AU-FHC Advisory Meeting - FY 19

June 27-28, 2018

SFWS Conference Hall

AGENDA

TIME	**EVENT**	**SPEAKER**
Wednesday – June 27		
11:00 – 1:00	Registration	Elizabeth Bowersock
1:00 – 1:10	Introduction – Welcome	Dr. Janaki Alavalapati SFWS Dean
	Forest Health Dynamics Lab Project Updates	
1:10 – 1:30	Forest Health Cooperative Diagnostics Laboratory Update and Sudden Oak Death Survey Laboratory Update	Luis Mendez Research Assistant
1:30 – 1:50	Chemical defensive reaction of *Pinus taeda* to *Leptographium terebrantis*	John Mensah Ph.D. Students
1:50 – 2:10	Growth and yield response of *Pinus taeda* to *Leptographium Terebrantis*	John Mensah Ph.D. Student
2:10 – 2:30	Study of soil microbial biomass and soil moisture in loblolly pine stands	Shrijana Duwadi MS Student
2:30 – 3:50	What is insect diversity like in a mature loblolly pine stand?	Jessica Ahl MS Student
2:50 – 3:20	**BREAK**	
3:20 – 3:40	The response of fine roots to the inoculation of *Leptographium terebrantis*	Shrijana Duwadi MS Student
3:40 – 4:00	Can you identify spores of fungal specie on coleopteran with Hyperspectral interferometry?	Jessica Ahl MS Student
4:00 – 4:30	Genetically determined fungal pathogen tolerance and soil variation influences ectomycorrhizal traits of loblolly pine	Dr. Bridget Piculell College of Charleston
4:30 – 5:00	New industry and partnerships with cross laminated timber	Dr. Brian Via Professor
5:00 – 5:30	Final Discussion – Questions	Dr. Lori Eckhardt Director
5:30	Adjourn	

Thursday – June 28

8:00 – 8:30	**Breakfast**	
8:30 – 9:30	Business Meeting	Dr. Lori Eckhardt Director
9:30 – 10:30	Budget Review	Dr. Lori Eckhardt Director
10:30-11:00	Final Thoughts – Questions	Dr. Lori Eckhardt Director
11:00	Adjourn – Have a Safe Trip Home!	

Forest Health Dynamics Laboratory Update

Luis Mendez and Dr. Lori Eckhardt
Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn AL

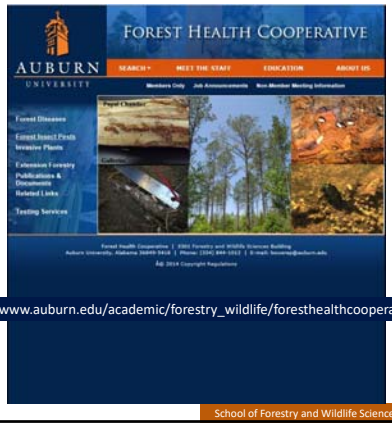
Forest Health Coop Diagnostic Laboratory Services - Overview

- History
- Weather Data
- Laboratory Sample Analysis
- Results

History

- Forest Health Cooperative began in 2008
- To bring together parties interested in maintaining forest health, productivity, and sustainability
- Membership for those managing for or purchasing forest products, wildlife and endangered species
- Address important and current forest health issues with real world management as a focus

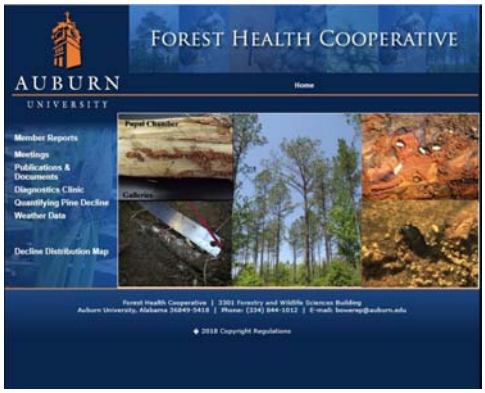
Forest Health Dynamics Laboratory



http://www.auburn.edu/academic/forestry_wildlife/foresthealthcooperative/

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

School of Forestry and Wildlife Sciences, Auburn University

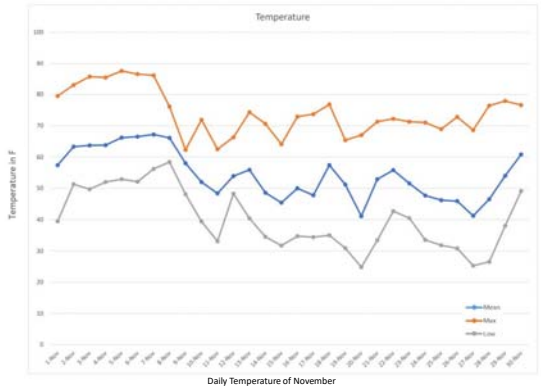
Forest Health Dynamics Laboratory

QPD site NOAA month report November 2017

	Temperature					Degree	Solar	Rh	Rain	Wind	
Date	Mean	High	Time	Low	Time	Days	Rad	Mean	Fall	Speed	Gust
1-Nov	57.4	79.5	02:45p	39.5	04:45a	10.6	161.9	81	0	0	6
2-Nov	63.3	83	03:00p	51.3	07:30a	13.3	138.5	82	0	0	4
3-Nov	63.7	85.7	03:00p	49.7	06:45a	13.7	171.7	83	0	0	3
4-Nov	63.8	85.4	02:45p	52	07:30a	13.8	121.7	86	0	0	2
5-Nov	66.2	87.5	03:00p	52.9	04:45a	16.2	165.1	84	0	0	5
6-Nov	66.5	86.5	02:45p	52.1	06:45a	16.5	164.8	85	0	0	4
7-Nov	67.2	86.1	02:00p	56.2	05:00a	17.2	145.1	87	0	0	5
8-Nov	66.1	76.1	12:30p	58.4	04:45a	16.1	50.6	91	0	0	2
9-Nov	58	62.3	12:15a	48.1	12:00a	8	36.2	96	0.8	0	3
10-Nov	52	71.9	03:00p	39.4	07:00a	5.7	171.1	86	0	0	3
11-Nov	48.4	62.5	11:45a	33.1	07:30a	3.3	101.1	89	0	0	6
12-Nov	53.9	66.3	02:30p	48.3	07:15a	4.2	93.7	83	0	0	4
13-Nov	55.9	74.3	03:00p	40.4	12:00a	7.1	164.3	84	0.01	0	3
14-Nov	48.6	70.6	02:30p	34.5	07:30a	5.3	165.8	84	0	0	4
15-Nov	45.4	64.1	03:00p	31.7	07:15a	3.4	142.2	84	0	0	3
16-Nov	50	72.9	03:15p	34.7	07:30a	6.2	150.8	85	0	0	4
17-Nov	47.8	73.7	02:45p	34.4	07:45a	5.3	158.1	82	0	0	2
18-Nov	57.4	76.8	01:45p	35	03:00a	12.5	120.2	81	0.07	0	8
19-Nov	51.2	65.4	12:15a	30.9	12:00a	4.9	155.9	71	0.04	0	10
20-Nov	41.1	67	02:30p	24.8	07:30a	2.9	147.3	80	0	0	3
21-Nov	52.9	71.3	02:15p	33.4	12:15a	6.9	85.5	90	0.01	0	2
22-Nov	55.8	72.2	01:00p	42.7	12:00a	6.6	130.6	80	0	0	4
23-Nov	51.6	71.3	01:45p	40.5	07:15a	4.9	96.2	86	0	0	3
24-Nov	47.7	71	02:30p	33.5	07:30a	4.9	140.9	83	0	0	3
25-Nov	46.2	68.9	12:45p	31.8	06:30a	3.9	81.5	87	0	0	4
26-Nov	45.9	72.8	03:00p	30.8	12:00a	5.3	144.6	76	0	0	5
27-Nov	41.2	68.6	03:00p	25.3	07:30a	3.7	137.3	78	0	0	4
28-Nov	46.5	76.4	03:15p	26.5	07:30a	6.2	135	82	0	0	4
29-Nov	54	77.9	02:15p	38	04:30a	7.3	97.2	91	0	0	2
30-Nov	60.8	76.6	11:45a	49.1	01:00a	10.8	82.1	90	0.11	0	4

School of Forestry and Wildlife Sciences, Auburn University

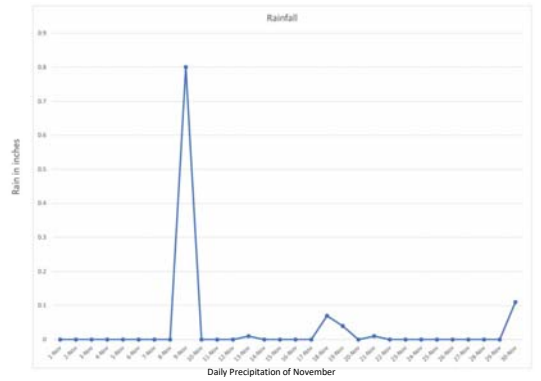
Forest Health Dynamics Laboratory



Daily Temperature of November

School of Forestry and Wildlife Sciences, Auburn University

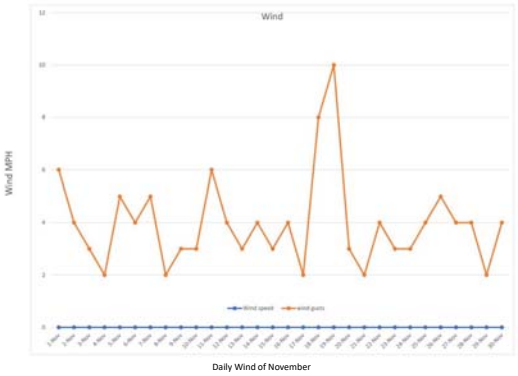
Forest Health Dynamics Laboratory



Daily Precipitation of November

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory



School of Forestry and Wildlife Sciences, Auburn University

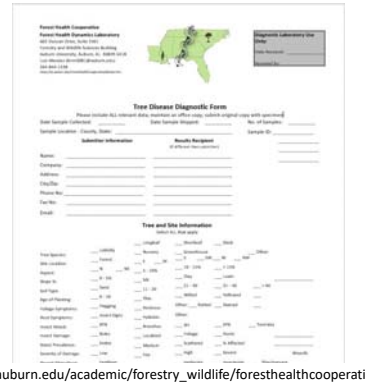
Forest Health Dynamics Laboratory

Diagnostics Clinic

- Sample collection and submission guide
  - Provide an instruction set for collecting "good" samples for laboratory analysis
- Tree Diagnostics Form
  - Provide a detailed sample/site history to aid in diagnosis accuracy
- Members only page – Diagnostics Clinic
- Project Updates in process

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory



http://www.auburn.edu/academic/forestry_wildlife/foresthealthcooperative/

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

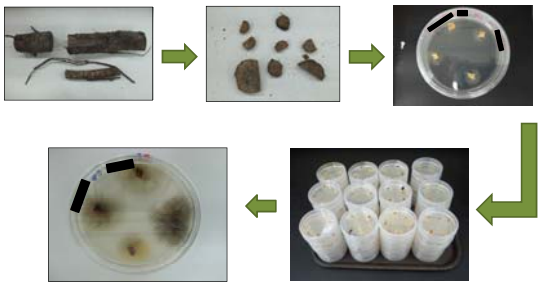
Field Consulting

- Travel to member's location
- Provide onsite diagnostic information
- Collect samples for laboratory analysis

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Laboratory Sample Analysis



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

- Results available after a minimum of twenty-one days after sample is received
- Results letter sent to member with description and relevant species information

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Emerging Forest Pests and Sudden Oak Death Review

Luis Mendez and Dr. Lori Eckhardt

Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn AL

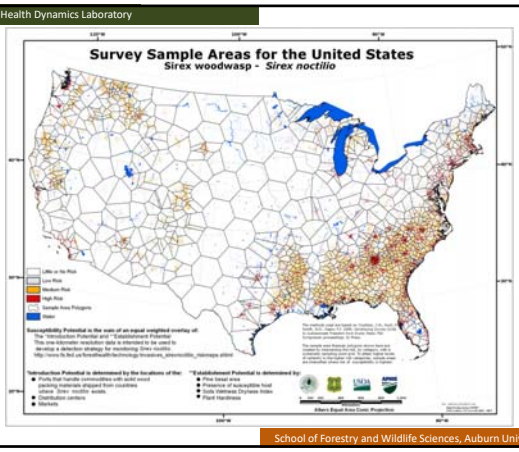
Forest Health Dynamics Laboratory

Sirex spp.

