Continuing Project

Enhancing Resistance to Fungal Pathogens in Commercial Tree Seedlings

CAFS 23.102

Dr. George Newcombe, University of Idaho
Abigail Ferson-Mitchell, University of Idaho

Abigail Ferson-Mitchell

Justification

- Endophytes are nonpathogenic microsymbionts within plant tissues
- Competitive exclusion and antagonism occur among endophytes
- *Bacillus* is known to produce strong antimicrobial compounds and is commonly isolated from foliage and seeds

Objectives

To enhance survival of commercial susceptible and ‘resistant’ varieties of seedlings against virulent strains of devastating pathogens:

1. *Acacia koa* against *Fusarium oxysporum f. sp. koae*.
2. *Pinus monticola* against *Cronartium ribicola*.
3. *Chamaecyparis lawsoniana* against *Phytophthora lateralis*.

Endophyte Inoculation - Methods

Koa

WWP

Images by Abigail Ferson

POC

Pathogen Inoculation - Methods

Koa

POC

WWP

Images by Abigail Ferson

Data Collection - Methods

Koa

Image by Michael Kaufmann

WWP

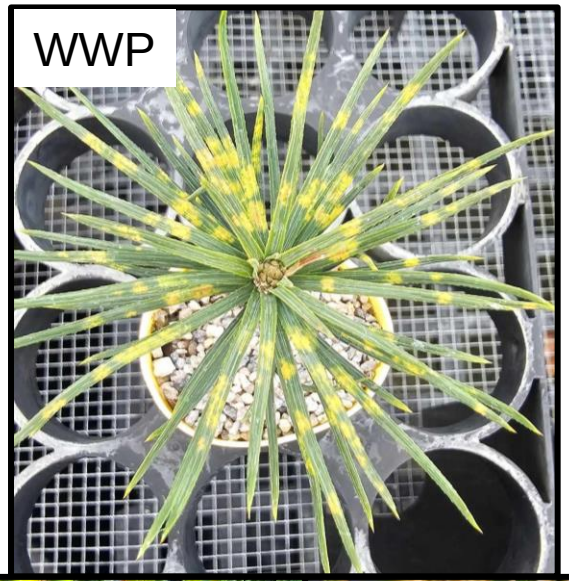
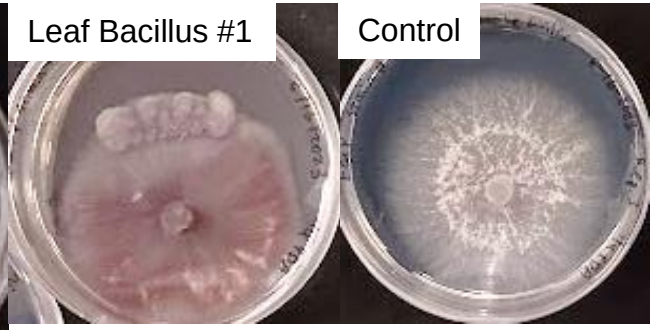


