



# **The Maui *Koa* Network: Deploying Wilt Resistance *Koa* for Watershed Restoration**

NS Dudley, Hawaii Agriculture Research Center





## **Koa (*Acacia koa* Gray)**

### **Endemic Hawaiian Keystone Species**

**Most important endemic Hawaiian tree species from  
an economic, ecological, and cultural perspective**

***Acacia koa* is an autotetraploid and *Acacia melanoxylon*  
is progenitor (*A. melanoxylon* not native to Hawaii)**



## **Ecological Importance of Koa**

- **Provides habitat to many native bird and insect species**
- **Most important native nitrogen fixing tree species**
- **Important role in watershed health**
- **Dominant tree species in many native ecosystems**





## **Cultural Importance of Koa**

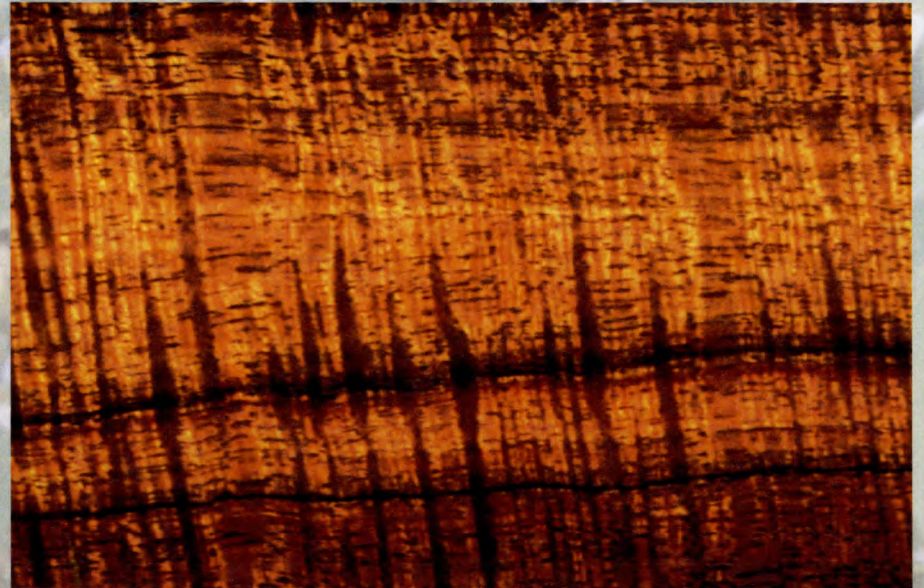
- **Native Hawaiian's primary wood for canoes**
- **Tannins from bark used as red dye for kapa cloth**
- **Integral part of many Hawaiian ceremonies**





# Economic Importance of Koa

- Koa represents 90% of the Hawaiian Forest Products Industry
- Valued at \$30 million dollars annually
- Harvested primarily from native forests
- Koa is the preferred wood of the Hawaiian Specialty Hardwood Market
- Koa is one of the most valuable woods in the world, with prices exceeding \$125 per board foot



