack miconia). Unfortunately progress with this nematode in Hawaii has been delayed due to lack of patholology quarantine facilities at Hawaii DOA. Taking advantage of the ongoing USDA-funded genetic study and nematode rearing at Clemson, we sought HISC support for international travel and facilitation of additional testing of this agent in Brazil and South Carolina.

Accomplishments

2018 was a challenging year on Hawaii Island, with the Kilauea eruption affecting multiple aspects of work and home life. Although we were able to maintain function of the Volcano quarantine facility for the several months of closure of Hawaii Volcanoes National Park, power outages and restricted access took a toll on our insect colonies. After struggling for 3-4 months, we suspended all rearing. Fortunately, most of our studies were brought to a suitable conclusion beforehand, and it will be possible to resume with selected biocontrol agents after they are recollected internationally.

Status of biocontrol agents:

Euselasia chrysippe (Lepidoptera; Riodinidae), gregarious leaf-feeding caterpillar on miconia. Testing of this butterfly was completed a few years ago, demonstrating feeding specificity for miconia and very close relatives. We contributed much of this data in 2018 to a draft environmental assessment for release in Hawaii. After regulatory approval is secured we will return to Costa Rica to collect eggs for quarantine processing and eventual field releases.

Cryptorhynchus melastomae (Coleoptera: Curculionidae), stem boring weevil for miconia. Before we stopped rearing this species, we were able to complete several repetitions of feeding tests on ohia (*Metrosideros polymorpha*) with both adults and newly hatched larvae. Despite abundant evidence that the weevil is a melastome specialist, these later tests demonstrated that feeding on ohia can occur under our laboratory conditions, although not to an extent that would sustain development. The level of damage occurring, however, might possibly generate wounds that could increase the risk of infection by the fungal pathogen causing Rapid Ohia Death. Under current circumstances, it appears that this level of risk to ohia would disqualify this biocontrol agent. We have suspended development of this agent until either circumstances or data suggest that it be revisited.

Syphraea uberabensis (Coleoptera; Chysomelidae), leaf-feeding beetle for *Tibouchina herbacea*, *Pterolepis glomerata*, and *Melastoma* spp.
This agent was being reared for eventual release, having completed all specificity tests. In 2018 we collated test results and other data to support a draft environmental assessment in preparation by DLNR for release in Hawaii. As approval of the EA and release for this species gets closer, we will recollect it from Brazil and return it to quarantine for final processing.

Allorhogas clidemiae (Hymenoptera; Braconidae), fruit-galling wasp on clidemia.
This wasp was formally described in 2018 from specimens our project collected in Brazil. The wasp was successfully reared in quarantine for over one year, but the colony eventually collapsed after a period of imbalance in sex ratio. We conducted well replicated tests in the Volcano quarantine with the two closest relatives of *Clidemia hirta* in Hawaii: neither *Miconia calvescens* nor *Tetrazygia bicolor* were accepted by female wasps for egg-laying. This insect will undoubtedly prove to be highly host specific, but final testing will await recollection and import from Brazil.

Allorhogas granivorus (Hymenoptera; Braconidae), fruit-galling wasp on miconia.
This species also is newly described from specimens we collected in Brazil. Our collaborator at Universidade Regional Blumenau has been able to propagate this species in Brazil on field planted miconia away from its natural habitat, which is encouraging for our prospect of doing the same in quarantine. In Hawaii we have continued to grow mature potted miconia which we'll use when we next import this wasp. Based on results with its clidemia-feeding relative, successful development of this future biocontrol agent for miconia is highly encouraging.

Ditylenchus gallaeformans (Tylenchida: Anguinidae), gall forming nematode on clidemia and miconia.
Captive rearing of this nematode has been an elusive goal. Despite successful efforts some years ago at artificially transferring and inducing robust galls in Costa Rica and Brazil, more recent efforts in Brazil, South Carolina and Trinidad have been disappointing, with only minor gall induction after repeated efforts. Despite these setbacks our collaborators have made some progress with genetic analysis of the nematode and important observations on host range. All evidence indicates that this agent will prove highly specific. Future rearing and testing will be conducted under the cool wet environmental conditions where the nematode thrives in its native range.