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United States Department of Agriculture
Project Initiation

Project Data for Accession Number 1034733

Project Title

Responding to drought effects on planted pine seedlings in the southeastern United States

Project Details

Sponsoring Institution National Institute of Food and Agriculture	**Project Status** ACTIVE
Funding Source NIFA Non Formula	**Grant Year** 2026
Grant No. 2026-68019-46679	**Cumulative Award Amt.** $299,718.00
Proposal No. 2025-13961	**Multistate No.** (N/A)
Project Start Date Sep 01, 2026	**Project End Date** Aug 31, 2027
Program Code [A1712] Rapid Response to Extreme Weather Events Across Food and Agricultural Systems	

Project Director

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Performing Department

(N/A)

Non Technical Summary

An extreme drought in the southeastern United States is threatening newly planted pine tree seedlings, creating financial risks for forest landowners and a timber industry that supports over 1 million jobs and $400 billion in economic output. To address this threat, this project aims to quantify drought risks in real time, identify heat and drought limits for popular pine varieties, and create easy-to-use forecasting tools so landowners can make informed management decisions to protect their investments. The team will achieve this by creating mapping tools using weather and soil data, monitoring soil moisture in over 40 real-world pine plantations, testing seedling survival under extreme heat and drought conditions in the lab, and sharing best practices through online workshops, published documents, and in-person presentations. Ultimately, researchers expect to produce dynamic soil-moisture models,

identify the hardiest pine seedling lines, and release an interactive online map tool that predicts seedling death risks across the region. By giving landowners early warnings and practical strategies to prevent seedling losses, this work will protect timber-dependent rural economies and build long-term resilience against recurring multi-year droughts.

Animal Health Component

Animal Health Component: 0%

Research Effort Categories

Basic	40%
Applied	60%
Developmental	0%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
807	0120	1070	50%
123	0611	1070	50%

Knowledge Area

[807] Disaster Preparedness, Mitigation, Response, and Recovery

[123] Management and Sustainability of Forest Resources

Subject Of Investigation

[0120] Land

[0611] Conifer forests of the South

Field Of Science

[1070] Ecology

Keywords

drought, pine seedling

Goals / Objectives

Our overarching objective is tohelplandownersdetermineif they have or are likely to develop drought conditions on their property and provide management options to avoidexcessive pine seedling mortality. Specific goals associated with this objective include:Disseminate information on drought conditions, plantation risk, and best practices for seedling handling and planting to forest landowners and managers.Create models of plantation soil moisture using publicly available weather and soils data.Test models against field or 'local' soil moisture / weather and silvicultural information.Determine physiological stress thresholds for drought and heat in the 5 most widely planted families and test seedling sensitivity to drought and hotter-drought stress as a function of nursery stock priming.Develop predictive model of seedling mortality using general (Task 1), local (Task 2), and seedling specific information (Task 4).

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Project Methods

MethodsNear-real time publicly available maps of plant available water are not presently available, which keeps landowners in the dark when trying to make critical decisions about deployment timing. Because drought conditions can develop quickly, the ideal drought warning system would derive from publicly available data that is frequently updated. These types of data (air temperature, precipitation, vapor pressure deficit) and soil moisture as spatially explicit products are updated at frequent intervals and are available for weather in the PRISM repository (https://prism.oregonstate.edu/downloads/). Translating this climate information to plant available water requires soil moisture release curves, and the Rosetta model (https://ncss-tech.github.io/rosettaPTF/) can predict soil moisture dynamics from soil characteristics (texture, bulk density) and weather information. The soil profile information will be compared for two spatial data sets SSURGO (https://nrcs.app.box.com/v/soils) and SOLUS (https://storage.googleapis.com/solus100pub/index.html) in running Rosetta with the PRISM data to dynamically estimate soil moisture availability across the landscape. This will be the first product from the effort, closing a key knowledge gap for decision makers regarding seedling deployment timing and drought risk.The Rosetta model will be tested by running it with field soils data and its output compared to field soil moisture data. In addition, an existing modeled soil moisture product from NASA, SPoRT-LIS (https://www.drought.gov/data-maps-tools/nasa-sport-lis-soil-moisture-products) will be compared to the soil moisture estimated from Rosetta. This will allow us to inform stakeholders whether SPoRT-LIS could be an adequate tool for predicting mortality while our model's development and evaluation proceeds.We have ongoing efforts to measure soil moisture in situ at pine plantations established in the fall of 2025 in collaboration with industrial forest cooperators. These include measurements with hand-held devices (HydroSense II, Campbell Scientific), continuous monitoring of air and soil temperature / moisture (Tomst TMS4), and collection of soils for bulk density, textural analysis, soil moisture release curves, and volumetric soil moisture content. At present, these efforts are concentrated in north central Florida, but this funding will allow it to be expanded to a larger number of plantations in Georgia and potentially Alabama. Our goal is to have sampled ~45 plantations with instantaneous measurements (hand-held probes, extracted soil samples) by the end of summer 2026, and instrument three locations per site with dataloggers that span a range of soil textures. The sensors will be placed so that they cover seedling rooting depths (0-15 cm) immediately after planting.Information about silvicultural treatments, including site preparation, herbicide application (timing and amount), seedling type (bareroot vs. containerized), and planting date will be gathered from forest landowners. Competing vegetation rankings, from little to no competition to high competition (numerical rank 1-5) will be assigned based on consensus visual diagnostics collected by cooperators at the time of instantaneous measurements. Landowner estimates of survival will be used as the response variable, with field crews from the University of Florida validating survival on a subset of sites (~20-30) in the summer of 2026.We will conduct physiological experiments with 5 families provided by stakeholders that are widely planted in the SEUS, with an annual estimated planting of tens of thousands of trees, and over 100,000 acres of these families currently planted across the SEUS. We will initially grow seedlings under simulated 'nursery stock' conditions. Each family's drought tolerance metrics will then be quantified via pressure-volume and xylem vulnerability curves, along with residual conductance measures on primary and secondary growth. Following these baseline trait measures, we will randomly assign plants to populations that undergo a drought stress (planting into "September field conditions" in either relative wet or dry soil), with populations having some various pre-treatment managements applied, including a drought-hardening at nursery stage, and removal of primary growth/candling/suckering tissues. We will initiate drought stress and monitor plants (water potential or relative organ widths) to develop mortality risk functions.A random forest model will be used to test the probability of seedling mortality using the general data collected in Task 1, the local data from Task 2, the soil moisture prediction framework from Task 3, and seedling-specific mortality risk curves developed in Task 4. Modeling will be led by co-PD Johnson, integrating near-real-time inputs from weather information with the derived products developed during this project to provide spatially explicit seedling mortality estimates across the southeastern United States.EffortsWe will providean interactive web-based tool that we will share and train stakeholders on the use of during our outreach seminars, first informing them during SREF webinar 1, and providing an overview and training of the first model outputs during SREF webinar 2. Finally, targeted extension efforts to disseminate this product will include an EDIS UF extension publication.EvaluationThe timeframe of the study (1 year)

does not allow for extensive scientific field testing and evaluation of project success. Instead, we will rely on continued engagement with forest landowner community to determine their engagement and use of the tool.