Image by Abigail Ferson

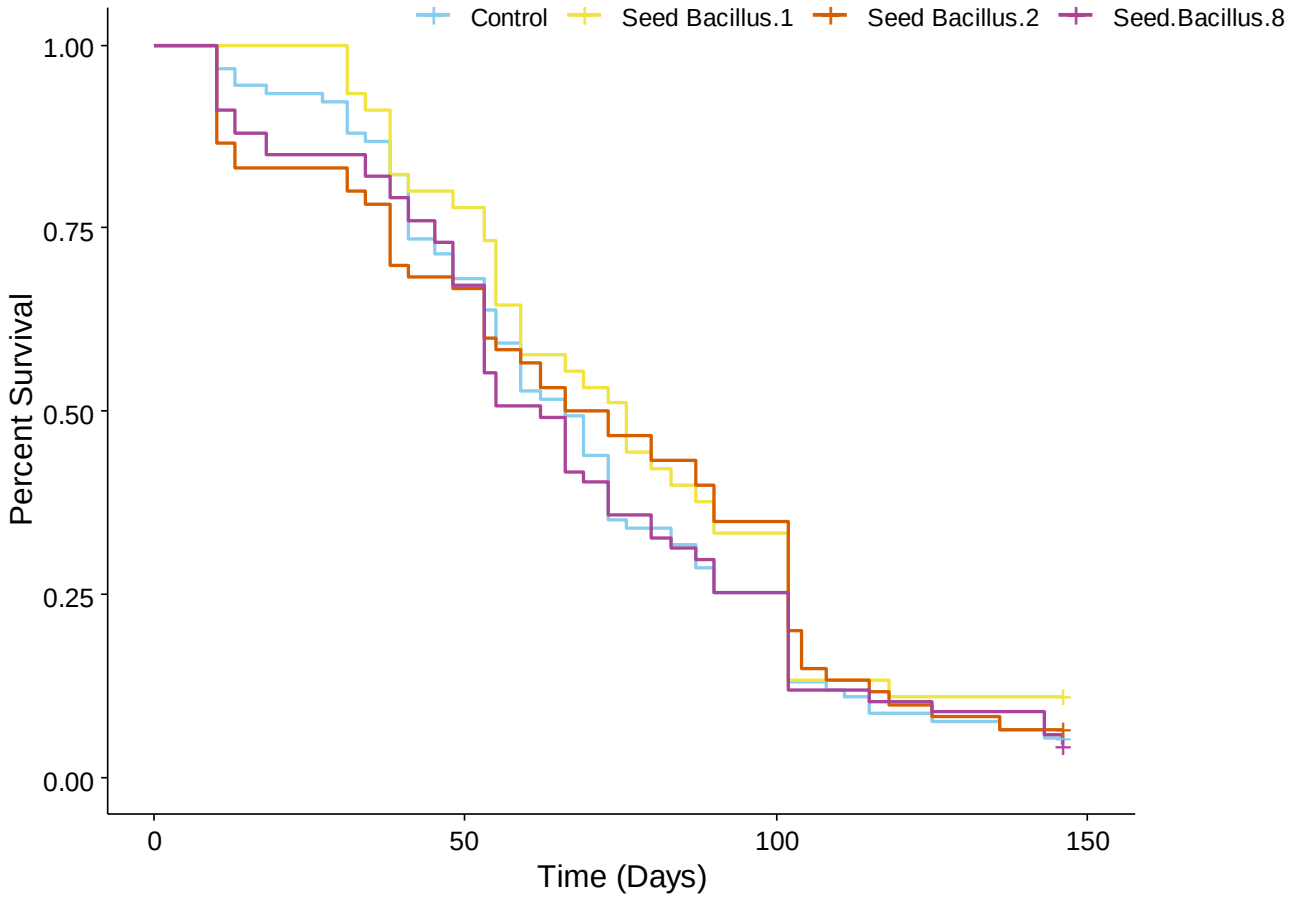
POC

Image by Abigail Ferson

Major Findings - Koa



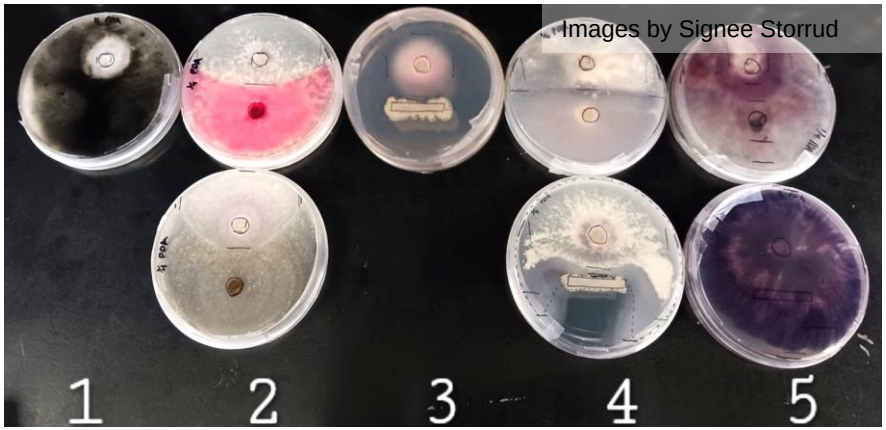
- Seed *Bacillus* #1 – no mortality for the first 30 days in FOXY trial



