AUBURN UNIVERSITY
SOUTHERN FOREST NURSERY MANAGEMENT COOPERATIVE

FY 2020 ACCOMPLISHMENTS

As submitted to the Southern Forest Nursery Management Cooperative Advisory Committee
November 5, 2020

AUBURN UNIVERSITY
SOUTHERN FOREST NURSERY MANAGEMENT COOPERATIVE

FY 2020 ACCPLISHMENTS

GOAL A: RESEARCH

Objective 1. Identify, test, evaluate, and promote the registration of cost-effective pesticides for use in forest tree nurseries.

Methyl Bromide Substitution

We will collect 2nd year data that examines the efficacy of the structural fumigant sulfuryl fluoride (Vikane®) that was installed as a spring fumigation in collaboration with TriEst Ag Inc and Weyerhaeuser in Magnolia, AR. The data collected will include seedling quality, nematodes, weeds and Trichoderma levels 2-yr post fumigation. Treatment plots were part of the 2019 Southern Forest Nursery Association's annual meeting hosted by Weyerhaeuser. Two-year seedling production with this compound will be compared to the standard MBr. (Nadel/Harges/Payne).

- ***Accomplishment: This trial was installed in Spring 2019 and sown again in Spring 2020 for second-year soil fumigation seedling production. Pre – and post-Trichoderma and nematode samples were measured. Seedling counts undertaken. Final seedling characteristics will be collected in Nov/ Dec 2020. Two-year summary seedling characteristics will be compiled and put into a Research Report in 2021.***

Seedling Dormancy & Storage

Using 3-yrs of data from Landspring trial (1-MCP) we will design an experiment that attempts to predict successful storage times using seedling and/or environmental parameters. December 2019-June 2020) (Nadel/Payne/Harges)

- ***Accomplishment: Data from the 3 year study was analyzed, with results presented both as a research report as well as a publication. The effects of environmental parameters and storage times were strongly influenced by seasonal variations in chilling hour accumulation (and de-accumulation). This variation demonstrates the importance of multi-year assessments. Conclusions based on just one year would not have captured the range of seasonal variability. The interactive effect of seasonal weather patterns***

and lift date makes it challenging to offer management recommendations, though it is clear that late lift dates and long storage durations can reduce field growth and survival after outplanting.

Nursery Weed Control

At the recommendation of SFNMC member nurseries, trials will be designed and installed to investigate weed control methods, including use of herbicides in bareroot and container growing systems. Several trials proposed are continuations or expansions of trials currently in progress.

- **Sequel to post-emergent herbicide screening in bareroot pine:** Replicated screening studies of post-emergent herbicides will be continued in member bareroot pine nurseries, using herbicides with positive tolerance results from previous trials and herbicides not previously tested by the SFNMC. Recommendations for new herbicides to be tested will be made in collaboration with Auburn University College of Agriculture faculty based on targeted weeds and protected crops. *Those active ingredients without negative affects on conifer seedlings after three years of trials will be brought forth to registrants for possible 24-C status.* (Payne)

- ***Accomplishment: Results from previous post-emergent herbicide studies show that bareroot loblolly and slash pine have exhibited tolerance to 8 of the 17 post-emergent herbicides tested since 2016. Of these 8 products, 3 were selected for retesting in 2020. These are Shieldex® (tolpyralate), Strada® (orthosulfamuron), and Tenacity® (mesotrione). Spray applications of the lowest rate of each were made at 5 SFNMC member nurseries between June 29 and July 10, 2020 to standardize applications at 9 weeks post-sowing. A total of 1,600 feet of bed space was used. Inspections in September at each nursery show no visible signs of herbicidal damage. Seedling collections and measurements will begin in late November 2020 with a research report summarizing results in early 2021. Depending on results, this study may continue in 2021 with an emphasis placed on earlier timing of spray applications in order to target specific weeds when smaller to increase herbicidal efficacy.***

- **Sequel to Ronstar®Flo in containers:** An additional replicated study using Ronstar®Flo at sowing will be conducted in several member container nurseries on various container sizes, types of media, capping material, and pine species. (Payne) *The need for and continuation of this study is dependent on results of 2019 trial. If three years of positive results on weed control without detrimental effects on conifer seedlings, nurseries could begin their own small-scale operational trials.*