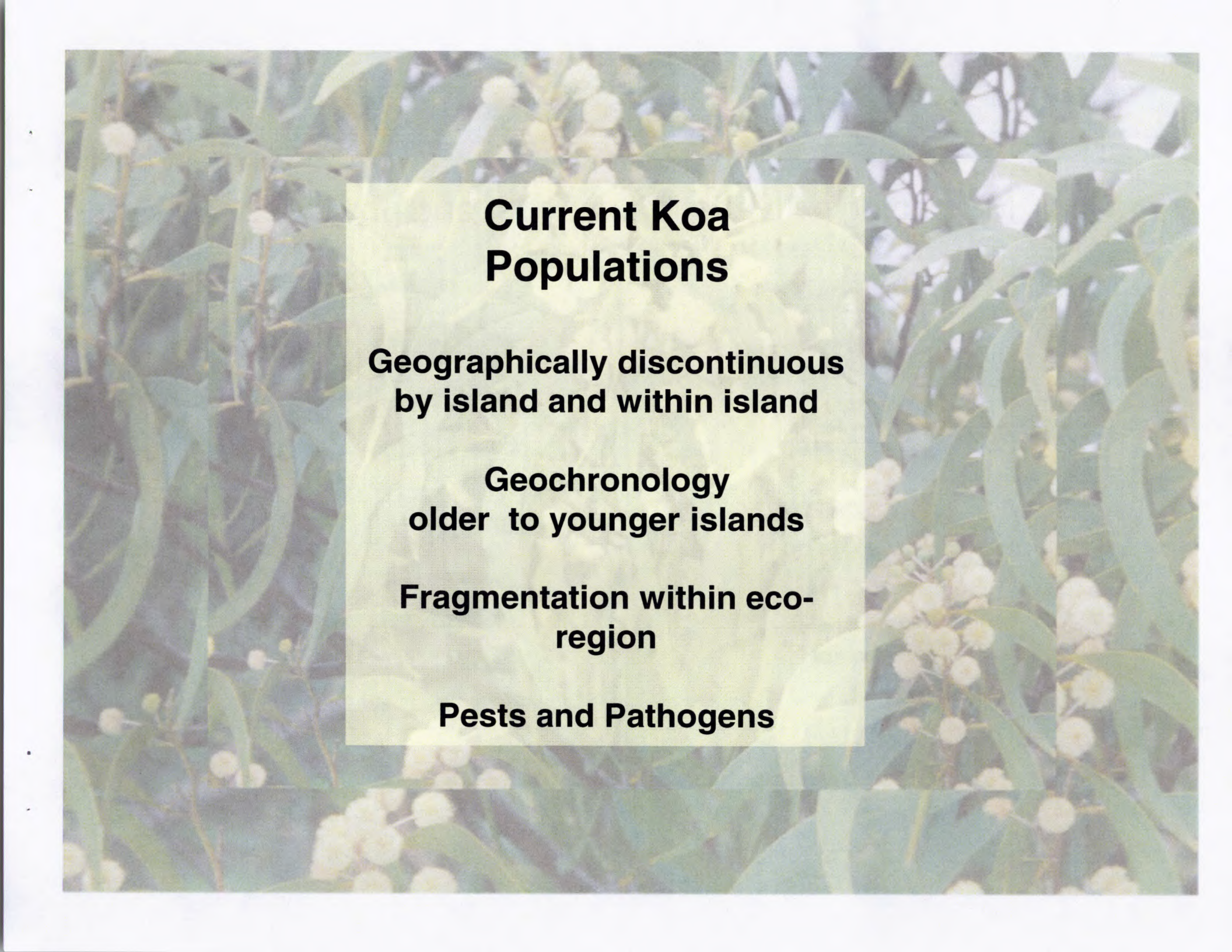




## **Koa Restoration and Reforestation**

- **Owing to high ecological, economic and cultural value there is strong interest in koa genetic conservation**
- **Reforestation / Restoration is severely impeded by koa wilt disease**
- **HARC, in collaboration with the US Forest Service, developed a program to select and conserve koa populations with Genetic Resistance to the disease**
- **High quality stocks of eco-regional koa seed**





## **Current Koa Populations**

**Geographically discontinuous  
by island and within island**

**Geochronology  
older to younger islands**

**Fragmentation within eco-  
region**

**Pests and Pathogens**



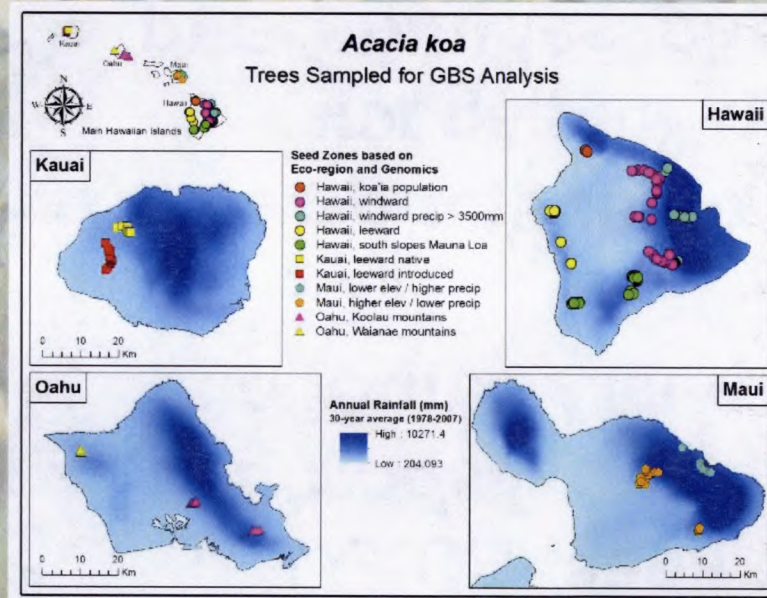
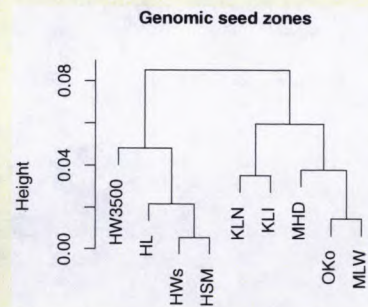
## Morphological variation in pods, and phyllodes