- *Sirex noctillio* not native to U.S.
- Vectors *Amylostereum areolatum*
- *A. areolatum* v.s. Ophiostomatoid fungi
- Damage caused by larvae and fungus
- Wasp needs healthy wood
- *Sirex nigricornis* native to southeastern U.S.

Forest Health Dynamics Laboratory

Forest Health Dynamics Laboratory



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Needle Diseases

- *Lophodermium spp.*
- *Phytophthora spp.*
- *Coleosporium spp.*
- *Dothistroma spp.*
- *Lecanosticta spp.*
- Mycosphaerellaceae family
- *Pestaltiopsis spp.*

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Emerald Ash Borer

- Family-Buprestidae (jewel beetles)
- First detected in Michigan 2002
- Damage caused by larvae
- Ash tree mortality in the millions
- Now in 33 states
- Confirmed in Calhoun County, AL

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Don't Move Firewood

- Limiting the movement of infested firewood could help control the spread
- Infested trees can be treated with insecticides, quarantined, or destroyed onsite

Larvae

S-Shaped Gallery

D-Shaped Exit Hole

Adult

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

School of Forestry and Wildlife Sciences, Auburn University

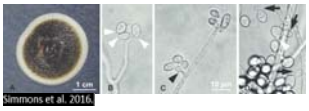
Forest Health Dynamics Laboratory

Laurel Wilt

- Caused by *Raffaelea lauricola*
- Family-Ophiostomatacea
- Vectored by Red Bay ambrosia beetle, *Xyleborus glabratus*
- Spread via natural flight and firewood movement
- Kills many species in the Lauraceae family
- Symptom-green leaves wilting then turning red-brown
- Has impacted Avocado industry in Florida

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

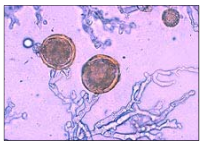
Sudden Oak Death

- First reported 1995 coastal region of central California with *Phytophthora ramorum* positively linked to the disease in 2001
- Fungus-like water mold (Oomycete)
- Spreads aerially and aquatically
- Pathogen has a wide host range
- Three expressions of the disease

School of Forestry and Wildlife Sciences, Auburn University

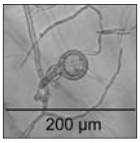
Forest Health Dynamics Laboratory

Phytophthora ramorum



Chlamydospores

Sporangia



Oospore

Source: Steve Oak - USDA Forest Service Forest Health Protection

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Risk To Our Forests

- *Phytophthora ramorum* persists in infected nurseries even after eradication measures.
- Inoculum is leaving infected nurseries via waste water
- A pathway from the water into terrestrial ecosystems is plausible
- Southeastern US climate is at least seasonally suitable for infection
- Eastern woody plants are susceptible

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Phytophthora ramorum symptoms

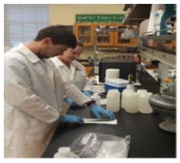
Source: Steve Oak - USDA Forest Service FHP

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

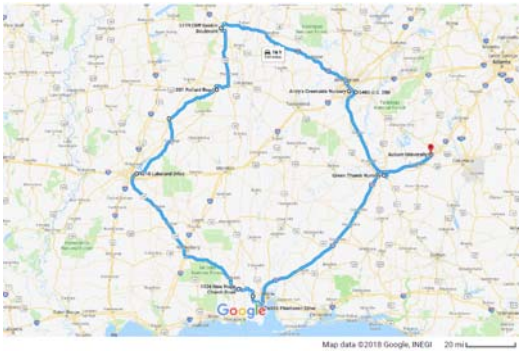
Field Sampling



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

- 2013: 7 Alabama sites, 2 confirmed positive; 6 Mississippi sites, 1 positive
- All sites negative for 2014 and 2015 sampling
- 2016 Spring: 7 AL sites, 3 confirmed positive; 6 MS sites, 1 confirmed positive
- 2016 Fall: 7 AL sites, 1 confirmed positive; 6 MS sites, all negative
- 2017 Spring: 7 AL sites, 1 confirmed positive; 6 MS sites, 1 confirmed positive
- Awaiting Fall 2017, Spring 2018 Results

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Acknowledgements

Dr. Ryan Nadel
Dana Stone
Shrijana Duwadi
Undergrad Student Workers

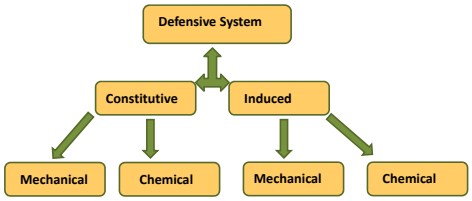
School of Forestry and Wildlife Sciences, Auburn University

Chemical defensive reaction of *Pinus taeda* to *Leptographium terebrantis* invasion

John K. Mensah[1], Ryan L. Nadel[1], George Matusick[2], Zhaofei Fan[1], Mary A. Sword Sayer[3] and Lori G. Eckhardt[1]

[1]School of Forestry and Wildlife Sciences, Auburn University, Auburn, Alabama; [2]The Nature Conservancy, Fort Benning, Georgia; [3]USDA Forest Service, Southern Research Station, Pineville, Louisiana

Background

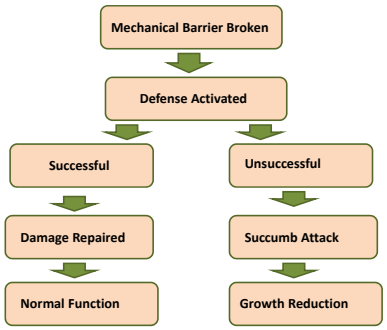


Background

- Chemical defensive responses
  - Constitutive
  - Induced
- Induced chemical responses
  - Protein based
  - Non-protein based
- Specific and toxic
- Bind hydrolytic enzymes
- Bind amino acids and proteins

Forest Health Dynamics Laboratory

Background



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Background

- Soil nutrients - Essential for plant growth
- Deficiency - Inhibit growth
- Nutrients - Translocated
- Immobile - Ca, Cu, B, S, Fe
  - Accumulation - leaf area reduction
- Remobilized - N, P, K, Mg, Cl, Mo, Zn

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objectives

- Assess the chemical defensive response and mineral nutrient dynamics to pathogen invasion
- Determine the relationship between the multiple defensive chemicals produced

Hypotheses

- A significant reduction of resins and phenolics in loblolly pine trees following fungal invasion
- Nutrient accessibility and supply to growing tissues will decrease with increased fungal inoculum

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Resins

- North-south sides of each tree were sampled by punching a hole with 1.9 cm diameter arch punch at DBH
- A plastic connector was screwed into the tree to direct resin into a pre-weighed plastic tube attached to the connector
- Tubes were removed after 24hrs and transported
- Average resin weights were determined

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Phenolics

- Upper crown branch tissue was shot
- Fascicles on branches were ripped off
- 10cm portion of the woody branches were excised
- The samples were freeze dried for about 24 hrs
- Milled into powder
- 50 mg of the powdered branch sample was extracted - 70% acetone

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Phenolics

- Extraction - 70% acetone
- Development - Na_2CO_3
- Absorbance - Spectrophotometry

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

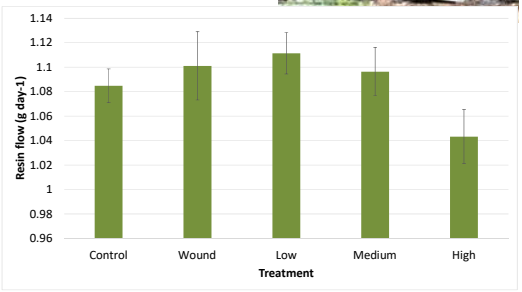
Approach - Foliar nutrients

- About 25 fascicles
- The samples were forced-air oven dried at 70^{O}C
- Foliar nutrients - Waypoint Analytical (Memphis, TN)

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

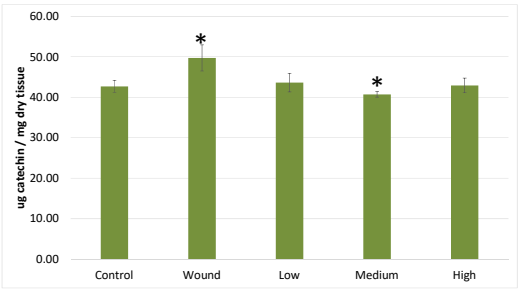
Results - Resins



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

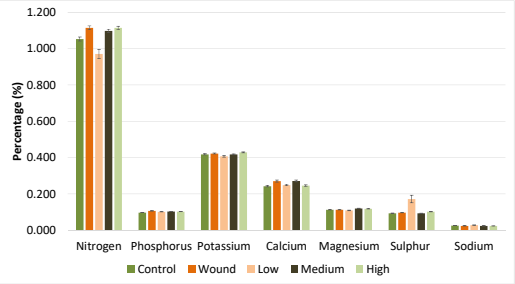
Results - Total phenolics



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

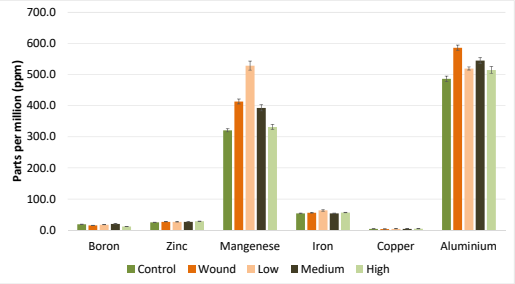
Results - Foliar macronutrients



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results - Foliar micronutrients



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Post Inoculation Reaction

Wound **High** **High**

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Conclusions

- Macro- and micronutrients were adequate except Cu
- Resin flow rate - 1.0 g/day and no significant difference prior treatment
- Phenolic content was highest and lowest in wound and medium treatments respectively
- High innoculum trees were characterized by pitch tubes and resinosis
- Inducible defensive system activated
- What happens next…….?

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Acknowledgements

- Luis Mendez
- Dalton Smith
- Andrea Cole
- Shrijana Duwadi
- Jessica Ahl
- Charles Essien
- Pratima Devkota
- Kristi Wharton
- Dr. Susana Sung
- Undergraduates

AUBURN UNIVERSITY

Forest Health Cooperative

Rayonier

School of Forestry and Wildlife Sciences, Auburn University

Growth and yield response of *Pinus taeda* to *Leptographium terebrantis*

John K. Mensah[1], Ryan L. Nadel[1], George Matusick[2], Zhaofei Fan[1], Mary A. Sword Sayer[3] and Lori G. Eckhardt[1]

[1]School of Forestry and Wildlife Sciences, Auburn University, Auburn, Alabama; [2]The Nature Conservancy, Fort Benning, Georgia; [3]USDA Forest Service, Southern Research Station, Pineville, Louisiana

Background - Loblolly Pine

Veit, J. 2016

https://www.barkbeetles.org/spb/spbbook/Chapt4.html

Background - Problem

- Pest and diseases - threat to forest productivity and sustainability
- On annual basis large acres of forest is loss
- > 6 million of acres of tree mortality - 2015
- 9% loss of forest product

Annapolis, M.D 2015

Forest Health Dynamics Laboratory

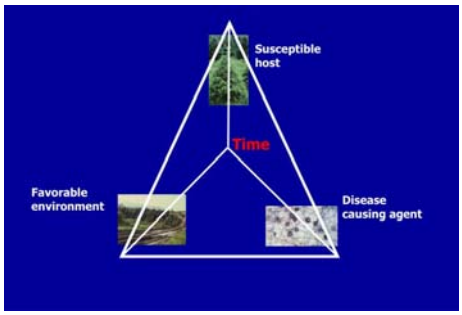
Background - Problem

- SPD - A disease complex
  - Bark beetle - Ophiostomatoid fungi
  - Fungal interferes - H_2O transport
  - Affect physiological processes
  - Growth reductions and mortality

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Background – Disease pyramid



https://www.slideserve.com/lynley/epidemiology

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objectives

- Assess growth and yield response of *P. taeda* to *L. terebrantis* inoculum density
- Determine the threshold of fungal inoculum density needed to cause growth reduction and mortality

Hypotheses

- *L. terebrantis* infectivity will affect physiological functions and negatively impact tree growth and productivity
- Growth reductions and stand productivity will parallel the severity of *L. terebrantis* infection

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Plot establishment

- 15 Plots were demarcated within 13 year old loblolly pine stand with 20 trees per plot
- Dendrometer bands were installed on 10 randomly selected trees per plot
- Radial and height growth were measured before treatment application

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Site location and map

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Pre-inoculation measurements

- DBH; Height; LAI

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - Treatment application

- Five treatments were randomly applied to five plots with three replications
- A total of 15 trees per treatment
- Treatments
  - Low (1 inoculation per 10cm i.e. circumference)
  - Medium (1 inoculation per 2.5cm)
  - High (1 inoculation per 1.3cm)
  - Wound (1 inoculation per 1.3cm)
  - Control

