Soil Microbes and Pine Seedling Success

How Soil Microbes Affect Seedling Establishment of Loblolly Pines from Differing Climates and Responses to Drought

Jade Thurnham
Dr. Gretchen North
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Importance of Seedlings

- Most vulnerable developmental stage
- Limited access to water and nutrients → more sensitive to stressors
- Predict future responses to species distributions under climate change → drought
Role of Soil Microbes

- Nutrient cycling
- Decomposition
- Pathogens

Plant-Microbe Interactions
- Potential to alter water and nutrient uptake and drought resistance?
Loblolly Pine

- Widely planted in southern USA
- High geographic distribution
- Driest in eastern Texas
- Wettest in mid-Atlantic coast
- Found in soil communities of high mycorrhizal fungi
Research Questions

- How do soil microbes differentially affect functional traits in seedlings originating from dry and wet climates?

- Do soil microbes enhance responses to drought in seedlings from dry and wet climates?
Methods

Dry

Wet
Functional Traits

Seedling establishment
- Germination

Water and nutrient uptake & carbon allocation
- Root:shoot biomass ratio
- Root exudate concentration
- Leaf C:N
- Leaf N15

Drought resistance
- Turgor loss point
- Leaf C13
Results

Figure 1. shows effect size of inoculation treatment on dry and wet families

- Inoculated plants showed higher germination in both families than control
- Treatment affect the rest of traits in opposite ways
Results

Figure 2C. shows mean number of individuals root:shoot biomass ratio

- Inoculation treatment increased ratio in wet family
- Dry family greater ratio regardless of treatment
Q1 summarised

Do soil microbes differentially affect functional traits in seedlings originating from dry vs wet climates?

- Presence of soil microbes caused greater germination regardless of family
- Soil microbes increased root:shoot biomass ratio in wet but not dry family
- Dry family still had higher overall root:shoot biomass ratio than the wet family regardless of treatment
Research Questions

- How do soil microbes differentially affect functional traits in seedlings originating from dry and wet climates?

- Do soil microbes enhance responses to drought in seedlings from dry and wet climates?
Materials and Methods

- Day 395: Drought treatment begins
- Chl a fluorescence used to measure photosynthesis performance
- Measured weekly until values declined to 0
Results

Figure 3. shows Fv/Fm of control and inoculated groups in dry (A) and wet (B) families throughout drought

- Fv/Fm of the inoculated treatment decreased faster than the control in the dry family
Do soil microbes enhance responses to drought in seedlings from dry and wet climates?

- Photosynthesis declined fastest in the dry family
Overall, the presence of soil microbes affected functional traits and families in different directions and magnitudes.

Why did seedlings originating from wetter climates respond more to the presence of dry-adapted soil microbes?
Limitations

- Sample size (n=15)
- Fv/Fm not measured before imposed drought
- Soil microbes originate from arid soil outside of contemporary range
Remaining Qs

1. Why was there a mix of effects of soil microbes on the dry family? Possible tradeoffs?

2. How does the species of soil microbial communities from differing climates affect drought tolerance?
Thanks!

Questions?