# Preliminary Seed Zones based on Eco-region and Genomics

- Modified with GBS





# The Problem: Koa Wilt Disease

High mortality of koa seedlings, saplings, and crown dieback in older stands

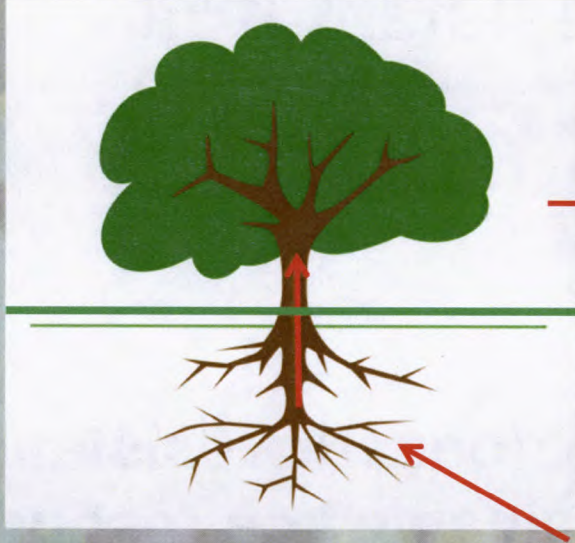
The primary pathogen:  
*Fusarium oxysporum* f.  
sp. *koa* (FOXY)  
Causes vascular wilt disease