- ***Accomplishment: After 2019 results were made available to SFNMC member container nurseries, the general consensus was that 3 years of similar results was sufficient to warrant the conclusion of testing of Ronstar®Flo by SFNMC staff.***

- **Testing of pre-emergent herbicide (flumioxazin) at sowing in hardwood nurseries:** Replicated studies with a water-dispersible granular flumioxazin product, Semera WDG, will be installed at sowing in member hardwood nurseries. The purpose of this study is to quantify the tolerance of multiple hardwood species to the product, weed control, and potential carryover effect in the subsequent season. (Payne)

- ***Accomplishment: This study was installed on 13 hardwood species in 1 SFNMC member nursery in 2020. The lowest labelled rate of flumioxazin was applied on February 12, 2020 on 6 hardwood species and on May 5, 2020 in 7 hardwood species, all within 2 days of sowing. Germination counts on all species made 12 weeks after spraying showed severe damage in 5 species. Two species had poor germination in both treated and non-treated plots due to washing of beds or poor seed quality, so will not be used in the study analysis. The remaining 6 species showed little to no visible damage 12 weeks after spray applications were made. Seedling collections and measurements will be made in late 2020 or early 2021, with data analyzed and included in a research report in 2021. This study may be repeated in 2021 in those species exhibiting tolerance to the herbicide. If feasible, additional nurseries and/or hardwood species may be included.***

- **Weeds/weed seed source management**: This is a 'by request' service to assist nurseries in identifying sources of weeds/weed seeds and recommending sanitation practices to lessen their impact and production. (Payne)

- ***Accomplishment: This is a continuing, normal function of the SFNMC done when SFNMC staff visits member nurseries, so will not be included in future Work Plans as a specific activity.***

Fusiform Rust Control

A seedling treatment study will be conducted on loblolly and slash, to test new chemistries in conjunction with the US Forest Service Rust Testing Laboratory in Asheville, NC. Seed will be sown at Auburn into USFS container systems until germination at which time the seedlings will be treated prior to being challenged with basidiospores of fusiform rust (April – Nov 2020) (Nadel/Payne)

- ***Accomplishment: Loblolly and slash seedlings were treated withtwo potential new chemistries Protect DF and Hurricane WDG, with standard Proline and water checks to determine the efficacy of the new chemistries to control fusiform rust. This study was a seedling treatment study. 6 weeks post sowing seedlings were treated and sent to the USFS Rust testing Laboratory where they were challenged with 30 000 basidiospores of Cronartium quercuum f.sp fusiforme. The final amount of infection will be recorded in November and determined by treatment.***

Based on the results from basidiospore inoculation studies, fungicide treatment chemistries (Compass, Stratigo and propioconizole) will be assessed for a second field season in Georgia. Conifer seed (loblolly and slash) will be sown, with Proline and once germinated, seedlings will be treated every two weeks with compounds to determine rust control. At the end of the growing season, seedlings will be assessed for the incidence of fusiform rust (April - Nov 2020) (Nadel/Payne)

- ***Accomplishment: Loblolly seedlings were treated with two chemistries (Compass and Stratego), along with standard Proline and control check, to determine the efficacy for of the new chemistries to control fusiform rust for the 2nd field study. Seedlings were sprayed 1-month post sowing and at two week intervals until the end of July. Seedlings were challenged by natural populations of basidiospores of Cronartium quercuum f.sp. fusiforme that occur within the nursery. Final amounts of infection will be recorded in November and determined by treatment***

Nanocellulose/lignin impregnated with insecticides to control pine tip moth

Dependent on 2019 results, using fipronil, we will assess whether to repeat the study on seedlings using imidacloprid. Nanocellulose particles will be created and impregnated with imidacloprid. Particles will be injected onto the root plug of seedlings in a greenhouse. Seedling needles will be sampled. Tissues will be ground and analyzed to determine movement of pesticide through seedling tissues. (Persin/Nadel)

