Understanding soil microbial biomass and its relation with loblolly pine decline

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

[1]Forest Health Dynamics Laboratory, School of forestry and Wildlife Sciences, Auburn University, Auburn, Alabama; [2]USDA Forest Service, Southern Research Station, Auburn, Alabama

Background

- Loblolly pine is the dominant species across most of the intensively managed commercial plantations in the southeastern United States
- Forest sustainability is difficult to achieve with pine health issues
- Role of soil in loblolly pine decline needs further understanding
- Soil microbial biomass (MB) may provide early warning symptom of changes in soil.

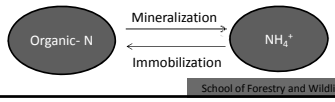
Soil microbial biomass (MB)

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

Forest Health Dynamics Laboratory

Some definitions

- **Decomposition:** Breakdown or decay of organic matter
- **Mineralization:** Decomposition of organic compounds to inorganic compounds or plant-accessible form. Takes place when soil C:N ratio< 20:1
- **Immobilization:** Conversion of inorganic compounds to organic compounds and is not available to plants. Takes place when soil C:N ratio > 30:1



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Key questions

- How soil MB will vary seasonally?
- How will soil MB change in loblolly pine stands inoculated with different densities of *Leptographium terebrantis* (pathogenic fungus)?

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

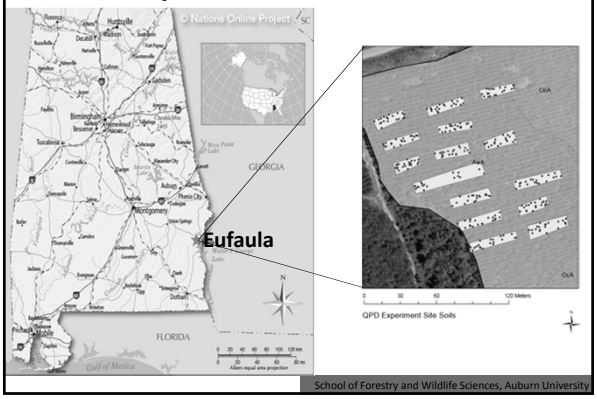
Hypotheses

- MB will be affected by season
- Different inoculum densities will have impact on MB quantity.

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Project site in Eufaula, Alabama



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods: Sample Collection

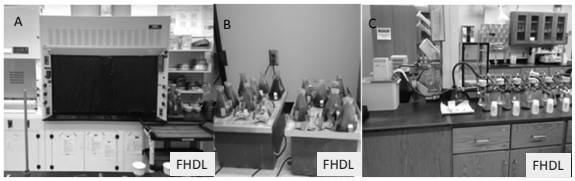
- Microbial biomass was collected by taking 4 soil samples from cardinal points from the top 10 cm at each plot
- January and April 2016

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods: Sample Processing

- Determine MB-C and MB-N present in each plot
- Determine soil C:N ratio
- Measure soil moisture content



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Materials and Methods: Sample Processing

Chloroform Fumigation Extraction (CFE)

Living organisms

↓ CFE

Dead organisms (99%)

↓ → Residual microbes

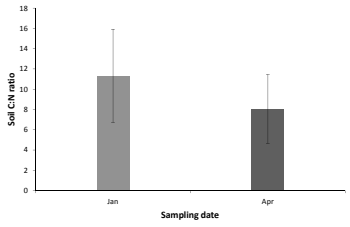
CO_2 and N

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

Comparing soil C:N ratio

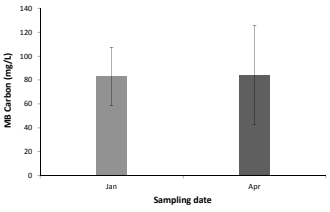


School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

Comparing MB Carbon

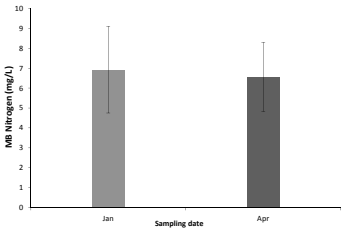


School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

Comparing MB Nitrogen

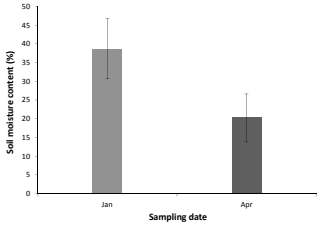


School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Results

Comparing soil moisture content



School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Summary

With respect to two different sampling dates:

- There was significant change in soil C:N ratio
- Plots are undergoing increased N mineralization and nitrogen is released in soil, i.e. nitrogen is available for plant uptake
- There was no significant difference in MB-C
- There was no significant difference in MB-N
- There was a significant difference in soil moisture content

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

What next?

MB Phosphorus

Bulk density

Soil pH

Soil nutrients

Fine root turnover

Inoculation → Impact in soil?

Pine decline?

School of Forestry and Wildlife Sciences, Auburn University

Forest Health Dynamics Laboratory

Thank you for your attention

AUBURN UNIVERSITY

School of Forestry and Wildlife Sciences, Auburn University