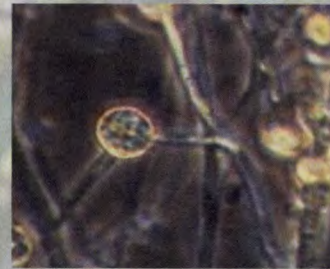


# Life cycle of *Fusarium oxysporum*

Macro and micro conidia



Chlamydospores produced in dead material



Chlamydospores





**The Solution:**

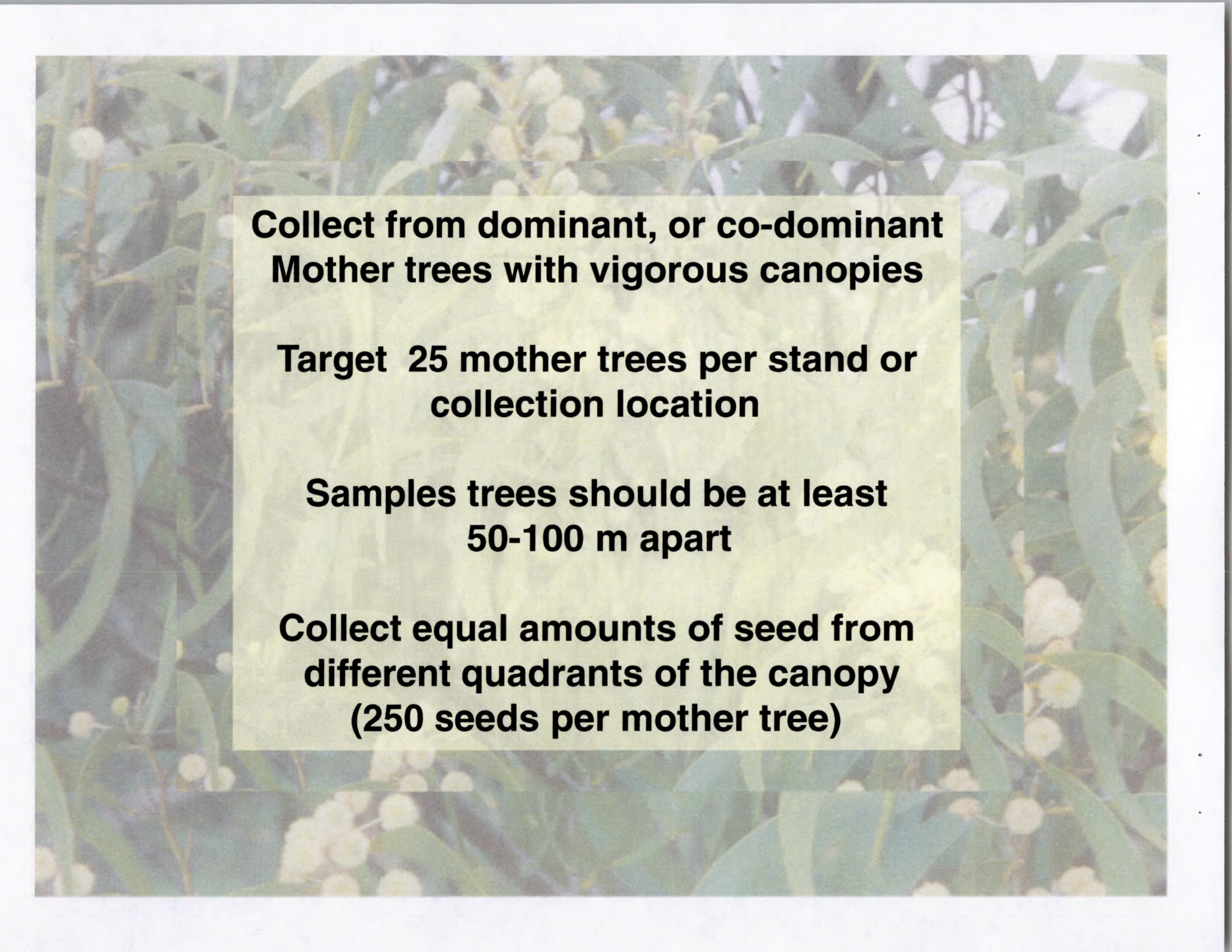
**Plant Wilt Resistant Koa**

**Land managers now have a tool (genetic resistance) to  