- ***Accomplishment: An invention disclosure and provisional patent for this system was filed for sampling and monitoring residuals. Seedling foliage was sampled in August to monitor residuals within the seedlings, 24 months following application. We await the results.***

Nematicide trial

We plan to assess the effectiveness of two chemical products used as nematicides (active ingredients to be tested include Fluopyram and Trifloxystrobin). The data collected from the trial will include seedling quality and nematode control (Jan – Nov 2020). (Payne)

- ***Accomplishment: With the cooperation of ArborGen, this trial was installed at 1 bareroot nursery in 2020. The product Broadform™ (fluopyram + trifloxystrobin) was applied with a boom sprayer in three different spraying regimes to determine optimum rate, time, and number of applications needed for desired nematode control. Counts of nematode populations were made prior to test installation and will be made again in November. Visible nematode damage has been seen in non-treated control plots. Seedling collections will be made by nursery staff in November/December, with shipment to the SFNMC lab for measurements. Analysis of data of seedling tolerance to Broadform™ and control of nematode populations by the product will be made and included in a research report. All nursery activities required in this trial (bed***

preparation, sowing, soil collections, nine spray applications, germination counts, and seedling sample collections) are being done by the nursery staff. Depending on results of this study, a second trial with this product may be conducted in 2021. Information from the different spraying regimes may be adjusted to develop new spray timing and rate schedules for better nematode control result. (Payne)

Assess the impact of a root stimulator product on pine germination.

To assess the impact of a root stimulator product on seed germination and root development. This project will be conducted only if the new owner continues to sponsor the project. (Jan – May 2020) (Harges)

- ***Accomplishment: Due to personnel changes within the Nursery Cooperative staff, this project was not initiated. There are no plans to continue with this project in the near future.***

Objective 2. Identify and develop economically feasible nursery cultural practices that enhance seedling quality.

Soil stabilizer trial

Multiple soil stabilizer products that have not been tested by the SFNMC (including Dirt Glue and AgriLock Plus) will be included in a product and rate comparison trial. This project will be conducted only if the manufacturer is willing to sponsor the project. (Payne)

- ***Accomplishment: Manufacturer was unwilling to fund this project and it was therefore not installed. Information on soil stabilizer products and sample field test designs have been provided to those individual nurseries requesting these for their own use or testing purposes.***

Assess the impact of organic soil amendment product on pine regeneration

Manufacturer sponsored project. To assess the impact of a soil amendment microbial inoculum product. Assessing its impact on seedling growth and development. Assess the impact of this product on soil organic matter and foliar nutrition levels. (April – Nov 2020) (Nadel)

- ***Accomplishment: This trial was established and maintained by Weyerhaeuser due to travel restrictions imposed by COVID-19. Product was applied at rate and intervals determined by manufacturer. Seedlings will be sampled in November and analyzed for differences in growth and nutrient content. Soil samples will also be taken at trial conclusion.***

Seedling Counting/Measuring

Researchers at AU's Biosystem Engineering Department will continue to examine and develop a system to count seedlings for inventory using new technologies. Nursery Cooperative Funds will not be used on this project. (Bao/McDonald/Nadel)

- ***Accomplishment: The nursery coop worked with the agricultural-cyber-physical engineering research lab on next generation smart agriculture to count bareroot seedlings. A prototype has already been developed with machine learning models to detect and count seedlings. We will be undertaking further field testing this lifting season with changes made to the prototype and machine learning models.***

Objective 3. Develop methodologies to minimize the environmental impact of nursery cultural practices while maximizing their effectiveness including the development of integrated pest management programs.

Hardening off practice of reducing water availability and its impact on root heath

Root heath and root hydraulic conductivity is of importance to outplanting success. With this study we aim to determine whether the hardening off practice of reducing water availability, prior to the lifting of seedlings, may inadvertently (in warmer winters) increase the vulnerability of seedlings to develop embolisms. As roots play a significant role on whole plant water transport, embolized roots will increase drought vulnerability for outplanted seedlings. Some southern pine species have moderate embolism resistance; however, the majority of studies were undertaken on mature trees. Little is thus known about root vulnerability to cavitation for loblolly seedlings undergoing water stress. As there is no direct comparisons at the seedling stage at a particular site we aim to determine whether there is any potential genetic variation to embolism resistance within loblolly. Nutrient levels of the seedlings will also be monitored overtime. (Nadel/Samuelson/Via).

