AUBURN UNIVERSITY- FOREST HEALTH COOPERATIVE

FY 2020 ACCOMPLISHMENTS

As presented to the Forest Health Cooperative Advisory Committee

Dr. Lori G Eckhardt - Director

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AUBURN UNIVERSITY - FOREST HEALTH COOPERATIVE

FY 2020 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 6

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

Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician. *Year 8

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

Wood chemistry and disease resistance – SFWS, Forest Products Development Center. *Year 7

- ***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 7

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

Identification and quantification of volatile chemicals emitted by *Amylostereum areolatum* and ophiostomatoid species to develop highly novel lures for monitoring and evaluating Sirex and bark beetle populations in the United States. *Year 1

- ***Accomplishments: Funded by AU-IGP, SFWS and University of Alberta***

Isolation and identifying of fungi associated with loblolly pine needle damage in the southeastern US. *Year 1

- ***Accomplishments: Funded by SFWS, FABI, Stallworth and FHC***

Objective 2. Recruit graduate students

Currently there are no openings for a graduate student 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.

1. ***Accomplishments:*** Study has been harvested. Data taken and analyzed. Research reports in preparation. Completed 2 Master's theses and 1 Ph.D. dissertation
    - Shrijana Duwadii - Impact of tree inoculation by *Leptographium terebrantis* on soil microbial communities in commercial loblolly pine stand
    - Jessica Ahl - Ophiostomatoid fungal infection and insect diversity in a mature loblolly pine stand
    - John Mensah - Influence of *Leptographium terebrantis* S.J. Barras and T.J. Perry on *Pinus taeda* L. physiology, growth and productivity

    ➢ ***Related Publications*:**
    - Devkota, P., Mensah, J. K., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (2019). *Pinus taeda* L. response to differential inoculum density of Leptographium terebrantis colonized toothpicks. *Forest Pathology*, 49 (1), e12474
    - Mensah, J. K., Sayer, M. A. S., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (2020). Physiological response of *Pinus taeda* L. trees to stem inoculation with *Leptographium terebrantis*. *Trees*, 34:869-880
    - Ahl, J.B., Eckhardt, L. G. (Submitted) Identifying fungal spores on the pine bark beetle with hyperspectral interferometry. Microscope Research and Technique – Under Review
    - Mensah, J. K., Sayer, M. A. S., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (In preparation) *Leptographium terebrantis* inoculation and associated crown symptoms and tree mortality in Pinus taeda
    - Mensah, J. K., Sayer, M. A. S., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (In preparation) Effect of *Leptographium terebrantis* and drought on foliage, new root dynamics and stemwood growth in plantation *Pinus taeda* L.
    - Mensah, J. K., Sayer, M. A. S., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (In preparation) Foliar nutrients response of *Pinus taeda* L. to *Leptographium terebrantis* infection.
    - Mensah, J. K., Sayer, M. A. S., Nadel, R. L., Matusick, G., & Eckhardt, L. G. (In preparation) Effect of *L. terebrantis* on the production of defensive chemical compounds.

Identification and quantification of volatile chemicals emitted by ophiostomatoid species to develop highly novel lures for monitoring and evaluating Sirex and bark beetle populations in the United States.

- ***Accomplishments:*** Volatile collection chambers have been put together to collect headspace volatiles from fungal cultures. A total of 216 samples have been collected from fungal cultures grown in the lab plus 63 different dilutions of chemical standards. Seedlings were inoculated with fungal species and later sampled for fungal volatiles. 150 samples have been collected. Currently, the samples are being analyzed with the Gas Chromatography-Mass Spectrometer.

Isolation and identifying of fungi associated with loblolly pine needle damage in the southeastern US.

- ***Accomplishments:*** Total of 22 infected stands across the southeastern US have been surveyed to collect unhealthy loblolly pine needle samples from March 2019 through October 2020. To date, 767 branch tips were examined from 376 sampled trees. Sterilized needle samples were plated onto various growth media, incubated, monitored and transferred to fresh media. Fungi identification were confirmed followed by a series of molecular steps such as DNA extractions, PCR, Gel electrophoreses, PCR purification and ITS sequencing.

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

- ***Accomplishments:*** Research reports completed. One manuscript submitted and one in review.