use for restoration and sustainable koa resource  
development  
to  
Ensure healthy koa forests and biosecurity**









**Collect from dominant, or co-dominant  
Mother trees with vigorous canopies**

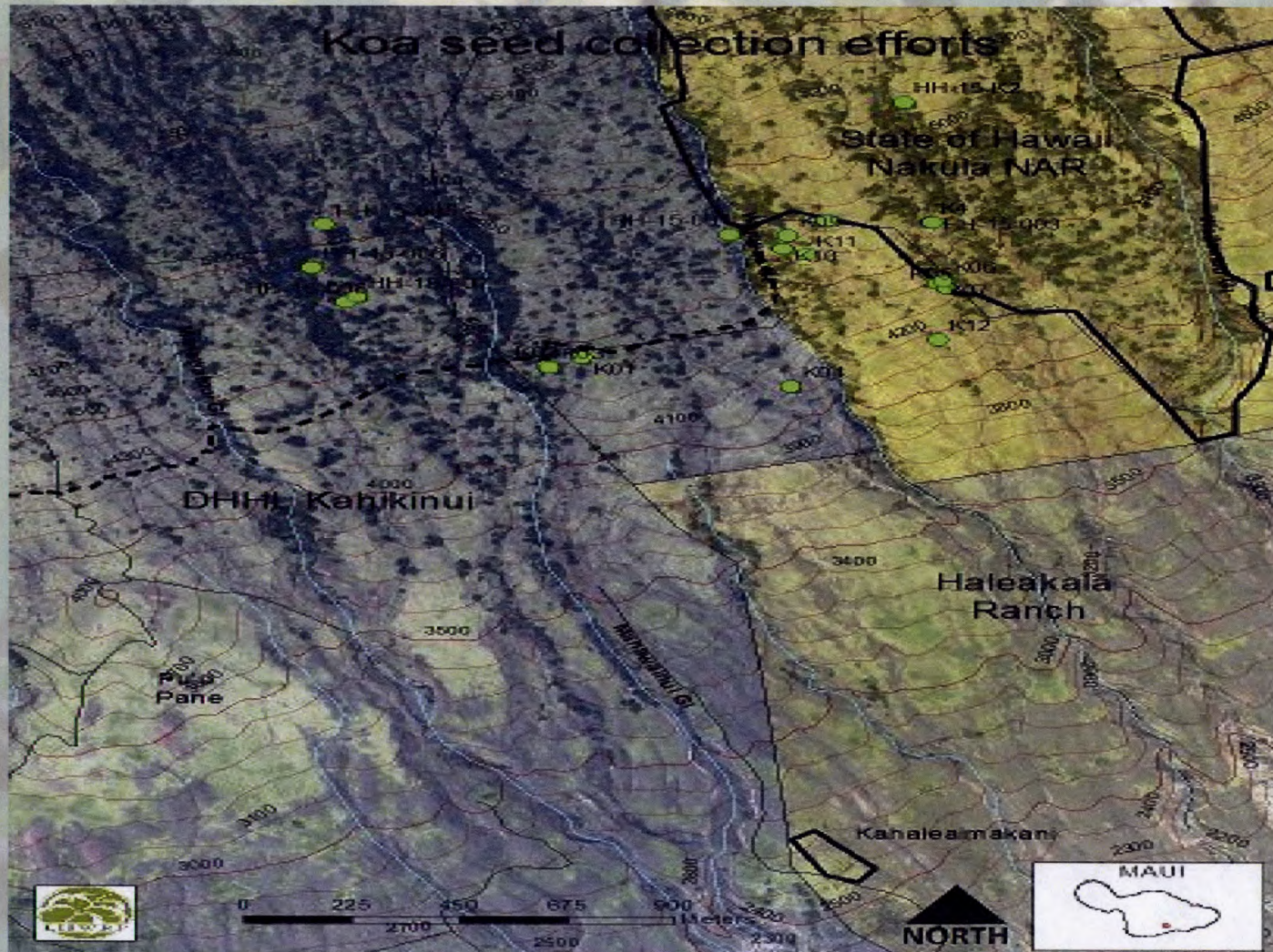
**Target 25 mother trees per stand or  
collection location**