Major Findings - Koa

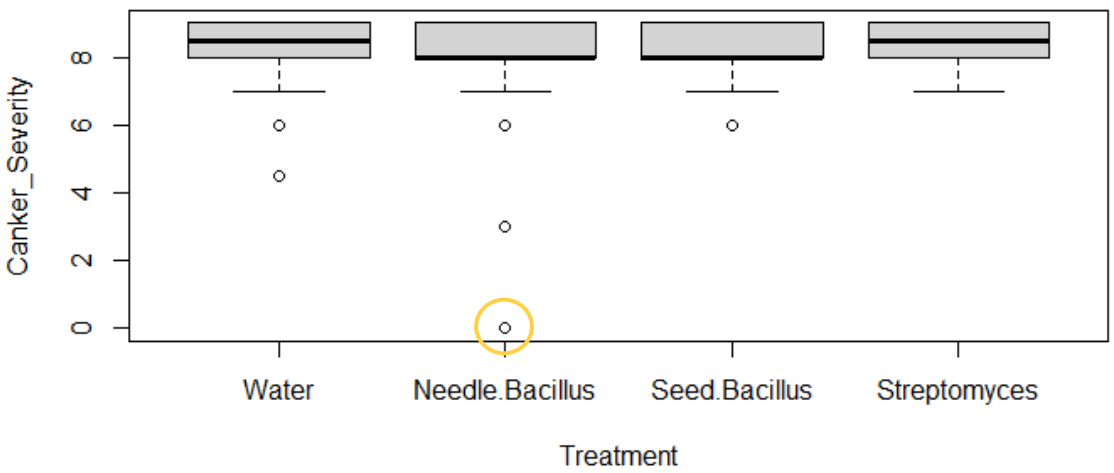
		FOXY #77			FOXY #1405			FOXY #1613A		
		Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Melanoxylon	B1									
	B2									
	B3									
	B4									
	B5									
	B6									
	B7									
	AMF1									
	AMF2									
	AMF3									
Koa	KSB1									
	KSB2									
	KSB8									
	KLB1									
	KLB2									
	KLF2									
	KLF4									
	KLF5									
	KLF7									
	KLF8									
Mangium	B1									
	B3									
	B4									
	B5									
	B6									
Control	Sterile DI									
	Self									
	Water Agar									

Key				
1	2	3	4	5
Strong Antagonism	Weak Antagonism	No Interaction	Weak Suppression	No Suppression



- One *A. melanoxylon* seed fungus 70% growth reduction of FOXY strains after four weeks.
- Four *A. koa* foliar fungi 56-76% growth reduction.
- Three seed *Bacillus* avg. 28% growth reduction.