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Inoculation Process

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Approach - LAI measurement

- Leaf Area Index (LAI) was measured with a ceptometer
- $L = [(1 - 1/2K) f_b - 1] * \ln\tau / (A (1 - 0.47 f_b))$
  - L – Leaf area index
  - τ – Ratio of PAR below to PAR above
  - f_b – fraction of incident PAR
  - K – Extinction coefficient for the canopy

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results - DBH

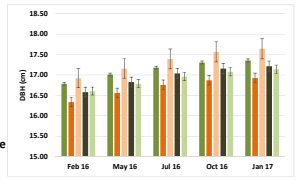


Figure 1: Before treatment

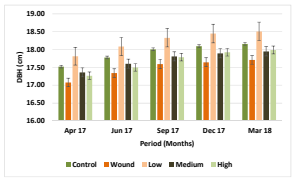


Figure 2: After treatment

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results - RBAI

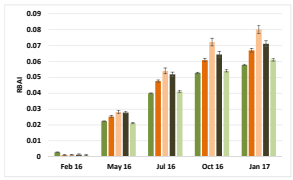


Figure 3: Before treatment

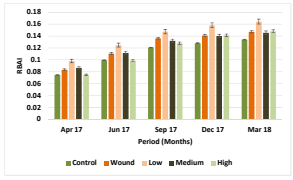


Figure 4: After treatment

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results - Height

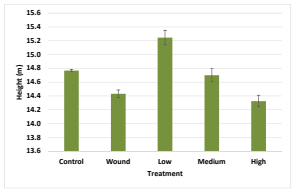


Figure 3: Before treatment

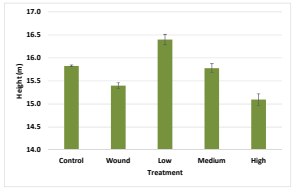


Figure 4: After treatment

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results - Yield

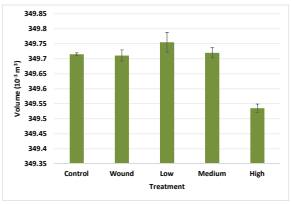


Figure A: Before treatment

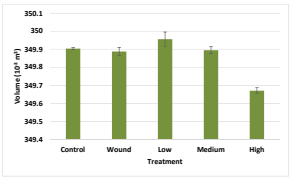
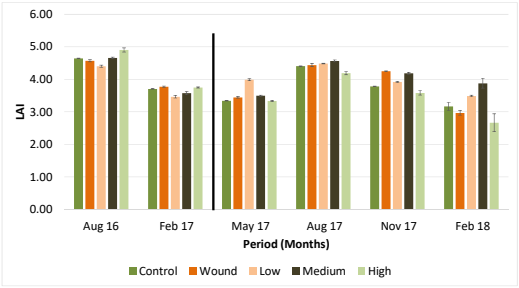


Figure B: After treatment

Forest Health Dynamics Laboratory

Results - LAI



Forest Health Dynamics Laboratory

Conclusions

- The trees selected for low and wound treatments had the highest and lowest DBH respectively
- DBH, RBAI and yield showed a consistent trend and there was no significant difference before and after treatment application
- The average LAI did not differ among the treatments but was affected by the period
- Nonetheless, a year after fungal treatment may be a short period to detect any significant growth reduction
- Unfavorable environmental conditions may have affected *L. terebrantis* growth and development to impact growth and productivity

Forest Health Dynamics Laboratory

Acknowledgements

- Luis Mendez
- Dalton Smith
- Andrea Cole
- Shrijana Duwadi
- Jessica Ahl
- Charles Essien
- Pratima Devkota
- Undergraduate Student

Forest Health Cooperative

School of Forestry and Wildlife Sciences, Auburn University

Study of soil microbial biomass and soil moisture in loblolly pine stand

Shrijana Duwadi[1], Ryan Nadel[1], Emily A. Carter[2], Yucheng Feng[3], Lori G. Eckhardt[1]

[1]Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; [2]USDA Forest Service, Southern Research Station, Auburn, AL; [3]College of Agriculture, Auburn University, Auburn, AL

Forest Health Dynamics Laboratory
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Background

Eckhardt, 2003

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Soil microbial biomass (MB)

- Total population of active microbes in the soil (bacteria, fungi, etc.) at the time of sampling
- Measured by amount of C and N
- Residue (C) decomposition
- Nitrogen (N) cycling and mineralization
- Indicator of soil quality
- Early indicator of changes in total soil carbon and soil properties

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objectives

- To determine the change in MB after inoculating trees with different densities of *Leptographium terebrantis*
- To determine the changes in MB during different sampling seasons

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

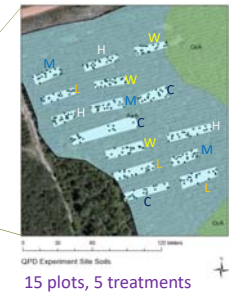
Hypotheses

- Inoculation of loblolly pine trees with *L. terebrantis* will significantly affect the microbial community in the forest floor due to the blocking of vascular bundles, resin soaking of roots and death of fine roots which will affect the transportation of the carbon and exudates from roots into the soil
- Different inoculum densities will have different impact on microbial biomass quantity
- Microbial biomass will be affected by sampling season

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Project site in Eufaula, Alabama



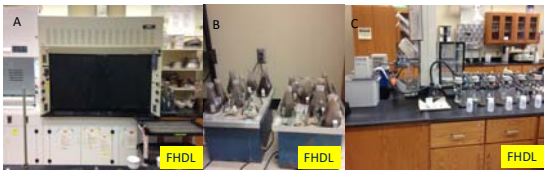
15 plots, 5 treatments and 3 replicates

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods (Microbial biomass)

- Microbial biomass was collected by taking soil samples from the top 10 cm at Eufaula, AL
- Microbial biomass C and N present in each plot was determined by Chloroform Fumigation Incubation (CFI) method
- Soil moisture was measured



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods (Ectomycorrhizae)

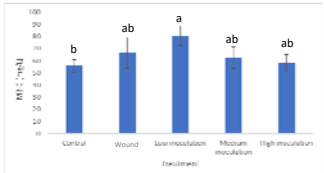
- Ectomycorrhizae (EM) was collected by taking 50 cm deep soil cores from the planting row
- Soil core was cut in 10cm increments and top 10cm was discarded
- Roots washed free of soil by running water, using 0.5mm sieve
- % fine root colonization by EM accessed by roughly sampling hundred 1-cm root segments/10cm soil core increment
- Mycorrhizal root tips identified and quantified with dissecting microscope at 10-40 times magnification, using gridline intercept method

School of Forestry and Wildlife Sciences, Auburn University

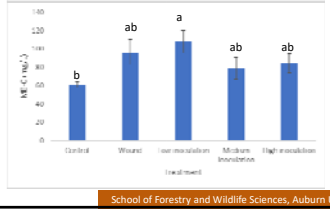
Forest Health Dynamics Laboratory

Results (MB-C)

Before inoculation



After inoculation

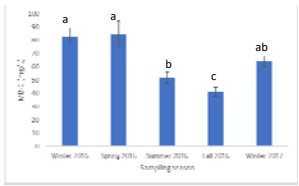


School of Forestry and Wildlife Sciences, Auburn University

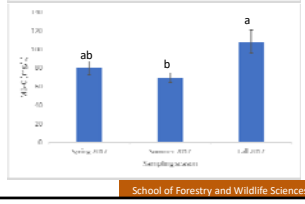
Forest Health Dynamics Laboratory

Results (MB-C)

Before inoculation



After inoculation

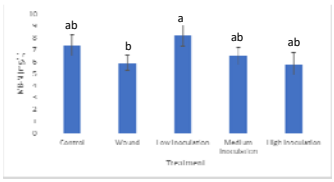


School of Forestry and Wildlife Sciences, Auburn University

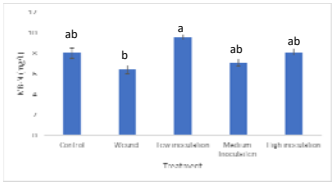
Forest Health Dynamics Laboratory

Results (MB-N)

Before inoculation



After inoculation

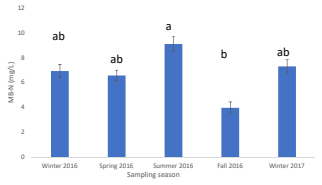


School of Forestry and Wildlife Sciences, Auburn University

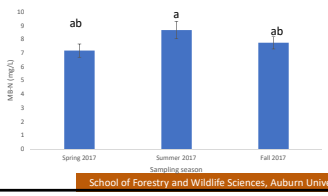
Forest Health Dynamics Laboratory

Results (MB-N)

Before inoculation



After inoculation

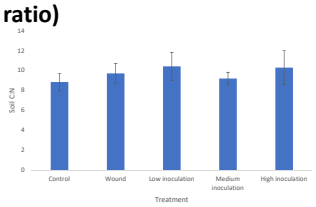


School of Forestry and Wildlife Sciences, Auburn University

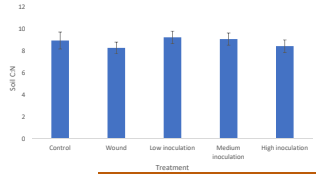
Forest Health Dynamics Laboratory

Results (Soil C:N ratio)

Before inoculation



After inoculation

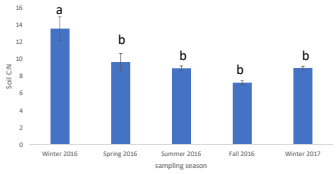


School of Forestry and Wildlife Sciences, Auburn University

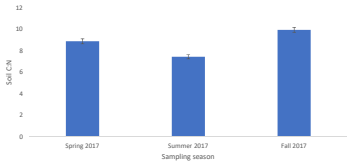
Forest Health Dynamics Laboratory

Results (Soil C:N ratio)

Before inoculation



After inoculation



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results (Correlation between MB and SMC)

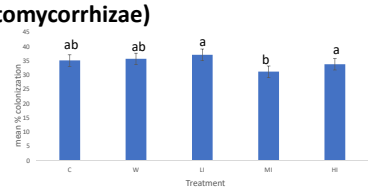
Sampling season	Average gravimetric SMC	p-value (MB-C)	p-value (MB-N)
Winter 2016	0.39	0.1182	0.5778
Spring 2016	0.20	0.5634	0.1887
Summer 2016	0.08	0.0012*	0.0003*
Fall 2016	0.02	0.0001*	0.0001*
Winter 2017	0.12	0.0051*	0.0082*
Spring 2017	0.16	0.0921	0.0001*
Summer 2017	0.14	0.3665	0.0001*
Fall 2017	0.13	0.6411	0.0008*

School of Forestry and Wildlife Sciences, Auburn University

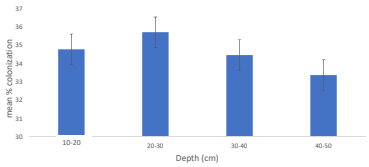
Forest Health Dynamics Laboratory

Results (Ectomycorrhizae)

On the basis of treatment plots



On the basis of depth



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Summary (MB)

- MB-N was significantly affected by treatment
- MB-C and soil C:N was significantly affected by sampling season
- Although the results from current study suggest no significant difference in MB concentration between the treatments within the sampling season, it is expected that over a period of time, an impact might be seen
- But in the long run, it is also possible that the stand will recover from disturbance and changes in MB might decrease
- MB-C was found to be significantly affected when the average SMC was ≤ 0.12 g/g, while SMB-N was significantly affected when the average SMC was ≤ 0.16 g/g

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Summary (Soil C:N)

- Soil C:N was significantly affected by sampling season
- Soil C:N was higher in winter, spring and summer of 2016 compared to same sampling seasons in 2017; suggesting higher mineralization and lower immobilization in 2017
- Soil C:N was lower in fall 2016 compared to fall 2017

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Summary (Mycorrhizae)

- Mycorrhizal colonization was significantly affected by treatment
- Mean % colonization was maximum in LI plots followed by W, C, HI plots, and minimum in MI plots.
- Comparatively lower amount of mycorrhizal colonization was observed in MI and HI plots from C, W and LI plots
- Mycorrhizal colonization increased from 10-20 cm to 20-30 cm and gradually decreased up to 40-50 cm
- No significant difference in mycorrhizal colonization was observed in between different sampling depths
- No significant treatment and depth interaction was found

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Recommendation

- Controlling competing and invasive vegetations
- Managing understory plant species
- Planting drought resistant loblolly pine varieties

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

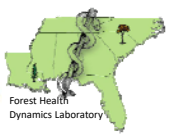
Acknowledgements

- Dalton Smith
- Andrea Wahl
- Sarah Pedan
- John Mensah
- Jessica Ahl
- Luis Mendez
- Robin Governo
- Dr. B.G. Lockaby
- Undergraduate student

AUBURN UNIVERSITY

UAS

Rayonier



Forest Health Dynamics Laboratory

School of Forestry and Wildlife Sciences, Auburn University

What is insect diversity like in a mature loblolly pine stand?

