

Albizia biological control project overview - FY2018

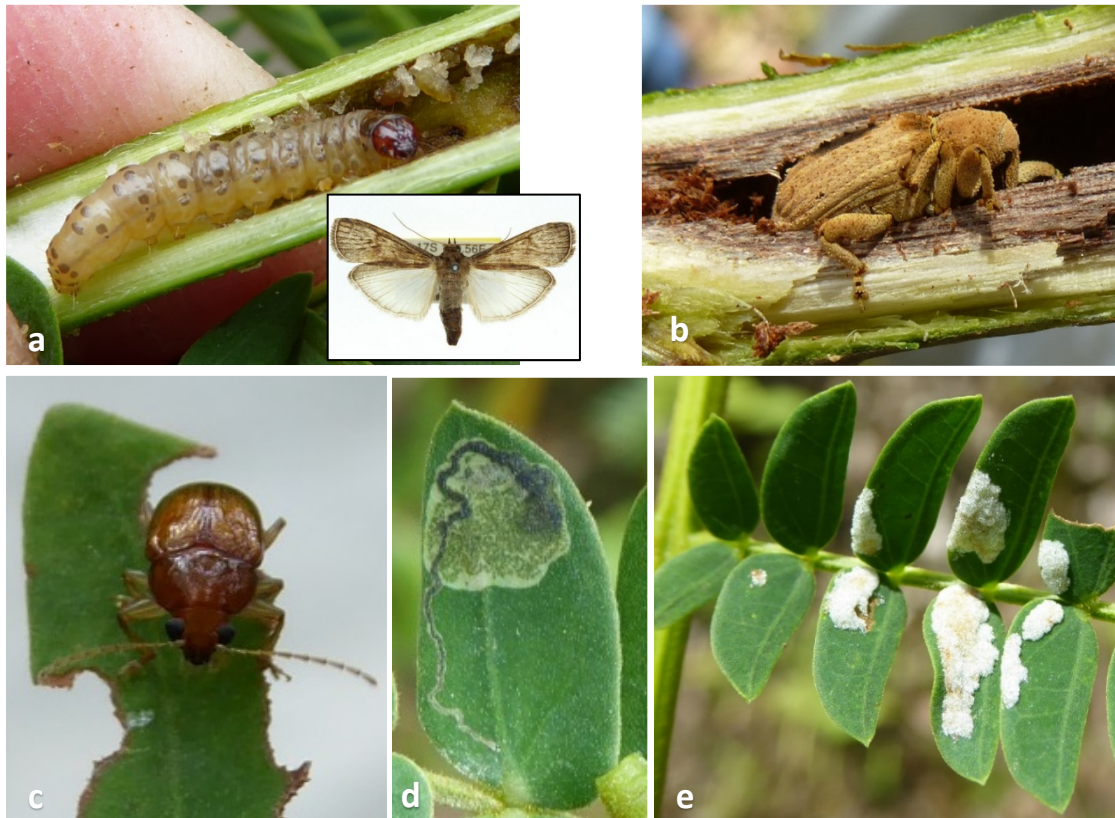
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Albizia (*Falcataria moluccana*) is one of the most economically menacing and environmentally destructive tree species to be introduced to Hawaii and several other Pacific Island nations. Despite several million dollars expended annually on mechanical and chemical control, invasions across Hawaii and the Pacific are already so widespread that long term management will depend on biological control using host-specific natural enemies. Albizia biocontrol has been prioritized by the interagency Hawaii Invasive Species Council and been supported by the US Forest Service, USFS – International Programs Office and the State of Hawaii.

One of the most exciting recent developments in our project has been the start of the molecular DNA analysis of *Falcataria moluccana*. IPIF technician Nancy Chaney began working with Dr. Jessica Wright, US Forest Service - PSW Davis and their colleagues at the University of California – Davis for two weeks in November & December 2017 on the initial analysis of plant samples from over 200 sites. During the very short time working together 148 samples of DNA representing 130 populations were extracted and 93 of these samples produced PCR product suitable for sequencing. Our goal is to compare the sequences of trees collected in Hawaii with those from the native range in Indonesia, East Timor and Papua New Guinea. This is an essential step for modern biological control programs because finding the source of the invasive population allows us to find the location of the most highly coevolved natural enemies to select as future biological control agents. The plant and insect collection surveys of the native range were sponsored in part by FS-IP along with the Hawaii Invasive Species Council. Additional plant material was submitted by our Pacific Island Nation partners to help us determine where their invasive populations of *Falcataria* came from as well. Sharing our knowledge of the plant's origin and spread across the Pacific will allow us to better serve Hawaii and other Pacific Islands with the safest and most effective biological control agents for the management of this invasive menace.

In 2017, Dr. Puliafico and our US Forest Service albizia biological control project collaborators and volunteers conducted three exploratory surveys for new potential biocontrol agents. USFS – International Programs sponsored two trips to eastern Indonesian's Maluku, Papua and West Papua provinces, and a brief visit to East Timor, while Hawaii State funds were used to explore Papua New Guinea's Bismarck Archipelago. The results of these surveys have allowed us to identify and prioritize potential biological control insect and mites as candidate agents for future host specificity and herbivore efficacy studies.

