

Proposal Title: Biocontrol of albizia

Content area: Research

Project Period: March 1 2024 – May 31 2025

Applicant:

Tracy Johnson (tracy.johnson@usda.gov) and Ellyn Bitume (ellyn.bitume@usda.gov), Institute of Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service. PO Box 236, Volcano, HI 96785; Ph. 808-967-7122

Partners:

Bogor Agricultural University (IPB), Department of Plant Protection, Bogor, West Java, Indonesia: Entomologist Dr. Purnama Hidayat and students.

Pattimura University, Department of Forestry, Ambon, Indonesia: Dr. Audrey Leatemala and students

Manaaki Whenua - Landcare Research, New Zealand: Dr. Quentin Paynter, Dr. Lynley Hayes, and others

Total Request: \$144,000

Executive Summary: (670/800 characters)

Biocontrol is needed for long term management of albizia, which destroys native landscapes and costs Hawaii businesses and taxpayers millions of dollars in damage and maintenance. Current studies are focused study on three natural enemies from the center of albizia's native range. With Indonesian and New Zealand partners we will continue evaluations of a rust fungus gall-former, a stem-boring weevil and leaf-galling eriophyid mite. Pending permits for international shipment, we plan to begin rearing and testing the weevil in Hawaii, while Landcare tests the fungus and mite. In 2024 we plan to search in Indonesia for new enemies attacking reproduction of albizia.

Project Deliverables:

FY23 Deliverables achieved

- Compare albizia genetics across native and invasive range
- Landcare received rust fungus for screening against Hawaiian plants
- Publications on biology of stem-boring weevil with Indonesian student

Project Overview: (4599/5000 characters)

Albizia (Falcataria moluccana) invasions in Hawaii are unparalleled in their impacts on island ecosystems and the lives and livelihoods of citizens. Costs can be very high: HDOT spent \$1 million per mile for albizia removal from a roadside in 2010; HELCO reported \$13.7 million in damage due to falling albizia trees during hurricane Iselle in 2014. Hawaii

County listed "Power and communication network vulnerabilities in windstorms with wind borne debris and treefalls" as its top unmet hazard mitigation need. Albizia biocontrol could result in future savings of hundreds of millions of dollars to Hawaii businesses and taxpayers, avoiding damage and maintenance costs from continual encroachment of enormous trees near utilities, roads, homes, and workplaces.

Ongoing mechanical and chemical control provides short term solutions for incipient infestations and high-hazard zones such as roadways, but invasions statewide are already so widespread that long term management will depend on biocontrol using host-specific natural enemies. With start-up funding from the USFS and HISC, we conducted exploratory surveys across the major areas of albizia's native range in eastern Indonesia and Papua New Guinea, where it is found with a rich variety of natural enemies. Since 2020 we have supported Indonesian researchers performing studies of potential biocontrol agents. Based on their expected effectiveness and suitability for release in Hawaii, we prioritized evaluation of gall forming eriophyid mites and a stem boring weevil. In 2022 we began collaborating with Landcare Research (New Zealand) to utilize their expertise and facilities suitable for pathogens and mites. Landcare has recently started culturing a rust fungus known to be severely damaging to albizia, with plans to test its specificity using plants we have provided from Hawaii.

Our methods follow internationally accepted principles in weed biocontrol (Balciunas and Coombs 2004). A full program typically requires several years to discover, evaluate, deploy, and monitor biocontrol agents. The early discovery phase has now shifted to evaluation of the first candidate agents. While travel to the native range is an essential component of biocontrol, COVID19 has constrained international travel in recent years. The collaborative framework we have established with Indonesian partners has allowed us to continue study of priority agents, with the eventual goal of export to quarantine in Hawaii. New Zealand biocontrol researchers secured independent funding and joined the albizia project in 2021 to support other Pacific Islands where the tree is invasive. Our continuing effort will include the following activities:

- 1) Host specificity and efficacy tests of the rust fungus and eriophyid mite in New Zealand with help from collaborators in PNG. Given the current lack of facilities in Hawaii suitable for testing pathogens and microscopic arthropods, we will work with colleagues at Landcare Research to evaluate genetics and host range of the rust and gall-forming mites. We send seeds of potential host plants in Hawaii to Landcare to support this research. We will also conduct field tests with the mites in Indonesia to better understand their biology, host range and impacts.
- 2) Refine methods for rearing the stem-boring weevil. In Indonesia we have supported a master's student at IPB University and technicians at Pattimura University to document biology of the weevil. Continuing efforts will develop information on mating and egg-laying of the weevil in its native habitat and under controlled conditions, to allow rearing through its full life cycle. Once we secure permits for export from Indonesia and import to quarantine, live weevils will be brought to Hawaii for further evaluation of host specificity.
- 3) Utilize next-generation sequencing to locate the geographic origin of albizia trees in Hawaii and other Pacific Islands. Population genetic data repeatedly has been

shown to be useful in developing successful weed biocontrol, because natural enemies may be so specialized that they are less adapted to, and less effective against, certain host plant genotypes. This work in collaboration with the University of Minnesota Genomics Center is approaching completion.

- 4) Additional prospective agents may await discovery in the native range. We will focus new searches in Indonesia on natural enemies associated with flowers and seed pods, working with our university collaborators to use drones to survey the canopy for feeding damage and deformities that would indicate the presence of galling insects.

Budget Request:

Budget Category	Item	HISC Funds Requested
Salaries & Fringe	1 FTE Postdoc, 12 months	100,000
Equipment & Supplies	Quarantine facility, plant nursery, collecting supplies	1000
Contractual Services	Genetic analysis of albizia	
	Insect identifications	1000
	Indonesia collaborators	28,000
Travel	2 trips by post-doc to native range (Indonesia)	14,000
Utilities		
Other		
Overhead	USDA Forest Service (20% in-house waived)	0
	Total Requested	144,000

Existing or anticipated funds and sources (including in-kind services):

Source of Funds	Existing or Anticipated?	Match Required?	Amount
USDA Forest Service (15%FTE of PI Johnson)	Existing	no	30,000
USDA Forest Service quarantine maintenance and other overhead	existing	no	30,000
SPREP to Landcare Research (NZ)	existing	no	100,000
USDA Forest Service (international travel by PI Johnson)	Anticipated	yes	6000

Priority 4 - Increasing Pacific Regional Biocontrol Research and Capacity

Justification:

Supports discovery, evaluation and testing of new biocontrol agents for albizia in Hawaii and other Pacific Islands.

FY24 Deliverables

- 1) Host specificity of rust fungus and gall mite (New Zealand quarantine, Indonesia field tests)
- 2) Methods for rearing and testing stem weevil
- 3) Survey of enemies attacking flowers and seed pods