Jessica Ahl, Ryan Nadel, and Lori Eckhardt

Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

Forestry in the Southeastern US

- Agricultural practices in the 1900s
- Large areas of monocultured pine species
- Pest insects typically respond to stressed trees
  - Poor soil, flooding, compaction, drought, mechanical damage
- Insects feed on tissues and vector pathogens

Insects in Forestry

- Nonnative pests are a large part
  - Economic damage
  - Alter ecosystems
    - Emerald ash borer, beech scale
- Native *Dendroctonus*
- Root feeding beetles of special concern
  - Belowground damage
  - Vector blue staining fungi that occlude xylem

Forest Health Dynamics Laboratory

Insects as Bioindicators

- Water quality
  - Mayflies, stoneflies, caddisflies
- Not all are pests
  - Pollinators, predators of pests, food for wildlife, biocontrol of weeds, human food source
- Ecosystem health
  - Decomposition
- Stand health

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objective

To obtain baseline data on annual insect population dynamics for a study investigating the impact of a beetle vectored fungus, *Leptographium terebrantis*

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Experimental Design

- 1 field site in Eufaula, AL
- 15 plots
  - 2 pitfall traps per plot (30 total)
  - 6 panel traps through out the study area, 2 on each side and 2 in the middle
- Insects were collected bimonthly for 1 year
  - Stored in the cooler until processed
  - Identified to family, sorted by morphospecies

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Experimental Design

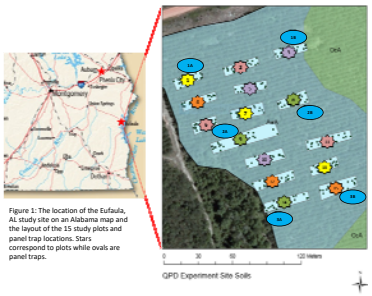
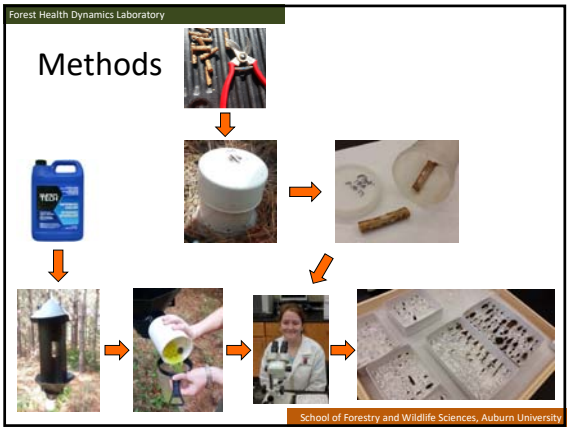


Figure 1: The location of the Eufaula, AL study site on an Alabama map and the layout of the 15 study plots and panel trap locations. Stars correspond to plots while ovals are panel traps.

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods



School of Forestry and Wildlife Sciences, Auburn University

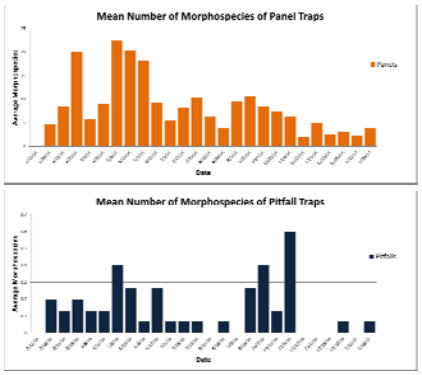
Forest Health Dynamics Laboratory

Results

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

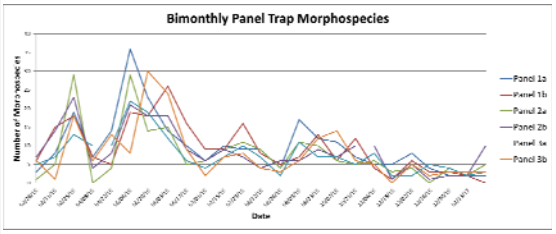
Results



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

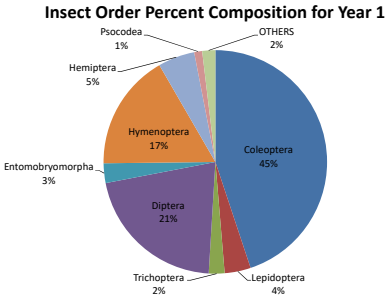
Results



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

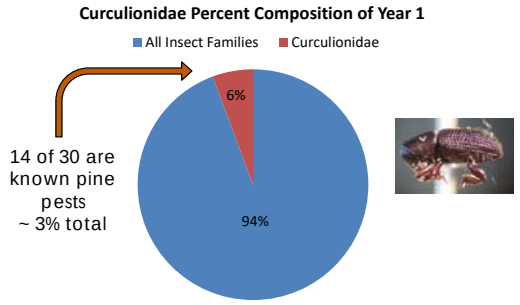


OTHERS: composed of the orders Orthoptera, Psylloidea, Pseudophasmatidae, Mecoptera, Blattodea, Neuroptera, Symphypleona, and unknowns.

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Conclusions

- Insects in 15 orders, including bark beetles and other insects of concern
- Panel traps caught more morphospecies than pitfall traps
- Insect totals varied seasonally
- Pitfall traps caught different species than panel traps
- A 3rd type of pitfall – larger holes and with propylene glycol – will be used in ongoing sampling

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Acknowledgements

John Mensah
Shrijana Duwadi
Dalton Smith
Luis Mendez
Andrea Wahl
Charles Essein
Undergraduate student workers

School of Forestry and Wildlife Sciences, Auburn University

Fine root dynamics in response to inoculation of *Leptographium terebrantis* in loblolly pine stand

Shrijana Duwadi[1], Ryan Nadel[1], Mary A. Sword Sayer[2],Emily A. Carter[3], Lori G. Eckhardt[1]

[1]Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; [2]USDA Forest Service, Southern Research Station, Pineville, LA; [3]USDA Forest Service, Southern Research Station, Auburn, AL

Forest Health Dynamics Laboratory
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Background

- *Leptographium terebrantis* has potentiality to stain vascular bundles of declining trees and has higher ability to infect and kill the root system (Eckhardt et al. 2004)
- Root mortality is one of the factors affected by decline (Hess et al. 2002)
- Belowground assessment of roots often demands destructive techniques
- Minirhizotron method of fine root study is less destructive and demands less time and labor

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objectives

- To determine the change in fine root dynamics in the trees inoculated with different densities of *Leptographium terebrantis*
- To determine the changes in fine root dynamics during different sampling seasons

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

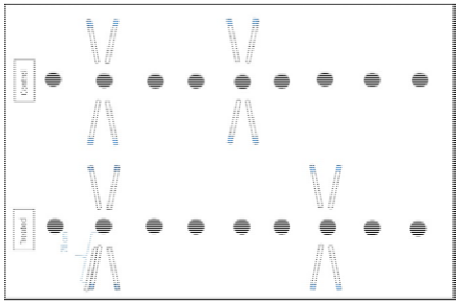
Hypotheses

- Pathogen action reduces water translocation to the crown causing reduced rates of carbon fixation and the loss of leaf area which in turn, lowers carbohydrate allocation to root system
- Different inoculum densities will have different impact on fine root dynamics
- Fine root density will be affected by sampling season and depth

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods (Tube installation)

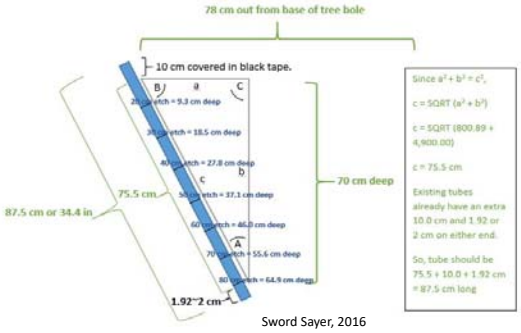


Sword Sayer, 2016

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods (Tube installation)



Sword Sayer, 2016

School of Forestry and Wildlife Sciences, Auburn University

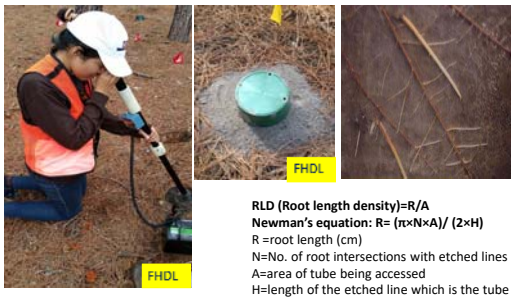
Forest Health Dynamics Laboratory

Materials and Methods (Tube installation)

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods (Data collection)

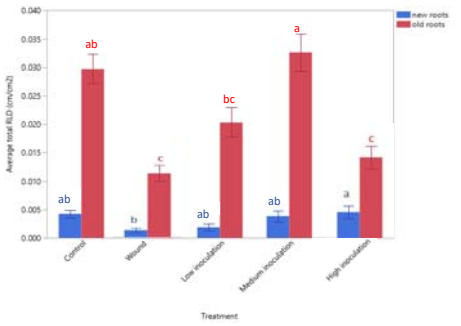


RLD (Root length density)=R/A
Newman's equation: R= (π×N×A)/ (2×H)
R =root length (cm)
N=No. of root intersections with etched lines
A=area of tube being accessed
H=length of the etched line which is the tube circumference

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

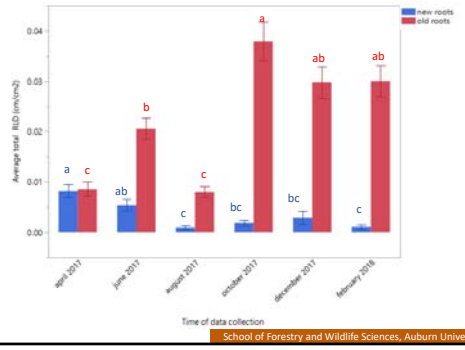
Results



School of Forestry and Wildlife Sciences, Auburn University

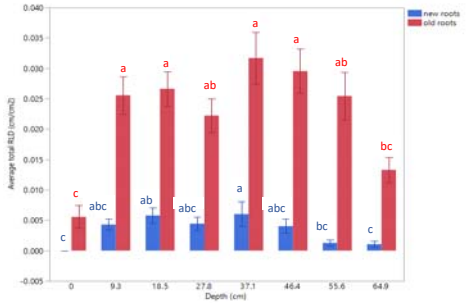
Forest Health Dynamics Laboratory

Results



Forest Health Dynamics Laboratory

Results



Forest Health Dynamics Laboratory

Summary

- Fine roots were observed at ground surface in very few cases
- New ARLD was significantly affected by treatment, depth, time of data collection and the interaction of treatment and time of data collection
- Old RLD was significantly affected by treatment, depth, time of data collection and the interaction of treatment and depth

Forest Health Dynamics Laboratory

Summary

- Both new and old ARLD increased gradually from 0 to 18.5 cm, decreased slightly at 27. 8 cm, was highest at 37.1 cm and gradually decreased up to 64.9 cm
- Within the data collection time, and at same depth, no significant difference in ARLD (both new and old) was observed in between the treatment trees
- No significant differences in ARLD at same depth was observed between the treated and untreated trees within the treatment plots

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Recommendations

- Frequently monitor for the presence of dead trees
- Timely fertilization
- Control soil and root compaction by decreasing the entry of heavy mechanical equipment

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

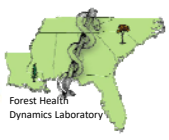
Acknowledgements

- Dalton Smith
- Andrea Wahl
- Sarah Pedan
- John Mensah
- Jessica Ahl
- Luis Mendez
- Undergraduate student

AUBURN UNIVERSITY

UAS

Rayonier



School of Forestry and Wildlife Sciences, Auburn University

Can you identify spores of fungal species on Coleoptera with hyperspectral interferometry?