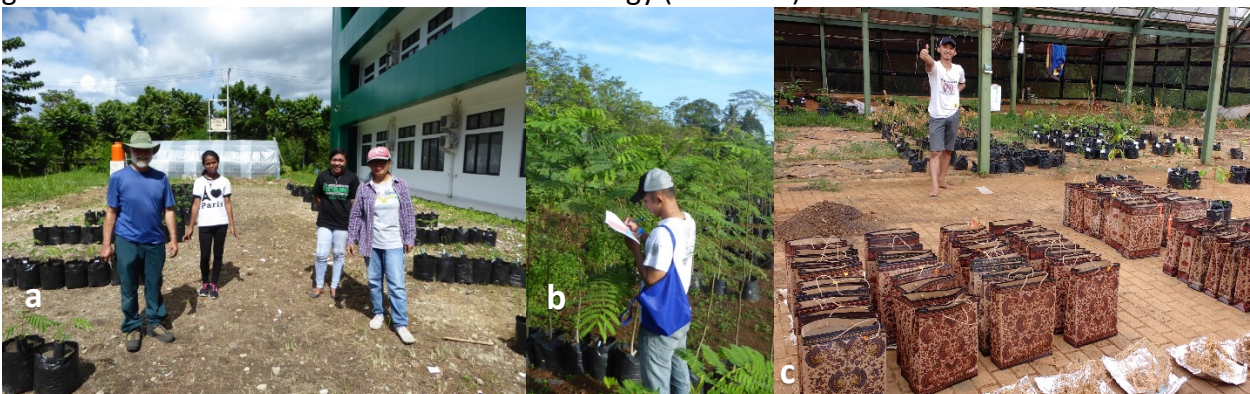


The five arthropod species prioritized for further study include (a) shoot mining moth caterpillars (inset: adult moth), (b) stem boring weevils, (c) leaf feeding flea beetles, (d), leaf blotch miner flies, and (e) gall forming eriophyid mites. These enemies belong to taxonomic groups that tend to be highly specific in their feeding behavior, and therefore more likely to pass upcoming screening to determine risk to nontarget plants.



Surveying albizia trees with researchers and students from (a) Universitas Pattimura, Ambon, Maluku, Indonesia, (b) Universitas Papua, Manokwari, West Papua, Indonesia, and (c) Warea Orapa (PNG – National Agriculture Quarantine Inspection Agency) and Tiberius Jimbo (PNG Forest Research Institute) and staff.

Two experiments investigating the insect community colonizing young albizia trees were completed in the native range and near agroforestry plantations in West Java in 2017. Master's degree students from Bogor Agricultural University (IPB) and Universitas Pattimura (Ambon, Maluku) grew plants in a large experimental arrays and monitored the herbivorous insects feeding on albizia every two weeks. Almost 100 insect species were recorded from these saplings, with marked differences between the two ranges. Yendra Setyawan, whose Master's degree project focused on these experiments, was the first student associated with this albizia biological control project to graduate in mid-September from the IPB Department of Plant Protection under the supervision of Dr. Purnama Hidayat. His paper and poster "Herbivorous insects associated with albizia (*Falcataria moluccana*) saplings in Bogor" presented in August 2017 won the first prize for student posters at the 2nd International Conference on Biosciences (ICoBio 2017). He also is first author on the scientific publication "Diversity and abundance of insect herbivores on Hawaiian and Indonesian albizia, *Falcataria moluccana*, in a Java common garden" for the Journal of Asia-Pacific Entomology (in review).



Insect colonization experiments involved (a) planting seedlings in polybags (Rick Warshauer - US Forest Service Volunteer, Dr. Audrey Leatemia and staff at Universitas Pattimura), (b) observing insect species and abundance every two weeks (Yendra Setyawan, Master's student at IPB), and (c) harvesting trees to determine insect herbivore impacts on tree biomass (Mr. Setyawan, IPB).



Falcataria Gall Rust forms on (a) seed pods, (b) leaves, and (c) tree stems.

Among the early biological control candidates is a gall rust fungus, *Uromycladium falcatarium*, which galls new growth and is a major problem for albizia plantations in the Philippines and Indonesia. Relatives of this fungus have been successfully used for biological control of invasive acacia species in South Africa. Dr. Sri Rahayu at the Forestry Department, Universitas Gadjah Mada (UGM) in Yogyakarta tested albizia from Indonesia and Hawaii along with several related tree species with spores of this fungus in a number of experimental settings. Early evaluations of this fungus suggest careful screening of different genetic strains will be necessary to avoid possible impacts on *Acacia koa* and other native Hawaiian plants that are related to albizia.

Future work

Trips to Indonesia are planned to continue and expand on the experimental work started with Universitas Gadjah Mada and Bogor Agricultural University. Testing of the five new candidate biological control species identified from our surveys will begin with collaborators in Indonesia. Graduate students are being recruited to develop methods for rearing and testing these candidates. When export permits have been secured, the most promising insects will be brought to the US Forest Service Insect Containment laboratory in Hawaii for further evaluation. Additional surveys to find the insects that specialize on feeding on the flowers, fruit and seeds of albizia will be emphasized. We will also continue to look for new strains of the Falcataria gall rust fungus in albizia's native range in a new joint project with plant pathologists from Universitas Gadjah Mada and Universitas Pattimura. In addition, we will begin examining the leaf samples of albizia taken from each field site using molecular techniques to identify the populations in the native range with the same genetic profiles as our trees in Hawaii, in order to focus further research to the most appropriate sites within the native range. Our Indonesian and PNG collaborators will continue to be essential for the development of a successful biological control program for Hawaii's invasive albizia trees.