Major Findings - WWP

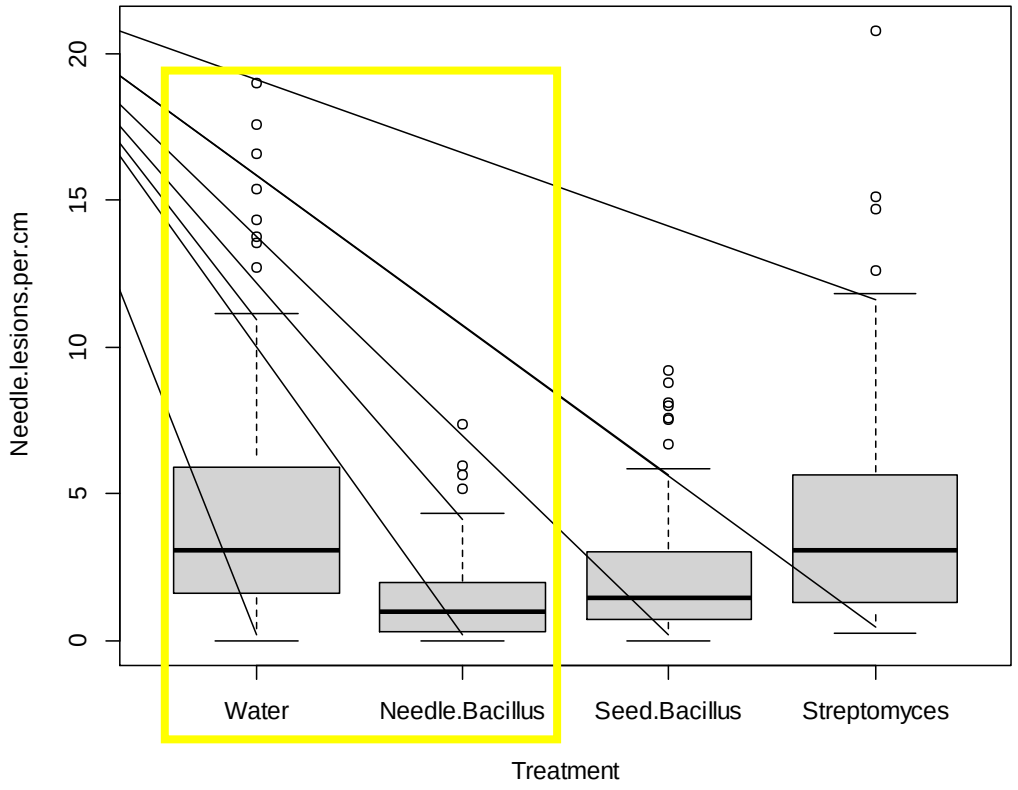


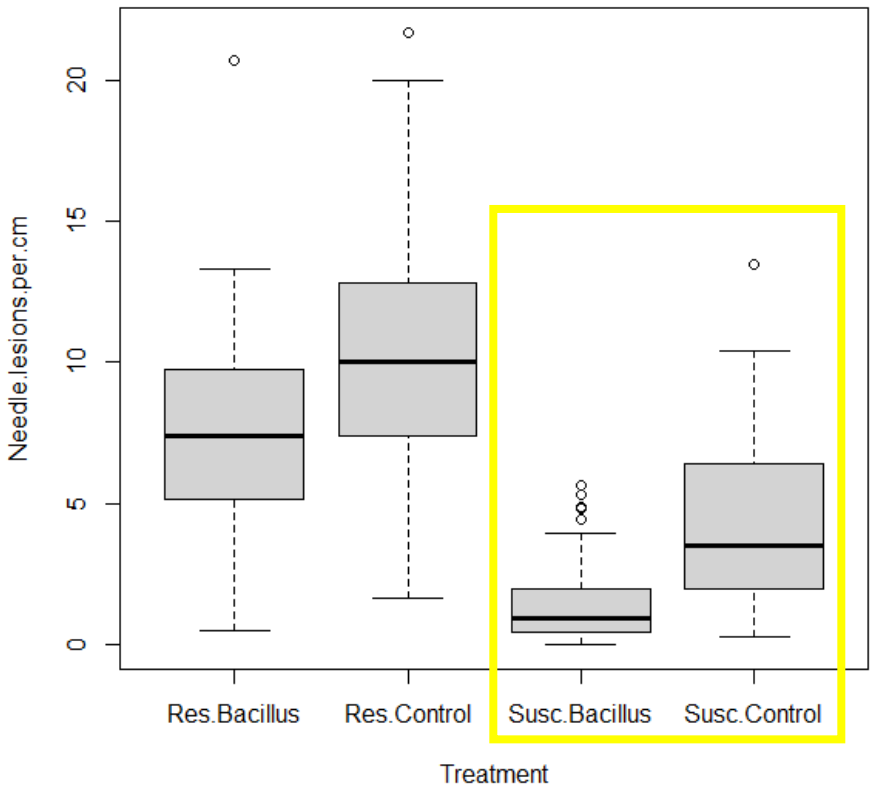
WWP 2022-2024 trial canker severity:

- 62% survival in needle *Bacillus*
- 57% survival in seed *Bacillus*
- 45% survival in *Streptomyces*
- 41% survival in the control.