- ***Accomplishment: Seedlings were grown under different water stress scenarios for a 3 month period. Seedlings were then allowed to grow under normal conditions with for a further 6 months. We found that embolisms were still present in water stressed seedlings 6 months following the end of the stress and this significantly affected seedling growth. We are still undertaking carbohydrate analyses to determine how water stress and embolisms affected these.***

Mycorrhizal tolerance to fungicides used to control fusiform rust

Evaluation whether *Pisolithus tinctorius* and *Thelephora terrestris* have adapted resistance to Bayleton (triadimefon), Proline (prothioconizole) and other rust control fungicides (Stratigo and Compass) for these mycorrhizal species using in vitro techniques. (Harges)

- ***Accomplishment: Due to personnel changes within the Nursery Cooperative staff, this project was not initiated. There are no plans to continue with this project in the near future.***

Improving Seeding Outplanting Survival

CropCoat is a novel product that covers plant tissue and provides protection from the environment as well as pests and diseases. The purpose of this study would be to determine if an application of this product can increase survival of seedlings outplanted in unfavorable (warm and dry) conditions. This project will be conducted only if the manufacturer is willing to sponsor the project. (Harges)

- ***Accomplishment: Due to personnel changes within the Nursery Cooperative staff, this project was not initiated. There are no plans to continue with this project.***

Objective 4. Further define the "optimal seedling" to maximize the cost effectiveness of artificial regeneration forestry systems.

Assessing loblolly root development in Ellepot container trays.

Manufacturer sponsored study. The design of their container trays/ system is very different than the more traditional container sets requiring more intensively management irrigation. Seedling quality will be evaluated. The containers have been modified since our previous study and now used in South America and South Africa. (March – Dec 2020) (Nadel)

- ***Accomplishment: This trial was not undertaken due to travel restrictions imposed by COVID-19.***

Impact of genetics on cold hardiness

In collaboration with the Tree Improvement Program at North Carolina State University (Dr. Kit Payn) as well as the Forest Products Development Center at Auburn University (Dr. Brian Via), we want to assess the impact that genetics has on cold acclimation and freeze tolerance. Building on from the collaborative research project undertaken at the Nursery Cooperative in which we showed near infrared spectroscopy to monitor variations in soluble sugars after cold acclimation, we wish to assess whether this model be used for various genetic families of Loblolly pine. If successful, nursery managers could assess the freeze tolerance of seed-lots before outplanting using NIR spectroscopy. (Nadel/Via/Payn)

- ***Accomplishment: In collaboration with the Tree Improvement Cooperative at NCSU, several seedlots were sown, representing several specifically chosen genetic families. Seedlings have been grown by Tree Improvement Coop and in December, seedlings will be shipped to Auburn. We will determine carbohydrates and assess freeze tolerance, building on the NIR spectrometry research that we have already undertaken. Allowing us to test and improve our models in assessing freeze tolerance between families.***

GOAL B: TECHNOLOGY TRANSFER

Objective 1. Serve as a clearinghouse of information related to nursery production and tree planting.

Methyl Bromide

In collaboration with MBr manufacturers, the Methyl Bromide Industry Panel (MBIP), the Chloropicrin Manufactures Task Force (CMTF) and applicators, the Nursery Cooperative staff will continue to keep abreast of EPA actions and/or possible legislative initiatives that may affect the future availability of soil fumigants. We will continue to inform the membership through the Advisory Committee to keep the membership knowledgeable of these activities

The Nursery Cooperative staff will continue to keep abreast of activities related to the Quarantine pre-shipment (QPS) process. We will inform the membership of any EPA initiatives and continue to work with the AF&PA, the Crop Protection Council, USDA and APHIS to provide input and influence the QPS process if necessary.

