Progress Report

Skills Training in Advanced Research & Technology (START)

NC State University, Montgomery Community College, Wayne Community College

Summer Internship Program,
CAFS.21.91

Rachel Cook and Andrew Trlica, NC State University
Dylan Hurley, Montgomery Community College

Presented by Rachel Cook

START 2-yr Community College Interns

- Often difficult to find paid internships for students
- Combination of field experience with CAFS member company and research experience at NC State
- Focus on GIS & Remote Sensing
  - Mentored by Dr. Andrew Trlica
- $3500 per summer
- $500 travel
- $300 supplies

Partners

- Montgomery Community College
  - Dylan Hurly
- Wayne Community College
  - Lynn Jenkins

Internships – Jordan Lumber

Montgomery Community College

- Cheryl-Lyn Chandler

Special Project

- Deciduous Understory Mapping
- Fertilization trial measurements & fungal sampling

How fertilizer rate and timing and soil microbiome interact to affect growth of Loblolly Pine (*Pinus taeda*)

Cheryl-Lyn Chandler[1]*, Rachel L. Cook[2], Sean Bloszies[2], Andrew Trlica[2]

[1](Presenting) Forest Management Technology Program class of 2023 Spring, Montgomery Community College; [2]Department of Forestry and Environment Resources, NC State University, Raleigh, NC

*chandlerc4419@student.montgomery.edu

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Introduction

Because loblolly pine is the most widely farmed forestry species in the Southeast, increasing growth is critical to meet demand. Key questions are whether growth can be maximized by altering fertilizer application frequency and rates, and / or timely herbicide prescription. The FPC RW18 research plots aimed to answer the first two questions, while Jordan Lumber land at large let us test for the exact emergence times of deciduous understory. We explored the residual effects of fertilization on a mature pine plantation and how microbial communities can boost or lower soil productivity, as well using satellite imagery to develop precise understory vegetation indices.

Objectives

1. Model growth and yield in high production loblolly stands.
2. Quantify how site, stand, and climate factors and frequency of nutrient appli-cation affects nutrient supply and yield.
3. Model how soil microbe diversity influences forest productivity.
4. Produce and validate deciduous understory maps utilizing LAI to determine what levels that a stand would get sprayed.

Methods

Jordan Lumber RW281303 Site Properties

- Location: 35.284° N, 79.94° W, Mt. Gilead, lower piedmont of NC with an elevation of 468 fasl. A perennial creek divides the stand, with 8 plots N and S of creek that replicate each other. All plots have previously been thinned
- Soil: Fine, kaolinitic, thermal Typic kanhaplodot.
- Data & soils (0-15cm) was taken at 2 reps X 4 treatments = 8 plots

Figure 1: Site within North Carolina (red dot)

Sampling:

- DBH using diameter tape and total height & HTL, using a vertex hypsometer. Damage and mortality was also recorded.
- 2016-2022 growth data was calculated
- Nine 0-6" soil and nine 4"^{2} forest floor samples per plot

Satellite imagery for understory vegetation

- Satellite imagery can provide info about hardwood understory
- The relationship between the "Understory Index" values and conditions on the ground is still unclear.
- We used a **new technique** with satellite imagery from *Sentinel-2* to map understory in several stands in Moore, **Montgomery**, and Richmond counties.
- Randomly selected points in stands and assessed understory at these locations.
- **Measured stems counts, stem height, and DBH of larger stems within a 10' radius of each point.**

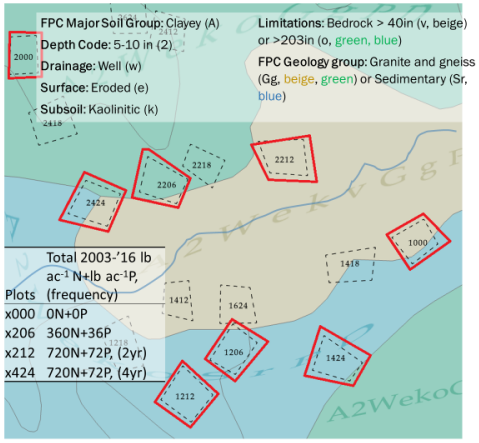

Figure 2: Plot Location over three different FPC soil code map units, plus fertilizer rates and frequencies