Jessica Ahl[1], James Beach[2], and Lori Eckhardt[1]

[1]Forest Health Dynamics Laboratory, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL; [2]CytoViva, Inc., 570 Devall Dr., Ste. 301, Auburn, AL

Vocabulary

- Hyperspectral interferometry
  - Hyperspectral = involving the electromagnetic spectrum
  - Interferometry = technique that uses superimposed waves (electromagnetic for example) to gain information
- Fabry-Perot etalon model
  - Consisting of 2 reflecting mirrors, it measures small differences in wavelength by the interference produced, including an adjustable distance between mirrors
- Power spectrum
  - Plots a signal's power (energy over time) within a frequency category

Vocabulary

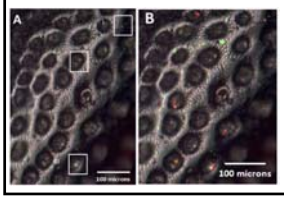
- Near infrared (NIR) spectrograph
  - Near infrared = 780 – 2500 nm of the electromagnetic spectrum, just above visible light
  - Spectrograph = a tool for photographing/recording spectra with a camera by separating light
- Fast Fourier Transform (FFT)
  - Used to calculate power spectra
  - An algorithm that converts a signal from its original form to a representation in a frequency category

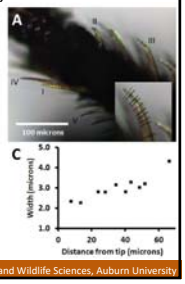
Forest Health Dynamics Laboratory

Introduction

Previous interferometry work used a Fabry-Perot etalon model to locate and size features on the surface of *Hylastes tenuis* (Beach et al. 2015)

- Measured the length of setae from the tip
- Located regions containing spores





School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Objective

Determine if hyperspectral interferometry can speciate fungal spores on the bodies of bark beetles

School of Forestry and Wildlife Sciences, Auburn University

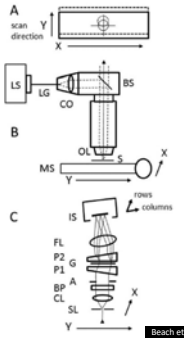
Forest Health Dynamics Laboratory

Methods – The Microscope

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

The Microscope



A) Specimen (circle) mounted on a glass slide, Y and X axes illustrated as the slide moves on a motorized stage

B) Microscope components with reflected light illumination: light source (LS), liquid light guide (LG), collimator (CO), beam splitter (BS), objective lens (OL), sample (S), motorized X/Y stage (MS)

C) Inspector prism-grating-prism spectrograph setup; camera mounted above beam splitter: entrance slit (SL), collimating lens (CL), higher order blocking band pass filter (BP), aperture stop (A), prism 1 (P1), holographic transmission grating (G), prism 2 (P2), focusing lens (FL), and camera image sensor (IS)

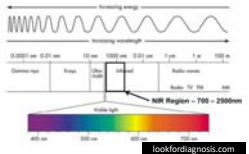
Beach et al. 2015

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

- Specimen is moved incrementally with a motorized stage
  - Spectrographic camera takes images with every stop
    - Has a visible near-infrared (NIR) spectrograph
    - The travel of the stage is guided by a motion algorithm so it is equivalent to the spacing of the image pixels for correct image geometry
  - 696 lines → processed into a final image and data cube
- Program ENVI 4.8 performs spectral analysis while ImageJ is used for spore sizing



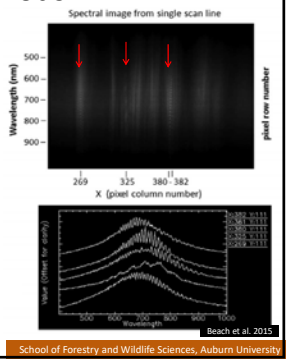
lookfordiagnosis.com

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

- Example:
  - Regions of interest appear as bars resembling venetian blinds
  - Wavelengths correspond to sizes



Beach et al. 2015

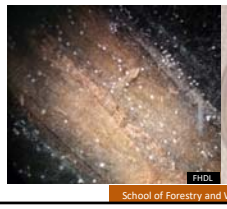
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods - Fungal Spores

- *Grosmannia alacris*
  - Oblong shaped, with truncate bases and rounded apices
  - Ranges from (3.3 – 7.8) x (1.4 – 2.8) microns
- Pine twig agar (PTA), oatmeal

Jacobs and Wingfield 2001


FHDL

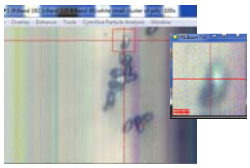

FHDL

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Fungal Spores

How can we get the size of a spore we see?



- Peaks/valleys occur at 495.11 (n_1) and 449.75 (n_2) nm
- Step 1: $1 / (n_1 - n_2) = 0.02205$
- Step 2: $0.02205 \times n_1 \times n_2 = 4909.08$
- Step 3: $4909.08 / (2 \times 1.53) = 1583.57$ nm

And thus . . . 1.583 microns

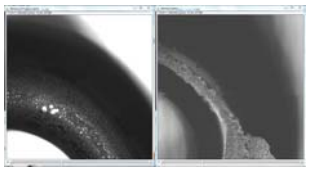
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

- Spores are sticky!
- Glass seed beads to reduce glare
  - Able to roll on media plates


Control bead

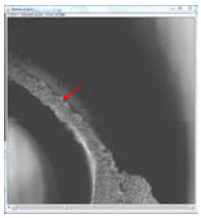

Beads with spores

School of Forestry and Wildlife Sciences, Auburn University

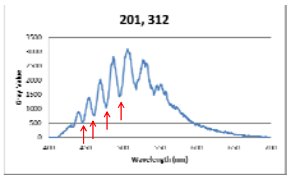
Forest Health Dynamics Laboratory

Methods

Spore size



Bead with spores



- Valleys occur at 444.1, 460.77, 478.08, and 496.04 nm
- Following the formula, this gives us an average spore size of 4.16 microns for this coordinate

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods - Beetle Capture

- *Hylastes salebrosus*
- Two locations:
  - Louise Kreher Forest Ecology Preserve
  - Mary Olive Thomas Demonstration Forest
- Baited with 95% ethanol + 90% 3-carene
  - Replenished every 3 days

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

- Captured beetles kept in the cooler (4°C) for up to 30 days
- Sterilized in 95% ethanol for 30 seconds prior to prep
- Rolled on plates of sporulating fungal cultures
  - Simulate how beetles naturally pick up spores
- Spore loaded beetles taken to CytoViva for imaging
- Resulting images were captured with ENVI and spore maps obtained with the use of ImageJ
  - Developed program (FFT map) for use in ImageJ to pick up objects (spores) that had wavelengths above certain amplitudes after observing control images

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

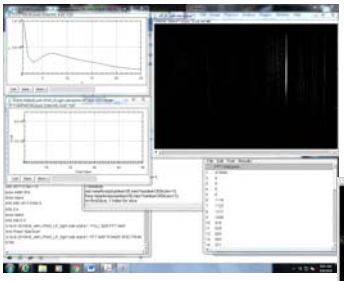
FFT map → into ImageJ

- "Macros" → "Run Macro" → open a captured ENVI image file

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods



FFT test results

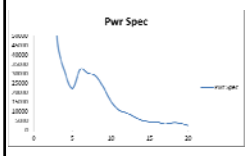
- Power spectrum
- Histogram
- Data file
- Log box
- Map

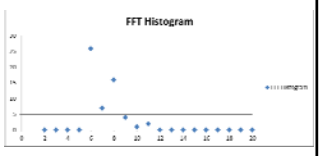
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Methods

- What does the power spectrum tell us?
  - Gives index of frequencies – a relative measure
- What does the histogram tell us?
  - Tells us where most objects rank in the image





School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

ENVI images FFT maps

← Control beetle

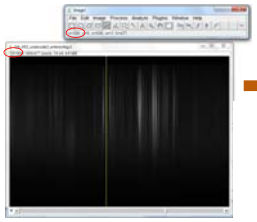
Beetle with *G. alacris* spores ↓

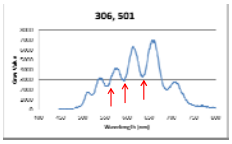
School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

Using maps and data file, go through and locate coordinates of interest



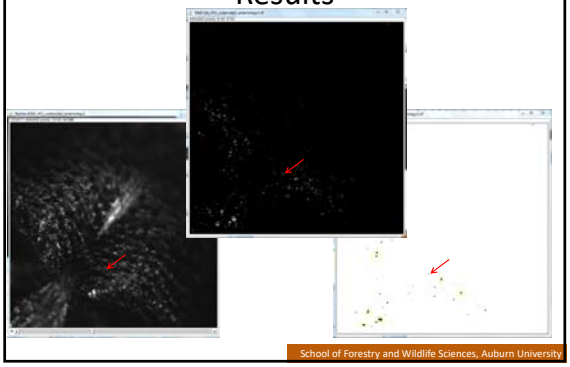


- From the 1st peak to the 2nd, the size is 2.59 microns
- From the 2nd peak to the 3rd, the size is 2.805 microns
- The average –and final – is 2.7 microns

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

From two images taken off a *Grosmannia alacris* spore loaded beetle, we obtained 5 points of interest

- Each image had an average spore size of 2.485 and 4.052 microns, respectively
- Overall average was 3.268 microns

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Discussion

- We know *G. alacris* (GA) spores are irregularly shaped, like pills/eggs
  - Sizes range from (3.3 – 7.8) x (1.4 – 2.8) microns
- Our average spore size for two hyperspectral images on a beetle was 3.3 microns, and falls in this range
- From an image of the GA spore loaded glass bead, we got an average size of 4.4 microns
- Next step is to compare with *Leptographium procerum* on beetles and compare with *G. alacris*
  - Look at sizes as well as power spectra patterns/curves
  - Then can run a statistical analysis with a t test to look for a difference

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Acknowledgements

Luis Mendez
Undergraduate student workers

CytoViva

AUBURN UNIVERSITY

School of Forestry and Wildlife Sciences, Auburn University

New industry and partnership with cross laminated timber.

My Background

- Resume
- International Paper
  - Wood Quality Project Leader
  - Chemometric Characterization
- Louisiana Pacific
  - New Product Development
  - Statistical Modeling
  - Development of cost effective and green adhesives
- Auburn
  - Combines these areas

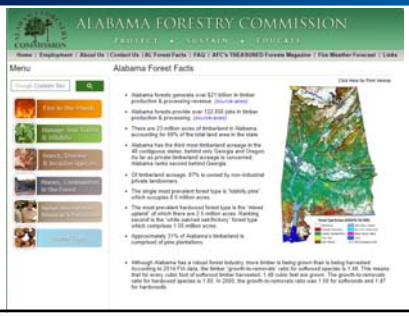
Dr. Maria Soledad Peresin Background

Dr. Maria Soledad Peresin
soledad.peresin@auburn.edu
School of Forestry and Wildlife Sciences, Auburn University

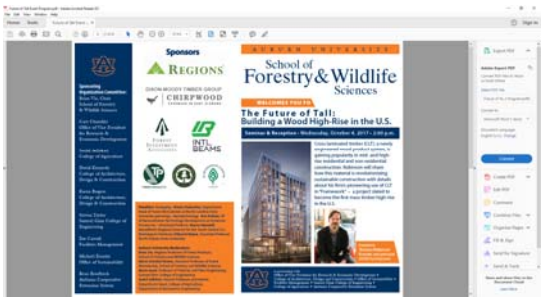
Vesa Kunnari, Panu Lahtinen, Tekla Tammelin
VTT Technical Research Centre of Finland

Orlando Rojas
Aalto University, Finland

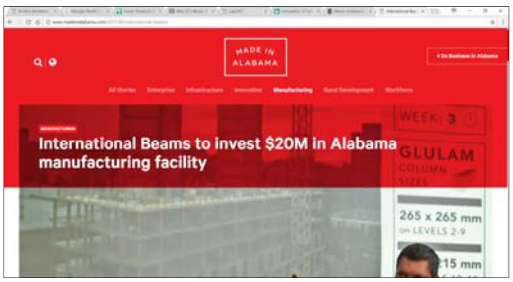
Relevance of Industry to Alabama



Blending Education and Research
Blending Industry and Academia



Auburn University is gearing up for CLT



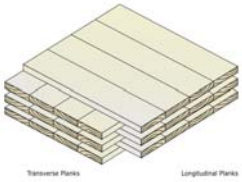
1/xx

Is CLT an Opportunity?

1/xx

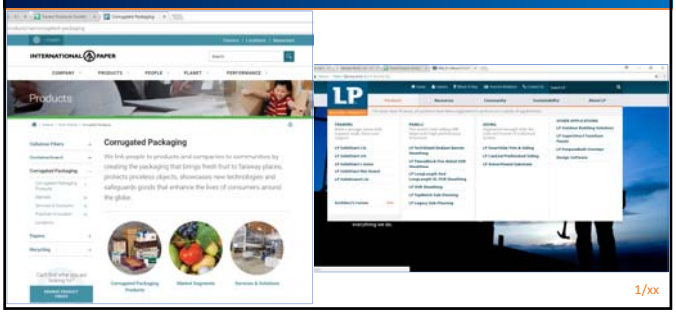
What is CLT?