The Nursery Cooperative staff will continue to work with the AF&PA, and USDA to inform and influence the EPA deliberations regarding pesticide regulation as it pertains to the soil fumigation re-registration decisions that were released in the 2013. (Nadel/Enebak)

- ***Accomplishment: There were no requests or questions to the Nursery Cooperative staff concerning the use of soil fumigants, MBr, Chloropicrin, etc from federal or state agencies.***

Update of Nursery Label Book

The pesticide spreadsheets on the Nursery Cooperative's website will be updated to include recent additions of herbicide, insecticide and fungicide labels. A technical note will be written that summarizes historical trials of herbicides and fungicides. (Harges)

- ***Accomplishment: The collection and listing of herbicides, insecticides and fungicide labels continues. Labels for herbicides, Insecticides and Fungicides were linked to an Excel Spreadsheet that is available on the Nursery Cooperative Web Page.***

Re-registration of Nursery Pesticides

The Nursery Cooperative staff will continue to follow the re-registration process for pesticides currently under review under the Food Quality and Protection Act (FQPA) used in seedling production and will provide information to the necessary regulatory agencies (USDA, APHIS, EPA) when necessary. (Enebak/Nadel)

- ***Accomplishment: There were three specific requests for data on pesticide use from USDA-APHIS and EPA in seedling production systems. These include imazapyr (Arsenal), oxyfluorfen (Goal Tender) and prothioconazol (Proline). Working with members and cooperators, the Nursery Cooperative submitted letters to the agency indicating the use of these compounds in nurseries and the importance to the industry. Those that make decisions on pesticide use are now up to date with how seedling production would be affected without these important pesticides.***

Maintain and Update Nursery Cooperative Web Site

The Nursery Cooperative staff will continue to update the Nursery Cooperative website for use by Nursery Cooperative Members. (Bowersock)

- ***Accomplishment: The Southern Forest Nursery Management Cooperative web site was updated to include all outreach efforts (Research Reports, Contact Meetings, Short Course) to members of the Cooperative.***

Leveraging Nursery Cooperative Data

The Nursery Cooperative staff will continue to stress the importance of Cooperative membership and when possible, leverage Cooperative information for grant proposals and data cite license for the seedling production survey. (Staff)

- ***Accomplishment: The Nursery Cooperative had a third year added to the 5-yr agreement to share seedling production data under a Cite License. For an annual fee of $10,000, seedling production data will be given to USFS Washington Office for them to use in their planning and reporting programs. Funds are used towards Elizabeth Bowersock's salary to compensate for her time.***

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

Contact Meeting

The 2020 Southern Forest Nursery Management Cooperative Contact meeting will be conducted as a ½ -day program in conjunction with the Southern Forest Nursery Association is scheduled to be held in Charleston, South Carolina. ArborGen will serve as the host during the week of July 20-23, 2020. As usual, the agenda on July 20, 2020 will cover presentations by Nursery Cooperative staff on current research activities and results. Details will be worked out with nursery members with meeting information outlined in the Spring 2020 Newsletter. (Enebak/Bowersock)

- ***Accomplishment: The 2020 Nursery Cooperative Contact meeting was held on July 20, 2020 during a half-day online program via Zoom. What was to be a 2.5-day joint meeting with the Southern Forest Nursery Association simply could not be planned in the midst of the pandemic and uncertainty in early April 2020. At its peak usage, there were 21 members who participated in the event. We will look at the history of the Contact Meetings and see where we need to go for the summer of 2021. Planning way ahead (and not breaking the contract with the hotel), the 2022 Contact Meeting will be conducted as a ½ day program to be held in conjunction with the Southern Forest Nursery Association.***

Information sheets

"A closer look" is a new outreach document for the SFNM cooperative, this information sheet on pests/ diseases will be produced biannually and will become the centerpiece for each newsletter. (Nadel)

- ***Accomplishment: We have continued to produce information sheets for each of the newsletters. Our recent "A closer look" provided information on planting southern pine seedlings. To date pests and diseases highlighted include: Rhizoctonia crown rot and needle blight; Tarnish plant bugs- Lygus spp.; Tip blight or tip dieback on southern pines.***

Research Reports (Staff)

We plan on producing Research Reports and Technical Notes in FY20. (Staff)