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

- ***Accomplishments:*** Research reports completed.
- ***Related Publications*:**
  Devkota, P., Enebak, S.A., and Eckhardt, L.G. 2019. A performance comparison of bareroot and containerized *P. taeda* L. seedlings to the effect of ophiostomatoid fungi. Tree Planters Note 62:52-57

Biocontrol of ophiostomatoid fungi by plant growth-promoting rhizobacteria.

- ***Accomplishments:*** Research reports completed.
- ***Related Publications*:** Devkota*, P., Kloepper, J.W., Enebak, S.A. and Eckhardt, L.G. 2019. Towards biocontrol of ophiostomatoid fungi by plant growth-promoting rhizobacteria. BioControl Sci Techn https://doi.org/10.1080/09583157.2019.1682517

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

- ***Accomplishments:*** Research reports being prepared.
- ***Related Publications*:** Essien, C., Devkota, P., Eckhardt, L.G., Via, B.L. 2019. Applying discriminate analysis and acoustic tool to assign *Pinus taeda* families into pine decline susceptibility classes. Eur J Wood Wood Prod. 77: 1117-1124

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. (Ciaramitaro)

- ***Accomplishments:*** The website is currently being 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 FY21 now that research projects are underway.

- ***Accomplishments:*** Research Report 2020-1 to 2020-4 are being completed.

  Ahl*, J. and Eckhardt, L.G. 2019. Identifying fungal spores on coleoptera with hyperspectral interferometry. Research Report 2019-05. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University

Ahl*, J. and Eckhardt, L.G. 2019. Insect diversity in a loblolly pine stand infected with *Leptographium terebrantis*. Research Report 2019-04. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University

Duwadi*, S. and Eckhardt, L.G. 2019. New root growth and ectomycorrhizal colonization of fine roots in loblolly pine as affected by the inoculation of *Leptographium terebrantis*. Research Report 2019-03. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University

Duwadi*, S. and Eckhardt, L.G. 2019. Fate of soil microbial biomass in the *Leptographium terebrantis* inoculated loblolly pine stand. Research Report 2019-02. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University

Duwadi*, S. and Eckhardt, L.G. 2019. Soil physiochemical properties and foliar nutrient analysis prior to inoculation loblolly pine stand with *Leptographium terebrantis*. Research Report 2019-01. Forest Health Cooperative, School of Forestry and Wildlife Sciences, Auburn University

Newletters (Staff)

Newsletter distribution is planned for Spring 2021. Members are encouraged to submit articles.

- ***Accomplishments:*** A February 2019 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	Ciarmitaro
Phone calls	**27**	**2**
Letters	**2**	**0**
Emails	**61**	**4**
Site Visits	**4**	**3**
Diagnosis	**42**	**4**

Short Courses

Forest Health Short Course will be offered in odd years. A Short Course in Forest Health will be planned for August 2021. (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 2021 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 FY20 Advisory Committee Meeting will be held in the last June 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/Ciaramitaro/Bowersock).

- ***Forest Health Advisory Meeting was held*** **June 26-27, 2019.**

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 10 presentations and published 5 articles on the subject of Forest Health**.**

Mensah*, J.K., Nadel, R.L., Matusick, G., Sword, M.A., Fan, Z., and Eckhardt, L.G. 2019. Quantifying southern pine decline: the role of *Leptographium terebrantis*. The 25th International Union of Forest Research Organizations (IUFRO) World Congress, Curitiba, Brazil (**Invited**)

Mensah*, J.K., Sword Sayer, M. A., Nadel, R. L, Matusick, G., Fan, Z., and Eckhardt, L.G. 2019. Effect of *L. terebrantis* on resins and phenolics production in *Pinus taeda*. Plant Science Research Symposium – Expanding Collaboration across the University. Auburn University Research Park, AL (*Poster*)

Menanyih*, S.A., Cale, J., Calderon, A., and Eckhardt, L.G. 2019. Fungal volatile organic compounds: their role in bark beetles' management in the southeastern United States. Plant Science Research Symposium – Expanding Collaboration across the University. Auburn University Research Park, Auburn, AL (*Poster*)

Datta*, D., Enebak, S.A., Coleman, J.J., and Eckhardt, LG. 2019. Fungal associations with loblolly pine needle decline in the southeastern USA. Plant Science Research Symposium – Expanding Collaboration across the University. Auburn University Research Park, Auburn, AL (*Poster*)