- https://youtu.be/jEmcJer3AUM



1/xx

Reminder of My Engineered Wood Background



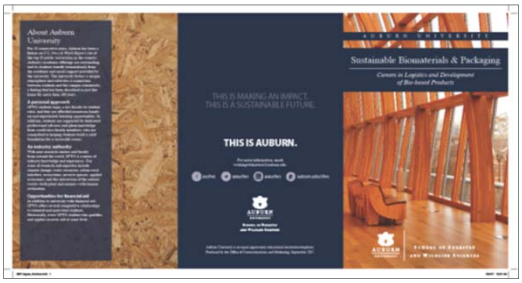
1/xx

More than CLT is at Stake

Video:
https://lpcorp.com/about-lp/why-lp/

1/xx

Auburn University is gearing up for CLT



1/xx

Auburn University is gearing up for CLT

1/xx

Thomas Robinson combats CLT misconception

https://www.cbsnews.com/video/wood-construction-catching-on-but-could-be-dangerous/

1/xx

Other capabilities

Auburn University Assistant Professor David Roueche analyzes damage after Hurricane Irma in Florida Roueche and fellow researchers are collecting data from more than 900 buildings after hurricanes in Texas and Florida to determine why some structures failed and others didn't.

1/xx

Other capabilities

1/xx

New Undergraduate Curriculum

Rationale for an undergraduate program

"Sustainable Biomaterials & Packaging"

Geospatial & Informatics

Wildlife Enterprise Management

Sustainable Biomaterials & Packaging

AUBURN UNIVERSITY

Rationale for an undergraduate program

Sustainable Biomaterials & Packaging <u>Themes</u>

Biomass & Logistics	Processes & Products	Sustainability & Business
• Planting (Seedling) • Feedstock Quality • Harvesting, Transportation • Supply Chain Management • Distribution & Logistics	• Traditional Forest Products • Forestry Materials Packaging • CLT, Wood Composites • BioBased Polymers for Packaging • Bioenergy • Pulp & Paper for Packaging • QC Control & Testing	• Marketing & Business • LCA • Eco-Design • Economics • Product Development • Recycling

AUBURN UNIVERSITY

Rationale for an undergraduate program

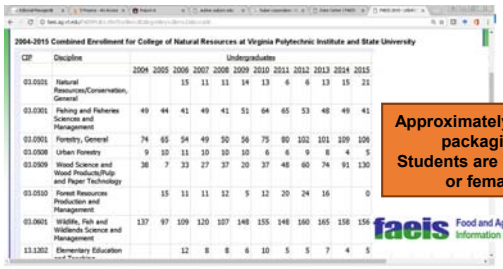
Interdisciplinary Team

- SFWS
- Chemical Engineering (College of Eng.)
- Biosystems Engineering (College of Ag.)
- College of Architecture. Design, & Construction
- Raymond J. Harbert College of Business

AUBURN UNIVERSITY

Rationale for an undergraduate program

Case: Sustainable Biomaterials & Packaging: VT Enrollment



2004-2015 Combined Enrollment for College of Natural Resources at Virginia Polytechnic Institute and State University

CIP	Discipline	Undergraduates											
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
03.0101	Natural Resources/Conservation, General			15	11	11	14	13	6	6	13	15	21
03.0301	Fishing and Fisheries Sciences and Management	49	44	41	49	41	51	64	65	53	48	49	41
03.0501	Forestry, General	74	65	54	49	50	56	75	90	102	101	109	106
03.0508	Urban Forestry	9	10	11	10	10	10	6	6	9	8	4	5
03.0509	Wood Science and Wood Products/Pulp and Paper Technology	38	7	33	27	37	20	37	48	60	74	91	130
03.0510	Forest Resources Production and Management		15	11	11	12	5	12	20	24	16		0
03.0601	Wildlife, Fish and Wildlands Science and Management	137	97	109	120	107	148	155	148	160	165	158	156
13.1202	Elementary Education			12	8	8	6	10	5	5	7	4	5

Approximately 30% of packaging Students are minority or female

faeis Food and Agricultural Education Information System

Rationale for an undergraduate program

Where is Industry Headed?

AUBURN UNIVERSITY

Rationale for an undergraduate program

Sustainable Biomaterials & Packaging <u>Equipment</u>

Dynamic Mechanical Analysis (Strength testing of polymer at Various temperatures)

Thermo-mechanical analysis

Donation of Used Thermal Analysis Equipment

Sustainable Biomaterials & Packaging <u>Equipment</u>

Thermal Gravimetric Analysis (TGA)

TGA + Infra Red Spectrometer

Differential Scanning Calorimeter (DSC)

Thermo-mechanical analysis

Conclusions

- *Cross Laminated Timber is the new industry in town.*
- *New Undergraduate Curriculum has 12 students!*
- *This program is sustainable with 17 trees grown for every 10 harvested.*

FHC Annual Meeting - June 2018
Invasive Plant Update
Nancy Loewenstein

1) **Bamboo as a crop in the Southeast? Current status, questions, and concerns.**
In collaboration with Southern Regional Extension Forestry, Clemson University and University of Florida IFAS, I'm working on a regional extension publication providing an update on bamboo culture and control the Southeast. A brief summary of the current situation is provided below in an abstract for a talk we'll be giving at the *Innovations in Invasive Species Management Conference*, Dec 12-14 in Nashville.

Interest in growing bamboo as a crop for timber and a variety of other products is on the rise across the Southeast, fueled in part by several bamboo-promoting companies. The majority of the proposed species are monopodial bamboos (i.e., running bamboos). One species that is being promoted in the region, *Phyllostachys edulis*, is a known invader in Japan and the congener of species that are currently spreading in the United States (e.g. *P. aurea*, *P. aureosulcata*). Invasive species specialists in the region have concerns with the widespread planting of these plant species. While running bamboos may be contained with dedicated efforts, with any lapse in efforts the bamboo will run - at which point it can drastically increase in area and extend well beyond original boundaries. Once established, bamboo is notoriously difficult to control. Some groups contend that bamboo is not invasive because many species only seed every 70-120 years and it is unlikely to produce seed while in production. However, seed production is not always the primary mode of dispersal and running bamboos clearly have strong potential to spread vegetatively and escape cultivation. Indeed, risk assessments by the University of Florida IFAS Assessment of Non-native Plants (https://assessment.ifas.ufl.edu/) have determined that several of the species proposed for widespread cultivation are predicted to be a high risk for invasion. We will cover basics of bamboo growth, risk assessments, and options for control and containment. We will also address other questions and concerns about growing bamboo in the Southeast, including potential economic and infrastructure issues. Bottom line, there is little information available about ecological impacts, management techniques, or economic return on investment for these species. We don't know enough about bamboo cultivation to recommend it. If landowners decide to grow bamboo, strong measures should be taken to ensure that growers follow best management practices to contain plantings and that viable options are available for growers who may wish to transition out of bamboo.

2) **Updating Invasive Plant List** - The Alabama Invasive Plant Council is beginning the process of updating their invasive plant list using protocol put forth by the National Association of Invasive Plant Councils. The goal of the protocol is to provide:
    - the highest standards for objectivity, scientific rigor and ecological expertise
    - transparent procedures and clear documentation
    - consistent methodology to assure comparability across lists
    - ample opportunity for public review

3) ***New Invaders of the Southeast*** **-** The US Forest Service recently published a guide providing identification and current distribution information on new and emerging invasive plants in the Southeast. It can be accessed online: http://bugwoodcloud.org/resource/pdf/FHTET-2017-05_New%20Invaders_SE.pdf .

Income Structure

INCOME STRUCTURE - FY2018

Dues **Full member - $10,000 / year**
Associate - $5,000 / year

Annual Income

Dues	**$ 112,280**
Auburn	**$ 696,935**
External	**$ 528,500**
Total	**$1,332,715**

For every dollar of dues, Coop members receive $133 of research and technology.

****We are still hoping for some outstanding grants to increase our external dollar amount for FY19!****

Income Structure

Fisical Year	$$ of Research and Technology per $ of dues paid
FY2008	$ 41
FY2009	$ 59
FY2010	$ 62
FY2011	$ 69
FY2012	$ 78
FY2013	$108
FY2014	$125
FY2015	$133
FY2016	$135
FY2017	$133
FY2018	$133

AUBURN UNIVERSITY FOREST HEALTH COOPERATIVE

FY2018 BUDGET - PROJECTED VERSUS ACTUAL

(Mid-June 2018)

FISCAL YEAR
(Oct. 1, 2017 - Sept. 30, 2018)

	FY18 (Projected)	FY 18 (Actual)	Difference
REVENUE			
Carryover from Previous Year	204,255	205,131	876
Current Year's Income - CAFS	55,000	50,000	(5,000)
Current Year's Project & Non-CAFS	51,152	41,820	(9,332)
Total Revenue	**310,407**	**296,951**	(13,456)
EXPENDITURES			
Personnel Costs			
Professional/Non-Faculty	42,558	0	(42,558)
Technician/Staff	0	2,705	2,705
Graduate Assistants	34,933	22,053	(12,880)
Other Personnel (Student Wages)	12,000	16,358	4,358
Employee/GA Benefits (ESTIMATED)	11,114	1,745	(9,369)
Total Personnel Costs	**100,605**	**42,862**	(57,743)
Operating Costs			
Travel/Vehicle Mileage	12,000	8,735	(3,265)
Supplies/Equipment	8,000	10,462	2,462
Total Operating Costs	**20,000**	**19,197**	(803)
Project Costs			
Travel/Vehicle Mileage	9,000	4,475	(4,525)
Supplies/Equipment	12,800	6,148	(6,652)
Lab Analysis	12,160	1,560	(10,600)
Total Project Costs	**33,960**	**12,183**	(21,777)
Total Expenditures	**154,565**	**62,059**	(92,506)
CARRYOVER FOR NEXT YEAR	**155,842**	**234,892**	79,050

AUBURN UNIVERSITY FOREST HEALTH COOPERATIVE

THREE YEAR FINANCIAL STATEMENT

(Mid-June 2018)

(SOD and CAFS Grants Paying for Professional until FY19)

	FISCAL YEAR October 1 - September 30		
	FY19 (Projected)	**FY20** (Projected)	**FY21** (Projected)
REVENUE			
Carryover from Previous Year	155,842	138,132	74,287
Current Year's Income - CAFS	50,000	50,000	50,000
Current Year's Project & Non-CAFS	48,320	48,320	48,320
Total Revenue	**254,162**	**236,452**	**172,607**
EXPENDITURES			
Personnel Costs			
Professional/Non-Faculty	14,585	35,790	36,864
Technician/Staff	0	0	0
Graduate Assistants	37,236	54,950	37,236
Other	12,000	12,000	12,000
Professional/GA Benefits (estimated)	5,839	13,055	12,964
Total Personnel Costs	**69,660**	**115,795**	**99,064**
Operating Costs			
Travel/Mileage	12,000	12,000	12,000
Supplies/Equipment	8,000	8,000	8,000
Total Operating Costs	**20,000**	**20,000**	**20,000**
Project Costs			
Travel	9,000	9,000	9,000
Supplies/Equipment	12,800	12,800	12,800
Lab Analysis	4,570	4,570	4,570
Total Project Costs	**26,370**	**26,370**	**26,370**
Total Expenditures	**116,030**	**162,165**	**145,434**
CARRYOVER FOR NEXT YEAR	**138,132**	**74,287**	**27,173**

AUBURN UNIVERSITY- FOREST HEALTH COOPERATIVE

FY 2018 ACCOMPLISHMENTS

As presented to the Forest Health Cooperative Advisory Committee

Dr. Lori G Eckhardt - Director

6/29/2018

AUBURN UNIVERSITY - FOREST HEALTH COOPERATIVE

FY 2018 WORK PLAN

GOAL A: RESEARCH

Objective 1. Identify research projects

Quantifying the impact of pine decline in the southeastern United States – FHC and SFWS. *Year 4

- ***Accomplishments: Funded by FHC and SFWS***

Novel analytical tools for the selection of superior loblolly pine genotypes for improved plant health, fuels, and chemicals – SFWS, Forest Products Development Center and AU-IGP (Good to Great Grant). *Year 3

- ***Accomplishments: Funded by AU-IGP (Good to Great Grant)***

Seedling production and forest health in the Southeastern United States – in cooperation with the Southern Forestry Nursery Management Cooperative. *Year 5

- ***Accomplishments: Funded by NSF***

Testing of a rapid PCR Screening test for the presence of *Fusarium circinatum*, the causal agent of pitch canker on pine planting material – FHM for supplies, travel and postdoc. *Year 5

- ***Accomplishments: Funded by USFS Forest Health Protection grant.***

Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician. *Year 7

- ***Accomplishments: Refunded by USFS Forest Health Monitoring grant.***

Wood chemistry and disease resistance – SFWS, Forest Products Development Center. *Year 6

- ***Accomplishments: Funded by Forest Products Development Center***

Pinus related diseases and molecular aspects - Collaboration between SFWS and FABI – University of Pretoria South Africa for travel and supplies and a graduate student stipend at UP. *Year 6

- ***Accomplishments: Funded by SFWS and FABI***

Objective 2. Recruit graduate students

Currently there are no openings for a graduate students in the Coop.