- ***Accomplishment: Nursery Cooperative staff produced 4 Research Reports, 1 Technical Note and 3 Management Alert that covered the following topics.***
  - ***RR 2020-01. Lifting Dates, Chilling Hours and Storage Duration on Root Growth Potential (RGP) Growth and Survival. Nadel, Payne, Stokes and Enebak***
  - ***RR 2020-02. Application of RonstarFlo® (oxadiazon) for Willow Control in Containerized Growing Systems: A summary of three years of trials. Payne, Nadel and Enebak***
  - ***RR 2020-03. Post-emergent herbicide screenings on bareroot pine seedbeds: A summary of multiple product Trials 2016-209. Payne, Nadel and Enebak.***
  - ***RR 2020-04. Results from the 2019 Fusiform Rust Greenhouse Trail; Testing the efficacy of two potential new synthetic fungicides. Nadel.***
  - ***TN 2020-01. Forest tree seedling production in the southern United States for the 2019-2020 planting season. Enebak.***
  - ***MA 2020-01. Be alert of upcoming freeze injury conditions. Nadel***
  - ***MA 2020-02. Be alert of upcoming freeze injury conditions. Nadel.***
  - ***MA 2020-03. Plant Seedlings Early. Nadel, Enebak, Starkey and Dougherty***

Newsletters

Newsletter distribution are planned for March and September 2020. Members are encouraged to submit articles and organizational updates. (Staff)

- ***Accomplishment: Two newsletters were produced and distributed via electronic delivery (first ever) to 102 contacts within the Nursery Cooperative membership in March and September 2020.***

Planting Southern Pine Seedling Appendix Update

Nursery Cooperative staff will update the Appendix Proper Care and Planting of Southern Pine Seedlings into a 2-pg document for distribution to planting organizations (Nadel/Enebak/Payne)

- ***Accomplishment: Produced two publications to address this.***
    - ***Nadel R.L., Enebak, S., Starkey, T. and Dougherty, P. (2020). Plant seedlings early as warmer and drier conditions expected. Nursery Cooperative – Management Alert 2020/03, Southern Forest Nursery Management Cooperative, Auburn University, Auburn.***
    - ***Nadel R.L. and Enebak S.A. (2020) Planting southern pine seedlings. Alabama Cooperative Extension System,***

Objective 3. Provide a limited consultancy function to the membership in the area of nursery seedling production and outplanting.

Individual and Organization Contacts

An on-going activity and is handled as individual situations within each organization within the Nursery Cooperative as cases arise during the growing and planting season. (Nadel/Enebak)

- ***Accomplishment: Staff participated in the following contacts.***

	Payne	Enebak	Nadel	Stokes
Phone calls	**Too many to count**	**23**	**20**	**I'll track better next year**
Letters	**Not so much**	**2**	**2**	***Ibid***
Emails	**A Lot**	**47**	**56**	***Ibid***
Site Visits	**Not so much**	**0**	**3**	***Ibid***
Diagnosis	**A Few**	**2**	**25**	***Ibid***

Seedling Production Survey

The Nursery Cooperative staff will continue the seedling production survey initiated in FY 03. The same questionnaire will be used to obtain production figures for the 2019 to 2020 planting season. The survey will be sent out in June 2020. (Enebak/Bowersock)

- ***Accomplishment: Accomplishment: A mailing list that included 56 nurseries was sent in May 2020 throughout the southern US to gauge seedling production for the 2019-2020 planting season. Data was compiled and put into Technical Note 20-01 that will be distributed to all participating nurseries in late November 2020.***

Nursery Customer Meeting Presentations

Over the past several years as schedules and travel permits, Nursery Cooperative personnel have participated customer (internal and external) meetings at nurseries in an effort to encourage and improve customer relations and educate nursery customers on seedling planting and successful plantation establishment. 30-minute presentations such as "*Why Did My Seedlings Die*?" and "*The Ten Commandments of Seedling Survival*" are presentation the staff have made.