- 4.5% symptomless and 8% low canker severity in the needle *Bacillus* treatment.

Major Findings - WWP

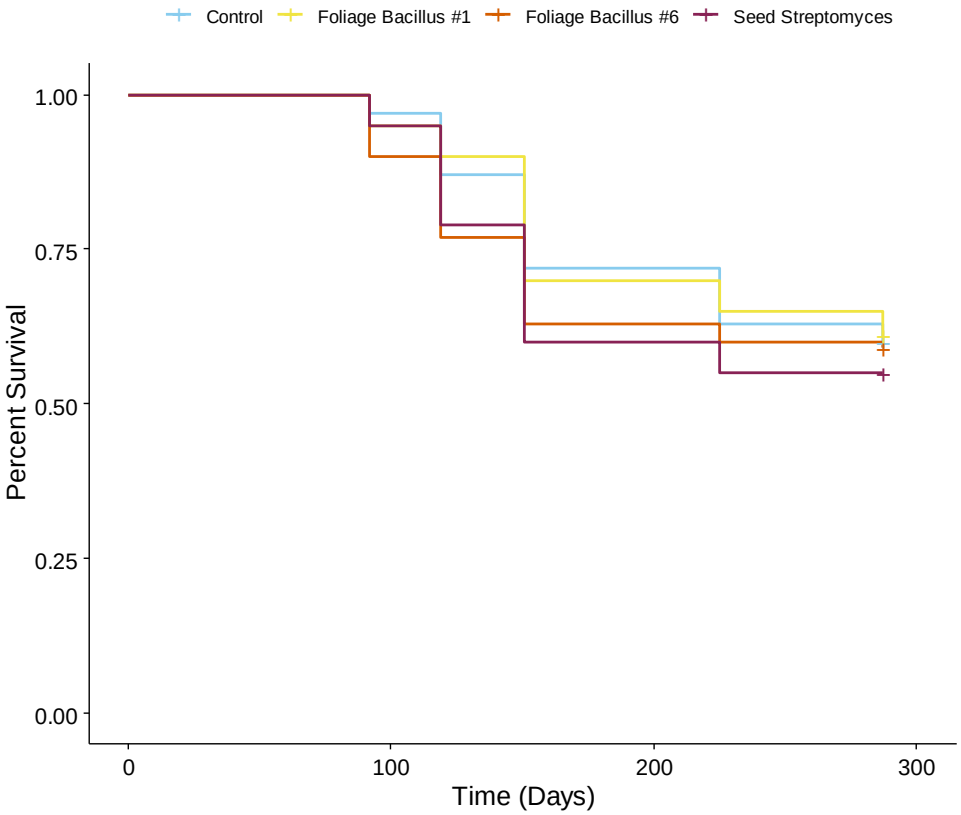


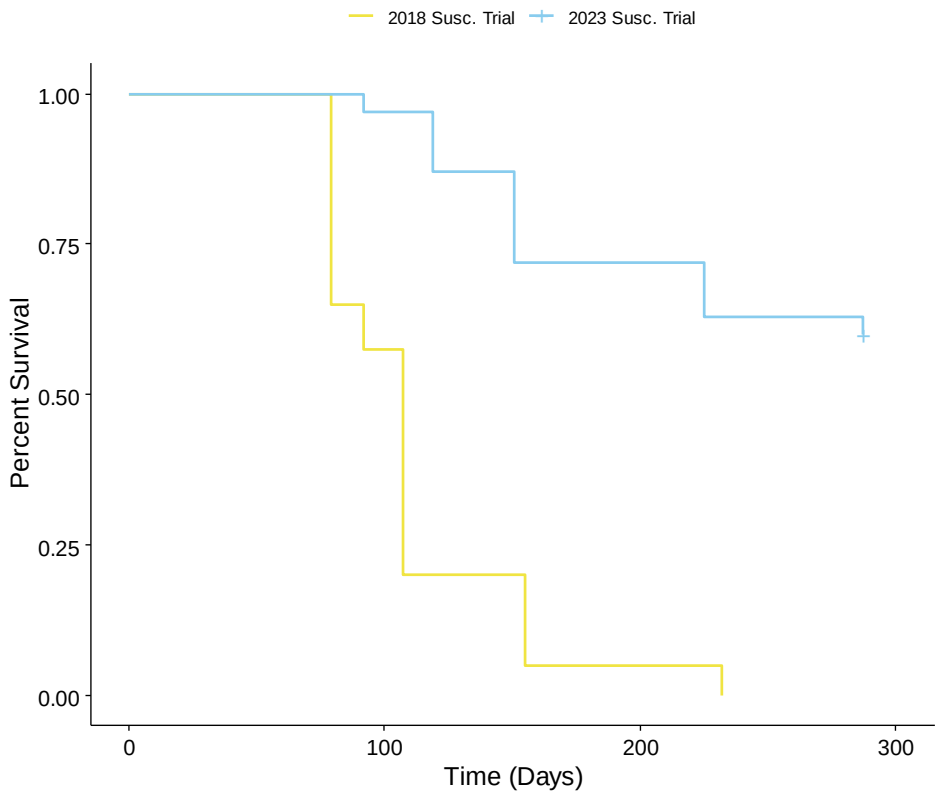


- WWP 2022-2024 trial: needle *Bacillus* and seed *Bacillus* significantly reduced needle lesion severity on a susceptible seed lot.

- WWP 2023-2024 trial: needle *Bacillus* significantly reduced needle lesion severity on susceptible and 'resistant' seed lots.

Major Findings - POC





- POC 2023 trial: Low mortality across all treatment groups. Anticipated mortality by 250 days based on prior trials with this seed lot.
- POC 2018 vs. 2023 control: Low mortality in the control despite prior trials with this seed lot, suggests homogenization.

Deliverables

- Dissertation and peer-reviewed publications in preparation.
- Protocol for screening and identifying beneficial endophytes for effectiveness against pathogens in the works.
- Improved understanding on how endophytes can be used to enhance the survival and success of both susceptible and resistant families.

Company Benefits

- Reducing the cost and effort for reforestation following a failed plantation.
  - Enhance survival of out-planted resistant varieties in areas impacted by low-medium-high pathogen loads.