Mensah*, J.K, Nadel, R.L., Matusick, G., Sword, M.A. Fan, Z and Eckhardt, L.G. 2019. Chemical response of loblolly pine (*Pinus taeda* L) to *Leptographium terebrantis*. Graduate Research Student Symposium, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL (*Poster*)

Datta*, D. and Eckhardt, L.G. 2019. What are the fungal pathogens associated with loblolly pine needle mortality in the southeastern USA? Graduate Research Student Symposium, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL (*Poster*)

Menanyih*, S.A., Cale, J., Calderon, A., and Eckhardt, L.G. 2019. Survey of volatile organic chemicals emitted by ophiostomatoid fungi for monitoring and evaluating bark beetles in the United States. Graduate Research Student Symposium, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL (*Poster*)

Zurillo*, D. and Eckhardt, L.G. 2019. Survey of *Phytophthora* species in Alabama and Mississippi. NSF REU Research Symposium, Jule Collins Smith Museum, Auburn University, Auburn, AL (*Poster*)

Zurillo*, D. and Eckhardt, L.G. 2019. Can you imagine Alabama without Oaks? NSF REU Research Symposium, Jule Collins Smith Museum, Auburn University, Auburn, AL (*Poster*)

Zurillo*, D. and Eckhardt, L.G. 2019. Survey of *Phytophthora* species in Alabama and Mississippi. NSF REU Midterm Oral Research Symposium, Auburn University, Auburn, AL

Publications

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

Mensah*, J.K., Sword, M.A.S., Nadel, R.N., Matusick, G. and Eckhardt, L.G. 2020. Physiological response of *Pinus taeda* L. trees to stem inoculation with *Leptographium terebrantis*. Trees http://link.springer.com/article/10.1007/s00468-020-01965-0

Devkota*, P., Kloepper, J.W., Enebak, S.A. and Eckhardt, L.G. 2019. Towards biocontrol of ophiostomatoid fungi by plant growth-promoting rhizobacteria. BioControl Sci Techn https://doi.org/10.1080/09583157.2019.1682517

Essien**, C., Devkota*, P., Eckhardt, L.G., Via, B.L. 2019. Applying discriminate analysis and acoustic tool to assign *Pinus taeda* families into pine decline susceptibility classes. Eur J Wood Wood Prod. 77: 1117-1124 (*This is a co-authored paper between the two graduates students*)

Devkota*, P., Enebak, S.A., and Eckhardt, L.G. 2019. A performance comparison of bareroot and containerized *P. taeda* L. seedlings to the effect of ophiostomatoid fungi. Tree Planters Note 62:52-57. (**Invited**)

Devkota*, P., and Eckhardt, L.G. 2019. Intraspecific response of *Pinus taeda* L. to *Grosmannia huntii* and *Leptographium terebrantis.* For Path http://doi.org/10.1111/efp.12512

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 $218,000**.**

- Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $42,000
- Identification and quantification of volatile chemicals emitted by *Amylostereum areolatum* and ophiostomatoid species to develop highly novel lures for monitoring and evaluating Sirex populations in the United States - AU-IGP and SFWS in collaboration with University of Alberta (Edmonton) $30,000
- Collaboration between SFWS and FABI – University of Pretoria South Africa to work on *Pinus* related diseases and molecular aspects. $5,000 per participant (*extend 3 more years 2019-2021*)
- Pine needle mortality – SFWS for travel, supplies and stipend ($25,000); Regions for stipend ($10,000) *Still looking for 1.5 years stipend and molecular costs ($40,000)*
- Two Undergraduate Research Fellowships, Jace McCauley (sawflies) $10,000 and Alec Welham (continuation of wild pig project in conjunction with wildlife) $15,000, SFWS

and AU Undergraduate Research Office. REU summer student, Diana Zurillo $30,000. (*These grants were submitted directly and won by the students. This covers their cost and labor on their projects. Both Jace and Alec have been undergraduate workers for the coop for 2+ years. Diana is from Puerto Rico and found out about our work via the REU program here at Auburn.*)

- Sudden Oak Death (*Phytophthora ramorum*) Detection Survey (Stream Sampling) in AL and MS – FHM, USFS for all travel, supplies and laboratory technician $36,000.
- Wood chemistry and disease resistance – SFWS and Forest Products Development Center (to get additional preliminary data for larger grant) $5,000