- ***Accomplishment: No invitations to speak were requested for FY 20.***

Short Course

With the Nursery Cooperative's short course in Auburn in September 2018 and September 2019, it is expected that we will not have a 2020 Short Course. However, we will send out a request in January 2020 to gauge interest. If enough interest, we will offer another Short Course in September 2020. (Staff)

- ***Accomplishment: There was not enough interest in conducting a Short Course for 2020. Cooperative staff will survey membership early next year to determine interest for a fall 2021 Short Course.***

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 FY21 Advisory Committee Meeting will be held on October 28-29, 2020. Two, half-day meeting will be planned. (Enebak/Bowersock)

- ***Accomplishment: Nursery Cooperative Advisory meeting will be conducted on Thursday, November 5, 2020 via remote Zoom conference from 900 am to 300 pm CDT.***

Nursery Cooperative Membership

The Nursery Cooperative staff will continue to recruit new members among those nurseries that will benefit from activities of the Nursery Cooperative. (Staff)

- ***Accomplishment: No new members joined the Nursery Cooperative. We continue to have conversations with PRT that operates the container nursery in Atmore, AL and the Florida Division of Forestry.***

Update the Coop Membership and Nursery Directories

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

- ***Accomplishment: Nursery Cooperative Membership Directory was updated and sent to Cooperative Members in November 2019 and again in June 2020.***

Objective 2. Increase the visibility and effectiveness of the Cooperative as a source of information on issues related to seedling production and plantation establishment.

Presentations at Meetings

Nursery Cooperative staff will continue to be encouraged to participate as a speaker or attendee in regional and national meetings related to artificial regeneration. (Staff)

- ***Accomplishment: Travel restrictions limited Nursery Cooperative's staff involvement with research meetings during 2020.***

Publications

Nursery Cooperative staff is encouraged to publish results outlined in annual Research Reports and Technical notes in scientific journals after a period of 2-3 years have elapsed. (Staff)

- ***Accomplishment:***
    - ***South, D. B. and Payne, N. (2020). Use of copper in pine nurseries. Reforesta 9:66-106.***
    - ***Nadel, R.L., Payne, N.D., Stokes, T.A. and Enebak, S.A. (In press). Lifting dates, chilling hours and storage duration on root growth potential (RGP), growth and survival. Tree Planters Notes, pg. 1 - 21***
    - ***Mensah J.K., Sayer, M.A.S., Nadel R.L., Matusick G. and Eckhardt L.G. (2020). Physiological response of Pinus taeda L. trees to stem inoculation with Leptographium terebrantis. Trees: structure and function, pg. 1 – 12. DOI 10.1007/s00468-020-01965-***

Extramural Funding of Nursery Cooperative Projects

Nursery Cooperative staff will continue to be encouraged to locate and generate extramural funding opportunities directly related to artificial regeneration. (Staff)

- ***Accomplishment: Two grants were prepared and submitted by staff to off-set salary and supply costs.***
    - ***Bao, Nadel and McDonald - Development of a vision based robotic seedling counting and geo-mapping system for bareroot pine. $50,000 - Auburn University Alabama Agricultural Experiment Station***
    - ***Nadel was a CoPI - Walk-in Environmental Growth Chamber for the Plant Sciences Interdisciplinary Research Team. $ 73,425 - AAES ARES – Equipment Funding Program***

Interaction with other Research Cooperatives

The Nursery Cooperative staff will make efforts to interact, attend, work with other regional and national forest research Cooperatives to broaden and strengthen research ties that can benefit seedling production. (Staff)

Accomplishment: Currently undertaking a study with the Tree Improvement Cooperative (NCSU) regarding looking at the Impact of genetics on cold hardiness (Nadel)

International Nursery Research Collaboration

Working with joint nursery research in other regions of the world, a 5-8 day trip that allows interaction of Nursery Cooperative Members with other nursery production systems will be identified and planned for late 2020.

- ***Accomplishment: Dr. Ryan Nadel had put together a trip that involved a number of forest seedling nurseries, outplanting sites and reforestation efforts in three different plantation forestry regions across South Africa that include the growth of pines and eucalypts. The tour included the opportunity for view African wildlife in two distinct landscapes and world heritage sites in South Africa. This 10-day trip was scheduled for July 28 – August 7, 2020. We will try again for the Summer of 2021.***