Objective 3. Initiate research projects: Determine location, cooperators, and set up research plots dependent upon projects chosen by the membership.

Quantifying the impact of pine decline in the southeastern United States.

- ***Accomplishments:*** **The growth performance of the inoculated and control trees with in the experimental plots have been monitored and data such as radial growth, height growth, leaf area index, foliar nutritional analysis and total phenolic content has been assessed. Insects were collected biweekly and are being identified and processed (year one baseline collections have been completed). Microbial biomass, soil cores and foliar samples have been taken and are being processed.**

Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition.

- ***Accomplishments: Study complete and manuscripts being worked on and submitted. Research reports completed.***

Response of different loblolly pine families to *Leptographium terebrantis* and *Grosmannia huntii.*

- ***Accomplishments: Research reports completed. Manuscript submitted.***

Virulence of *Leptographium terebrantis* and *Grosmannia huntii* on loblolly pine families under drought stress.

- ***Accomplishments: Research reports completed. Manuscript submitted.***

Mature root inoculation of families from seedling screening study to look at reliability of seedling screening.

- ***Accomplishments: Research reports completed. Manuscript published.***

Wood chemistry and disease resistance – SFWS, Forest Products Development Center.

- ***Accomplishments: Families selected from the screening study and LGEPop on Plum Creek and Rayonier property. Trees harvested on Plum Creek and Rayonier property Spring 2014 and Spring 2015, processed in the forest products lab. Manuscripts being prepared and research reports being prepared.***

Identification of Climate Effects on Microbial Symbionts of Longleaf Pine - in collaboration with CERL personnel and University of Mississippi for all travel and supplies.

- ***Accomplishments: Manuscript submitted.***

GOAL B: TECHNOLOGY TRANSFER

Objective 1. Serve as a clearinghouse of information related to forest health issues.

Maintain and Update Forest Health Cooperative Web Site

The Forest Health Cooperative Staff will continue to update the Forest Health Cooperative website for use by Forest Health Cooperative Members. (Eckhardt)

- ***Accomplishments: The website is updated. Advisory Agenda's with each speaker's presentation available for Forest Health Cooperative Members. Research Reports and Technical Notes are updated. Changes in Forest Health Cooperative staff updated and current.***

Objective 2. Efficiently and regularly transfer the results of cooperative research to the membership.

Research Reports (Staff)

We plan on producing Research Reports and Technical Notes in FY12 now that research projects are underway.

- ***Accomplishments: Research Report 2017-1 to 1017-6 and several currently being written which will be online before the end of the year.***
- Wahl, A.C. and Eckhardt, L.G. 2017. Flight phenology of *Sirex nigricornis* (Hymenoptera:Siricidae) and other woodwasps in Alabama. Research Report 2017-01. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.
- Wahl, A.C. and Eckhardt, L.G. 2017. *Deladenus* species associated with native siricid woodwasps in Alabama. Research Report 2017-02. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.

- Wahl, A.C. and Eckhardt, L.G. 2017. Effects of growth rate on *Amylostereum* spp. Fungus by terpenes. Research Report 2017-03. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.
- Wahl, A.C. and Eckhardt, L.G. 2017. Competitiveness of *Amylostereum* spp. fungi against *Leptographium* spp. fungi. Research Report 2017-04. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.
- Devkota, P. and Eckhardt, L.G. 2017. Intraspecific and inter-stocktype response of *Pinus taeda* L. to *Grosmannia huntii* and *Leptographium terebrantis.* Research Report 2017-05. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.
- Devkota, P. and Eckhardt, L.G. 2017. Intra-species variation in response of mature *Pinus taeda* families to root-infecting ophiostomatoid fungi. . Research Report 2017-06. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University.

Newletters (Staff)

Newsletter distribution is planned for November FY2018. Members are encouraged to submit articles.

- ***Accomplishments: A Spring2017 Newsletter was sent to all Forest Health Cooperative Members, approximately 20 on the mailing list.***

Objective 3. Provide a limited consultancy function to the membership in the area of forest health.

Individual and Organized Contacts

An on-going activity and is handled as individual situations and cases arise. (Staff)

	Eckhardt	Mendez	Nadel
Phone calls	**30**	**6**	**1**
Letters	**1**	**0**	**0**
Emails	**55**	**23**	**1**
Site Visits	**6**	**3**	**0**
Diagnosis	**25**	**8**	**1**

Short Courses

Forest Health Short Course will be offered in odd years starting with FY2009. A Short Course in Forest Health will be planned for August 2019. (Staff)

- ***Accomplishments: A short course was held August 15-16 at the request of membership with 45 participants. The next short course will be planned for summer 2017 if there is interest.***

GOAL C: COOP DEVELOPMENT

Objective 1. Provide for the continual relevancy and efficiency of the Cooperative research and technology transfer programs.

Advisory Committee Meeting

The FY18 Advisory Committee Meeting will be held the last week in June 2018. A 2 day meeting will be planned. If there are any meetings that conflict with this time frame, let us know and we can try and accommodate Advisory Members. (Eckhardt/Bowersock).

- ***Forest Health Advisory Meeting was held in Auburn on October 23-24, 2017.***

Forest Health Cooperative Membership

The Forest Health Cooperative staff should make an effort to recruit new members. (Staff)

- ***Looking for new members.***

Update the Cooperative Membership Directory

An on-going activity. (Bowersock/Eckhardt)

- ***Accomplishments: Membership directory updated and loaded onto website.***

Objective 2. Increase the visibility and effectiveness of the Cooperative as a source of information on issues related to forest health.

Presentations at Meetings

Forest Health Cooperative staff will continue to be encouraged to participate as a speaker or attendee in regional and national meetings. (Staff)

- ***Accomplishments: Forest Health Cooperative Staff gave 43 presentations and published 6 article on the subject of Forest Health.***

*Mensah, J.K., Sword Sayer, M. A., Nadel, R. L, Matusick, G., Fan, Z., and Eckhardt, L.G. **2018**. Physiological response of naturally regenerated *Pinus taeda* L. saplings to four levels of

stem inoculation with *Leptographium terebrantis*. International Congress of Plant Pathology, Boston, MA

*Mensah, J., Nadel, R.L., Matusick, G., Sayer, M.A.S., Carter, E.A., and Eckhardt, L.G. **2018**. Quantifying the impact of pine decline in the southeastern United States. Center for Advanced Forestry Systems 2017 Industrial Advisory Board Meeting, Burlington, VT

*Mensah, J.K. and Eckhardt, L.G. **2018**. Susceptibility and tolerance of loblolly pine to Leptographium terebrantis: Student Research Symposium, Auburn University, Auburn, AL

*Duwadi, S., Nadel, R., Carter, E.A., Feng, Y., Eckhardt, L.G. **2018**. The response of soil microbial biomass to inoculation due to plant pathogenic fungus, *Leptographium terebrantis* in loblolly pine stand. This is Research: Student Symposium, Auburn University, Auburn, AL

*Ahl, J.B., Nadel, R. and L.G. Eckhardt, L.G. **2018**. What is insect diversity like in a mature loblolly pine stand? This is Research: Student Symposium, Auburn University, Auburn, AL

*Mensah, J.K., Sword Sayer, M. A., Nadel, R. L, Matusick, G., Fan, Z., and Lori G. Eckhardt, L.G. **2018**. Pathogenicity of *Leptographium terebrantis* to saplings of *Pinus taeda* L.: Efficacy of the toothpick inoculation approach. American Phytopathological Society, 95th Southern Division Meeting, Fayetteville, AR

*Ahl, J.B., Eckhardt, L.G. and Beach, J.M. **2018**. Can you identify spores of fungal species on coleopteran with hyperspectral interferometry? Southeastern Society of American Foresters, Pine Mountains, GA

*Duwadi, S., Nadel, R., Carter, E.A., Feng, Y., Eckhardt, L.G. **2018**. Response of soil microbial biomass to soil moisture content in loblolly pine (*Pinus taeda*) stand. Southeastern Society of American Foresters, Pine Mountains, GA

*Mensah, J.K., Sword Sayer, M. A., Nadel, R. L, Matusick, G., Fan, Z., and Lori G. Eckhardt, L.G. **2018**. Pathogenicity of *Leptographium terrebrantis* to saplings of *Pinus taeda* L.: Efficacy of the toothpick inoculation approach. Southeastern Society of American Foresters, Pine Mountains, GA

Eckhardt, L.G. **2018**. Native pathogens affecting *Pinus* species in the southeastern United States. CTHB Meeting, Forest and Agricultural Biotechnology Institute. University of Pretoria, Pretoria, South Africa.

Devkota, P., and Eckhardt, L.G. **2018**. The response of loblolly pine families to root-feeding bark beetle vectored fungi. Southern Forest Nursery Association Meeting, Pensacola, FL

*Duwadi, S., Carter, E.A., Nadel, R., Feng, Y., and Eckhardt, L.G. **2017.** Effect of soil moisture on soil microbial biomass in loblolly pine (*Pinus taeda*) stand. Soil Science Society of America. Tampa, FL

Eckhardt, L.G. **2017**. Forest insect and diseases. Forestry Invitational Training Workshop. Auburn, AL

Eckhardt, L.G. **2017**. Complexity of recent pine tree losses in southern forests. Chambers County Forestry Planning Committee Meeting, Lafayette, AL

Eckhardt, L.G. **2017**. Bark beetles 101. Alabama Forestry Commission Workshop: Are your trees dying? Landowners Meeting, Marengo County, Linden, AL

Eckhardt, L.G. **2017**. Forest pests and diseases. Alabama Teachers Conservation Workshop. Auburn, AL

Eckhardt, L.G. **2017**. Bark beetles 101. Alabama Forestry Commission Workshop: Are your trees dying? Landowners Meeting, Oxford, AL

*Essien, C, Via, B.K., Cheng, G., Gallagher, T., McDonald, T. and Eckhardt L. **2017**. Applying discriminate analysis and acoustic tool to assign loblolly pine families into susceptibility classes. International Nondestructive Testing and Evaluation Symposium. Madison, WI

Publications

Forest Health Cooperative staff are encouraged to publish research results in scientific journals. (Staff)

*Piculell, B.J. Nelson, C.D., Roberds, J., Eckhardt, L.G., and Hoeksema, J.D. (*Accepted*) Genetically determined fungal pathogen tolerance and soil variation influences ectomycorrhizal traits of loblolly pine. Ecology and Evolution

Eckhardt, L.G. **2018**. Loblolly Pine Decline (sidebar, Chapter X). In: (eds.) *The Conifer Compendium*. American Phytopathological Society Press, USA.

*Devkota, P., Nadel, R.L., and Eckhardt, L.G. **2018**. Intra-species variation of mature *Pinus taeda* in response to ophiostomatoid fungi. Printed online first http://onlinelibrary.wiley.com/doi/10.1111/efp.12415/full Forest Pathology. (*In Press*).

*Essen, C., Via, B.K., Gallagher, T., McDonald, T., and Eckhardt, L.G. **2018**. Distance error for determining the acoustic velocity of standing tree using tree morphological, physical and anatomical properties. Printed online first https://doi.org/10.1007/s13196-018-0208-3 Journal of the Indian Academy of Wood Science (*In Press*).

*Acquah, G., Via, B.K., Fasina, O., Adhikari, S., Billor, N., and Eckhardt L. **2018**. Estimating the basic density and mechanical properties of elite loblolly pine families with near infrared

spectroscopy. Printed online first https://academic.oup.com/forestscience/advance-article/doi/10.1093/forsci/fxx009/4916890?guestAccessKey=dda83216-c452-4e85-a640-fec2ef9745a5 Forest Science (*In Press*).

*Essien, C., Via, K.B., Acquah, G.E., Gallagher, T., McDonald, T., Wang, X. and Eckhardt, L.G. **2017**. Effect of genetic sources on the anatomical, morphological, and mechanical properties of 14-year-old genetically improved loblolly pine families selected from two sites in the southern United States. Printed online first https://link.springer.com/article/10.1007/s11676-017-0584-3#citeas. Journal of Forest Research (*In Press*).

