

TITLE: Monitoring the incidence, spread, and impact of koa wilt (*Fusarium spp.*) of *Acacia koa* and ohia rust (*Puccinia psidii*) on *Metrosideros polymorpha* in Hawaii

LOCATION: The four major Hawaiian Islands (Hawaii, Kauai, Oahu, Maui)

DURATION: Year 1 of 3-year project

FUNDING SOURCE: Base Plan

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PROJECT OBJECTIVES.1) Systematically survey native forests and plantation stands containing *Acacia koa* to determine distribution of decline/wilt disease. This expanded survey would supplement a preliminary survey that was completed during 2005, where more than 900 *Fusarium* isolates were collected and identified. By utilizing fixed plots, progressive quantification of undesirable changes in forest health would be possible.

2) Establish long-term monitoring plots within selected stands to establish baseline levels of existing koa wilt, evaluate disease distribution, rates of spread, symptom progression and rate of tree mortality. Monitoring plots will be selected in conjunction with a planned aerial survey. This will help target areas of greatest concern.

3) Collect data and establish long-term monitoring plots to examine the incidence of ohia rust on ohia seedlings, saplings and trees, as well as provide initial information on current and potential impacts of this newly introduced, non-native disease throughout Hawaii.

JUSTIFICATION: This project seeks to address three of the primary emphases of the Base EM program:

Tree mortality and poor crown conditions. Our 2004-5 survey sampled over 300 diseased trees, across about 12,000 acres on the four main Hawaiian Islands. Koa

mortality, crown dieback, and wilt symptoms will be quantified as the fixed plots are established.

Insects and diseases. We have identified several apparently aggressive pathogenic isolates of *Fusarium oxysporum* f.sp. *koae*, the putative cause of koa decline/wilt disease.

Linkage to FHM Detection Monitoring. Decline of *Acacia koa* in Hawaiian forest ecosystems was first reported several years ago by our observations and by others rather than from an FHM Detection Monitoring program.

Significance of geographic scale. Surveys have indicated that this disease is commonly found on the four main Hawaiian Islands (Hawaii, Oahu, Kauai, Maui), occurring in natural forests, plantations, and nurseries.

Biological/political impact of the issue. Natural range of *Acacia koa* in Hawaii, considered the second most common tree species in Hawaiian forests, has been greatly reduced due to logging and land clearing for agricultural production and cattle pastures. Due to recent large reductions in plantation agriculture and ranching on several islands, much land is currently available for koa restoration or commercial reforestation. Due to the high value of koa wood (currently ranges from \$10-65/board foot) and importance of koa as a key component of the native forest, there is extensive interest from both private landowners and public land managers to re-establish koa on many underutilized lands. However, the major limiting factor to re-establishment of koa is the decline/wilt disease that adversely affects tree survival and growth. Because of this disease, koa plantings are currently discouraged in certain areas. Increased koa production will occur if seedlings from disease-resistant families become available or if more information is learned on what sites are likely to be low hazard for koa wilt.

Forest workers and land owners believe disease severity and geographical distribution of diseased trees have recently greatly increased. Although factors contributing to increased disease severity are unknown, recent changes in historical precipitation patterns may be important. Stress caused by altered precipitation and the occurrence of koa on many fragile soils with limited nutrient availability may have exacerbated the disease situation. In any event, existing koa tree mortality is much higher than has historically occurred in many areas. Our recent survey confirmed that koa decline/wilt has spread to higher elevations sites previously unaffected.

Ohia trees constitute approximately 75% of native Hawaii forests and provides important habitat for Hawaii's endemic birds. *Puccinia psidii* was introduced into Hawaii in 2005; the pathogen is not native and poses a significant threat to Hawaii's forests and biodiversity. In addition to Ohia, its hosts include, guava (*Psidium guajava*), rose apple (*Syzygium jambos*), the native and endangered *Eugenia koolauensis*, and other many other members of the Myrtaceae family. The potential for rapid spread is significant and its impacts are hard to predict but could be devastating.