**Samples trees should be at least  
50-100 m apart**

**Collect equal amounts of seed from  
different quadrants of the canopy  
(250 seeds per mother tree)**



# Recent Koa Seed Collection



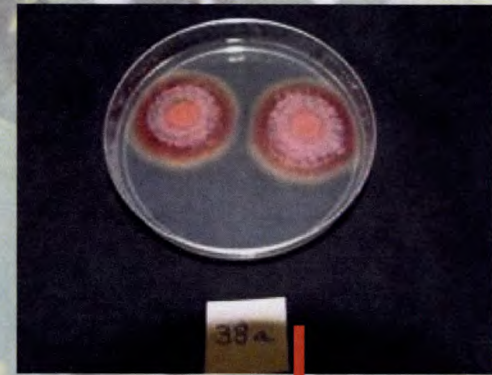






# Screening for wilt resistance: materials & methods

- Inoculum 'powder' mixed with peat moss & perlite medium
- Medium mixed placed into 'dibble tubes'
- Germinating seedlings transplanted to containers containing inoculum











165007  
NONALLO  
VALLEY  
T-24

T-24

Koa wilt 2007-03 trial - August 2007



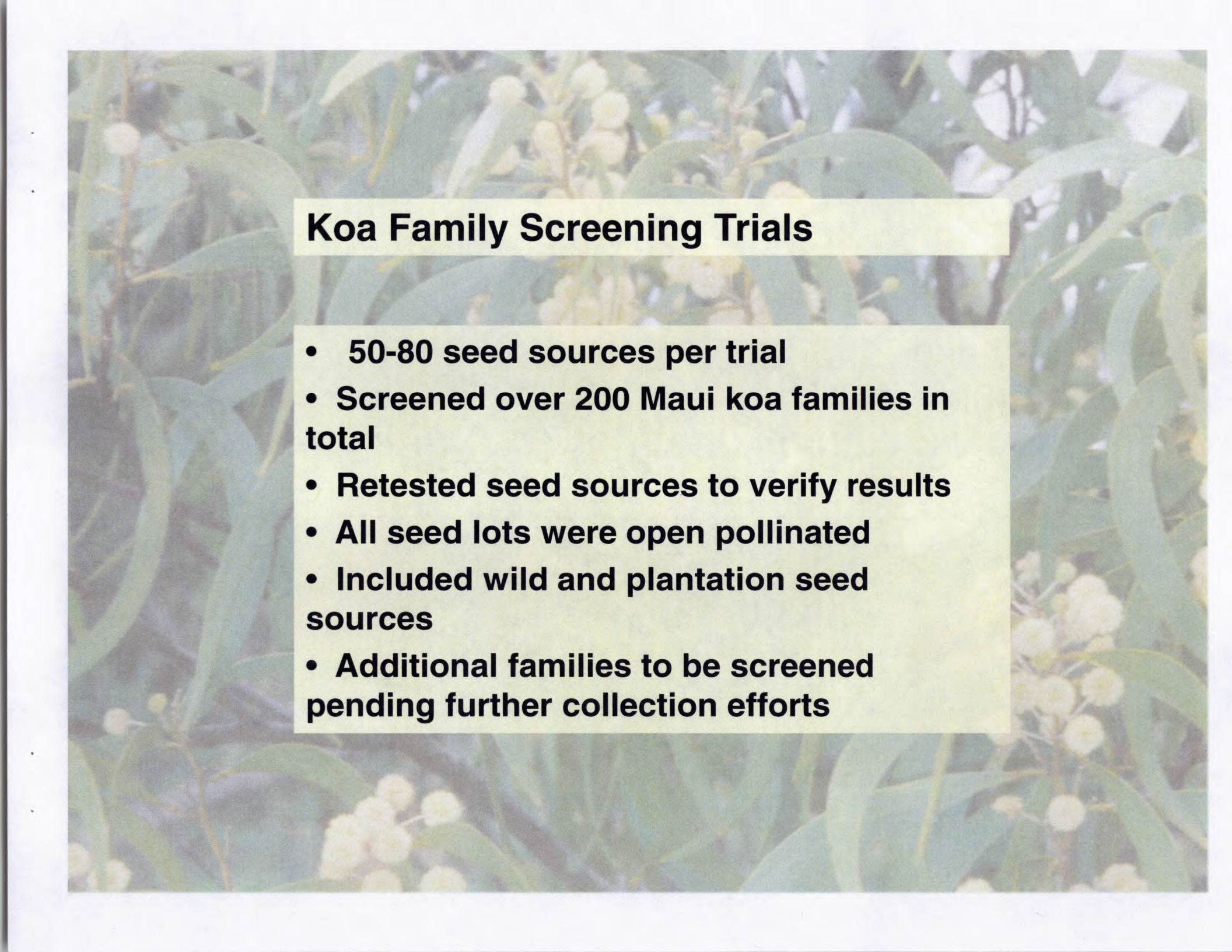


16/10/07  
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WAVES 1

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Koa wilt 2007-03 trial – August 2007





## **Koa Family Screening Trials**

- **50-80 seed sources per trial**
- **Screened over 200 Maui koa families in total**
- **Retested seed sources to verify results**
- **All seed lots were open pollinated**
- **Included wild and plantation seed sources**
- **Additional families to be screened pending further collection efforts**



Wilt  
Resistant  
Koa  
Seedling  
Ready for  
Deployment





# **Wilt Resistant Seed Orchard Mahanalua**









# Wilt Resistant Seed Orchard Haleaimakani





# Location of Koa Sites







# Benefits of Watershed Restoration with Koa

- Increased rates of cloud fog interception
- Contribute to Groundwater Recharge: reducing runoff & evapotranspiration
- Assists in the management and control of invasive species
- Increase habitat diversity for native T & E species
- Koa can be a long-term sink for **CO<sup>2</sup>**



# Koa in Mauka Pasture








**Mahalo  
and  
Aloha**






**•Major Funding Provided by:**

- Maui Department of Water Supply**
- USDA-Forest Service-FHP, S&P Forestry**
- USDA-NRCS**
- Hawaii Division of Forestry and Wildlife**





**Acknowledgements:**

**Plant Disease Consulting Northwest  
Forest Management Consultants-Hawaii**

**Haleakala Ranch**

**Wung Ranch**

**Parker Ranch**

**Kuapo Ranch**

**Ulupalakua Ranch**

**Maui Land and Pineapple**

**Kamehameha Schools**

**Queen Emma Foundation**

**The Nature Conservancy**

**Leeward Haleakala Watershed Partnership**

**Renewable Resources**

**Colorado State University**

**Oregon State University**