*Essen, C., Via, B.K., Gallagher, T., McDonald, T., and Eckhardt, L.G. **2017**. Sensitivity tools to variation in equilibrium moisture content of small clear samples of loblolly pine (*Pinus taeda*). Printed online first https://doi.org/10.1007/s13196-017-0202-1. Journal of the Indian Academy of Wood Science (*In Press*).

Extramural Funding of Forest Health Cooperative Projects

Forest Health Cooperative staff will continue to be encouraged to locate and generate extramural funding opportunities directly related to forest health. (Staff)

- ***Accomplishments: Forest Health Cooperative Staff were awarded the following grants totaling $935,500.***

- Eckhardt and Bernard. 2019. *Pinus* related diseases (molecular aspects) and *Sirex*. SFWS and FABI – University of Pretoria South Africa for travel and supplies - $30,000.
- Eckhardt and Enebak. 2018. Sudden Oak Death – *Phytophpora ramorum* surveys - $36,000.
- Eckhardt and Wingfield. 2018. *Pinus* related diseases and molecular aspects. SFWS and FABI – University of Pretoria South Africa for travel and supplies and a graduate student stipend at UP - $30,000.
- Via and Eckhardt. 2017. Wood chemistry and disease resistance. SFWS - $5,000.
- Eckhardt and Enebak. 2017. Sudden Oak Death – *Phytophpora ramorum* surveys - $36,000.
- Eckhardt, Nadel, Matusick, Sword, Carter. 2017. Quantifying loblolly pine decline – FHC and SFWS – SFWS portion $60,000
- Eckhardt and Bernard. 2016. *Pinus* related diseases (molecular aspects) and *Sirex*. SFWS and FABI – University of Pretoria South Africa for travel and supplies - $30,000.
- Eckhardt and Enebak. 2016. Sudden Oak Death – *Phytophpora ramorum* surveys - $34,000.
- Enebak and Eckhardt. 2014. Testing of a rapid PCR Screening test for the presence of *Fusarium circinatum*, the causal agent of pitch canker on pine planting material – FHM - $150,000.

- Enebak and Eckhardt. 2014. Seedling production and forest health in the Southeastern United States – NSF-CAFS - $300,000 ($150,000 to FHC).
- Eckhardt. 2014. Root disease model – SFWS - $64,500.
- Hoeksema and Eckhardt. 2014. Mycorrhizal fungal colonization and disease resistance – SFWS and University of Mississippi - $25,000.
- Via and Eckhardt. 2014. Wood chemistry and disease resistance. SFWS - $5,000.
- Eckhardt and Wingfield. 2015 *Pinus* related diseases and molecular aspects. SFWS and FABI – University of Pretoria South Africa for travel and supplies and a graduate student stipend at UP - $30,000.
- Via and Eckhardt. 2015. Novel analytical tools for the selection of superior loblolly pine genotypes for improved plant health, fuels, and chemicals – IGP - $100,000.

AUBURN UNIVERSITY- FOREST HEALTH COOPERATIVE

FY 2019 PROPOSED WORK PLAN

As presented to the Forest Health Cooperative Advisory Committee

Dr. Lori G Eckhardt - Director

6/28/2018

AUBURN UNIVERSITY - FOREST HEALTH COOPERATIVE

FY 2019 WORK PLAN

GOAL A: RESEARCH

Objective 1. Identify research projects

Proposed FY2019:

1. Quantifying the impact of root disease on the function of a tree - NIFA-AFRI for travel, supplies, graduate students and post-doc $497,691 – *Reviewed as high priority with good reviews for 2015 submission. Wanted more preliminary data, asked to resubmit July 2016. Not funded. Resubmitted July 2017, Not funded.* W*ill resubmit July with modifications if suitable RFP released.*
2. Novel analytical tools for the selection of superior loblolly pine genotypes for improved plant health, fuels, and chemicals – NIFA-AFRI for travel, supplies, graduate students and post-doc $494,377 – *Reviewed as high priority with good reviews in 2015. Wanted more preliminary data, asked to resubmit July 2016.* W*ill resubmit July with modifications if suitable RFP released.*
3. Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition – APHIS for travel, supplies and graduate student $99,493 - *Decision pending dependent upon continuation of funds*
4. A *Hylastes* species-*Leptographium* species mutualism and *Pinus palustris* restoration – DoD (3 years) $211,404 - *Decision pending dependent upon continuation of funds*
5. Exploring soil microbial communities as mediators of complex threats to southern conifers – Agriculture and Food Research Initiative Competitive Grant (3 years) $497,000 - W*ill resubmit July with modifications if suitable RFP released*
6. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $36,000 – *Will submit March 2019*

Newly Funded FY2018:

1. Fungal host resistance in loblolly pine – SFWS and University of Alberta (Edmonton) $30,000
2. Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition – SFWS and FABI $30,000
3. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $34,000.

4. Collaboration between SFWS and FABI – University of Pretoria South Africa to work on *Pinus* related diseases and molecular aspects. $5,000 per participant
5. Wood chemistry and disease resistance – SFWS and Forest Products Development Center (to get additional preliminary data for larger grant) $5,000

Newly Funded FY2017:

1. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $34,000.
2. Collaboration between SFWS and FABI – University of Pretoria South Africa to work on *Pinus* related diseases and molecular aspects. $5,000 per participant (3 years)
3. Wood chemistry and disease resistance – SFWS and Forest Products Development Center (to get additional preliminary data for larger grant) $5,000
4. Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition – SFWS and FABI $20,000

Funded FY2016:

1. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $36,000.
2. Collaboration between SFWS and FABI – University of Pretoria South Africa to work on *Pinus* related diseases and molecular aspects. $5,000 per participant (3 years)
3. Wood chemistry and disease resistance – SFWS and Forest Products Development Center (to get additional preliminary data for larger grant) $5,000
4. Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition – SFWS and FABI $20,000

Funded FY2015:

1. Seedling production and forest health in the Southeastern United States – NSF-CAFS - $300,000.
2. Rapid assessment tools for the genetic improvement of forest products and bioenergy – HATCH for travel, supplies and graduate student $50,000.
3. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $36,000
4. Testing of a rapid PCR Screening test for the presence of *Fusarium circinatum*, the causal agent of pitch canker on pine planting material – FHM for supplies, travel and postdoc - $150,000

Funded FY2014:

1. Identification of Climate Effects on Microbial Symbionts of Longleaf Pine – ERDC-CERL in collaboration with CERL personnel (Ryan Busby) and University of Mississippi for all travel and supplies - $50,000
2. Interactions of future climate change scenarios of elevated tropospheric ozone and decreasing rainfall amounts with loblolly pine decline – HATCH for all travel, supplies and graduate student - $49,986.
3. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $36,000.
4. Field evaluation of a controlled vapor delivery method in an integrated pest management system for citrus and loblolly pine – AU-IGP in collaboration with AU Chemical Engineering for all travel, supplies and student worker - $97,000
5. Root disease model to determine how pine decline and annosum root rot interact – SFWS for travel, supplies, graduate student stipend - $64,000
6. Mycorrhizal fungal colonization and disease resistance – SFWS and University of Mississippi for all travel, supplies and graduate student stipend - $25,000
7. Wood chemistry and disease resistance – SFWS and Forest Products Development Center (to get preliminary data for larger grant) $5,000
8. Collaboration between SFWS and FABI – University of Pretoria South Africa to work on *Pinus* related diseases and molecular aspects. $5,000 per participant (3 years)

Funded FY2013:

1. Hylastes population dynamics and forest health evaluation in association with thinning and fertilization on new RW19 in Louisiana – Funding through FHP and FHC
2. Delineating loblolly pine decline in the Southeast using FHM/FIA data – submitted to FHM, USFS for all travel and supplies associated with the project $35,000 – (Funded Year 2 for $17,000)
3. Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $47,000
4. Mature root inoculation of families from screening study found in the LGEPop study in GA and FL (Study 3 of the Resistance of *Pinus taeda* families under artificial inoculations with native and non-native *Leptographium* species involved in premature mortality under different nutritional regimes project) – SFWS and Forest Health Cooperative.

Objective 2. Recruit graduate students

1. Currently seeking a M.S. candidate to study ophiostomatoid fungi associated with pine decline in loblolly pine across the southeastern U.S. The research will investigate how fungal volatiles interact with semiochemicals to mediate interactions. The student will

collaborate with researchers from the USDA Forest Service, University of Alberta, University of Pretoria and the Forest Health Cooperative membership.

2. Currently seeking a Ph.D. candidate to study host resistance in loblolly pine. The research will investigate how terpenes affect fungi associated with various insects that attack loblolly pine. The student will collaborate with researchers from the USDA Forest Service, University of Pretoria and the Forest Health Cooperative membership.

Objective 3. Initiate and continue research projects: Determine location, cooperators, and set up research plots dependent upon projects chosen by the membership.

Quantifying the impact of pine decline in the southeastern United States

1. Following successful inoculation of the trees in 2017, the growth performance of the inoculated and control trees within the experimental plots will continue to be monitored and evaluated. During the period (2019), radial and height growth; leaf area index; foliar nutritional analysis and total phenolic content will be assessed.
2. Continue processing and sorting insect samples collected at the Eufaula, AL QPD site.

Ecology of siricids and fungal associates in southeastern pine forests: potential for biological control and competition.

1. Manuscripts being submitted.

Virulence of *Leptographium terebrantis* and *Grosmannia huntii* on loblolly pine families under drought stress.

1. Manuscript to be submitted.

Resistance of *Pinus taeda* families under artificial inoculations with native and non-native *Leptographium* species involved in premature mortality.

1. Manuscript to be submitted.

Identification of cogongrass effects on microbial symbionts and physiological vigor of loblolly pine.

1. Manuscript to be submitted.

Blue-stain fungi associated with wild pigs causing rooting damage in longleaf and loblolly pine stands.

1. Manuscript to be submitted.

Wood chemistry and disease resistance.

1. Manuscript to be submitted

Mycorrhizal fungal colonization and disease resistance.

1. Manuscript to be submitted

GOAL B: TECHNOLOGY TRANSFER

Objective 1. Serve as a clearinghouse of information related to forest health issues.

Maintain and Update Forest Health Cooperative Web Site

The Forest Health Cooperative Staff will continue to update the Forest Health Cooperative website for use by Forest Health Cooperative Members. (Mendez)

Leveraging Forest Health Cooperative Data

The Forest Health Cooperative staff will continue to stress the importance of the Cooperative membership and when possible, leverage Cooperative information for grant proposals. (Staff)

Objective 2. Efficiently and regularly transfer the results of cooperative research to the membership.

Research Reports (Staff)

We plan on producing Research Reports and Technical Notes in FY19.

Newsletters

Newsletter distribution will be planned for March (Spring) 2019. Members are encouraged to submit articles.

Objective 3. Provide a limited consultancy function to the membership in the area of forest health.

Individual and Organized Contacts

An on-going activity and is handled as individual situations and cases arise. (Eckhardt/Bauman)

Short Courses

The Forest Health Cooperative will offer a Forest Health Short Course in Auburn for member personnel in July 2019. We need a minimum of 20 attendees and will survey the membership in January 2019 for interest.

GOAL C: COOP DEVELOPMENT

Objective 1. Provide for the continual relevancy and efficiency of the Cooperative research and technology transfer programs.

Advisory Committee Meeting

The FY19 Advisory Committee Meeting will be held on June 26-27, 2019. A 2 day meeting will be planned. If there are any meetings that conflict with this time frame, let us know and we can try and accommodate Advisory Members. (Eckhardt/Bowersock)

Forest Health Cooperative Membership

The Forest Health Cooperative staff should make an effort to recruit new members. (Staff)

Update the Cooperative Membership Directory

An on-going activity with an updated directory distributed annually. (Bowersock)

Objective 2. Increase the visibility and effectiveness of the Cooperative as a source of information on issues related to forest health.

Presentations at Meetings

Forest Health Cooperative staff will continue to be encouraged to participate as a speaker or attendee in regional and national meetings. (Staff)

Publications

Forest Health Cooperative staff are encouraged to publish research results in scientific journals. (Staff)

Extramural Funding of Forest Health Cooperative Projects

Forest Health Cooperative staff will continue to be encouraged to locate and generate extramural funding opportunities directly related forest health.

Interaction with other Research Cooperatives

The Forest Health Cooperative staff will make efforts to interact, attend, work with other regional and national forest research Cooperatives in an attempt to broaden and strengthen research ties that can benefit forest health.