Feasibility of project completion. In 2005, our team completed a preliminary state-wide koa wilt survey. As a part of the survey, more than 900 *Fusarium* isolates were obtained from diseased trees, seedlings and koa seeds. Pathogenic isolates of *F. oxysporum* have been identified from seedling inoculation trials. Several reports and publications from this work have been produced. Our approaches to evaluating and monitoring this disease should provide necessary disease impact information within projected time periods.

DESCRIPTION:

Background. This project will quantify disease occurrence and severity in koa /ohia forests on the four major Hawaiian Islands (Hawaii, Oahu, Kauai, Maui). Monitoring disease progression in different areas will be used to develop hazard rating systems that can be helpful to predict future disease impacts. A separate project involving periodic monitoring of nurseries which produce and distribute koa seedlings is on-going with State of Hawaii and matching funds from the Hawaii Agriculture Research Center to determine if the disease is being spread throughout Hawaii on infested nursery stock.

Preliminary surveys have located forest stands with high disease potential (i.e. symptoms suggesting koa wilt) which need further analyses to determine current disease impacts and future disease progression. These primarily roadside surveys of diseased *Acacia koa* and sampling for associated pathogens began in June, 2004. To date approximately 300 diseased trees have been sampled, across about 12,000 acres on the four main Hawaiian Islands. Sampling has so far resulted in a collection of more than 900 isolates, representing 15 fungal taxa within the genus *Fusarium*. These preliminary surveys will serve as the basis for locating and evaluating diseased stands as proposed in this project.

Methods. Systematic surveys using standard forest health monitoring protocols to estimate percentage of koa trees displaying disease symptoms will be conducted along elevational gradients within selected forest areas. Disease incidence and severity will be incorporated into a GIS database which can be used for future reference. Long-term monitoring plots will be established across a range of sites with varying hazard levels for future disease occurrence. Plots will include maps of existing koa trees and seedlings; growth data will be periodically added. Selected photo points will also be established and disease symptom progression monitored over time via digital photographs. A numerical disease severity rating system based on levels of above-ground symptoms will be developed. Plots will be monitored for disease progression annually for at least three years. Isolation of putative pathogens (particularly *Fusarium oxysporum* f.sp. *koae*) will confirm disease etiology in all surveyed stands and monitoring plots.

In addition to surveying koa, we will survey for a recently introduced rust disease (*Puccinia psidii*) which is attacking ohia (*Metrosideros polymorpha*), an ecologically important tree that is often co-dominant with koa. When ohia trees and seedlings are present in plots they will be surveyed for rust presence and impact using a damage index being developed in parallel Evaluation Monitoring project "Incidence and Evaluation of a New Rust Disease on Myrtaeaceae in Hawaii." This plot-based data will complement the

on-going survey that focuses on the environmental and host range of the rust, and it will provide an important baseline from which we can monitor damage over time.

Products. The major products will be establishment of the monitoring plots and disease monitoring reports to interested forest managers and landowners, disease severity summaries to government agencies and legislative representatives, and a preliminary disease hazard rating system. Results will be summarized in annual progress reports, a final comprehensive report, and presentations to landowner and professional groups, including the FHM Working Group.

Schedule of Activities:

Activity	Spring/ Summer 2007	Fall/ Winter 2007	Spring/ Summer 2008	Fall/ Winter 2008	Spring/ Summer 2009	Fall/ Winter 2009
Conduct Systematic Surveys	X		X		X	
Establish and Monitor Plots	X					
Analyze Data		X		X		X
Annual Progress Reports		X		X		X

Progress/Accomplishments: Annual progress reports will be prepared and a final summary report prepared at the end of the project.

COSTS:

	Item	Requested FHM EM Funding	Other- Source Funding	Source
YEAR: FY 2007				
Administration	Salary	20,000	17,500	HARC*
	Overhead	0	4,000	HARC*
	Travel	4,000	5,000	HARC*
Procurements	Contracting	3,500	4,000	HARC*
	Equipment	2,500	2,500	HARC*
	Supplies	2,000	2,000	HARC*
Total		32,000	36,000	

* Hawaii Agriculture Research Center

Costs of about \$25,000 anticipated for FY 2008 and FY 2009.