  - Increase survival of ‘susceptible’ families that lack genes for resistance but have other desirable genetic traits that improve hardiness and yield.

Recommendations

- Prior to establishing a stand, consult a forest pathologist regarding site conditions and risk factors to determine what material to plant.

Image by: Jason A. Smith, 2010 (DOI:10.1111/j.1439-0329.2010.00659.x)

Acknowledgements:

- **NSF CAFS**
- **USDA – Forest Service**
  - Dr. Richard Sniezko
  - Angelia Kegley
  - Evan Heck
  - Lee Riley & DGRC crews
- **Hawaiian Agricultural Research Center**
  - Dr. Nickolas Dudley
  - Michael Kaufmann
  - Jenna Lidua
- **Oregon State University**
  - Dr. Jared LeBoldus
  - Biz Stamm
  - Dr. Posey Busby
  - Melissa Vergara
- **University of Idaho**
  - Dr. Andrew Nelson
  - Signee Storrud
  - Berklund Family

Summary

- 2024 Koa trial with fungal endophytes is being prepared to begin June 2024, anticipated completion by October 2024.
- 2022-2024 WWP mortality is progressing; anticipated completion by September 2024.
- 2023-2024 WWP cankers are developing; stem symptom assessments beginning June 2024.
- 2024 POC mortality has begun and will continue to progress over the next 150 days.