Results and ongoing activities

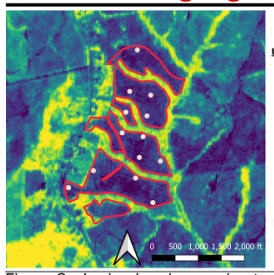

Figure 3: Jordan Lumber understory

Satellite imagery :

- We compared the values found in the ground survey to their corresponding locations in satellite imagery to determine their relationship (Figure)
- Stem counts may not be ideal ground truthing data; it remains to be seen if in situ understory LAI may be a better solution

2016-2022 growth data

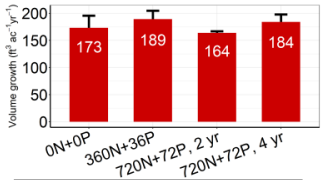

Figure 4: Last six years'volume growth

- While 0-8 year data shows strong treatment response (Figure 10), 2016-2022 residual growth effect was minimal (Figures 4, 5, & 6).
- This late in the rotation, the control is growing similarly to the fertilized.

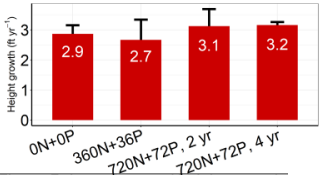

Figure 5: Last six years' height growth

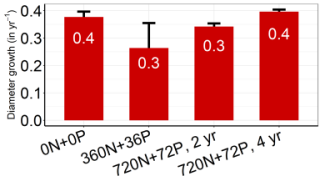

Figure 6:Last six years' DBH growth

Soil Microbiome

- RW 18 soils are being processed for DNA extraction and fungi and bacterial species and gene quantification

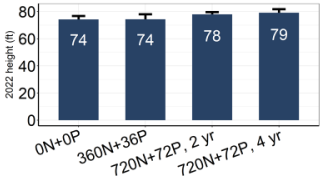

Figure 7: Taller trees in each 720N

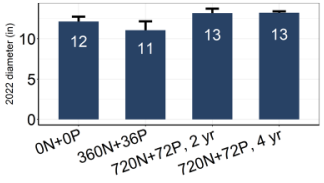

Figure 8: Larger DBH in each 720N

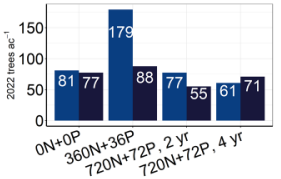

Figure 9: 360N plots: Thinning differs

2022 data

- However, trees in higher 720N fertilizer treatment plots are numerically taller than controls and 360N plots This late in the rotation, the control is growing similarly to the fertilized.
- High variability between 2 360N plots is explained by different thinning (Figure 9)

8th year data

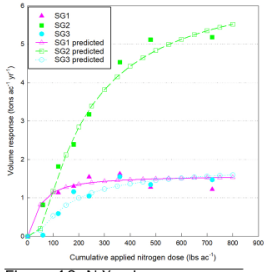

Figure 10: N X volume response

- Among other RW18 sites with similar SG3 soils, N response up to ~240N

Conclusions

- While trees are taller in higher fertilizer plots at year 22 of the rotation, fertilizer effects seem to be baked in by 2016
- Deciduous understory modeled via satellite imagery shows clear differences within and outside stands (Figure 3)
- 720N+72P height and DBH response similar to other CRIFF SG3 soils, with and 0N+0P 360N+36P somewhat lower (Figure 10)

References: Albaugh, Timothy J., Thomas R. Fox, H. Lee Allen, and Rafael A. Rubilar. "Juvenile Southern Pine Response to Fertilization Is Influenced by Soil Drainage and Texture." Forests 6, no. 8 (August 2015): 2799–2819

Acknowledgments: Support for this work was provided by the Center for Advanced Forestry Systems, the Forest Productivity Cooperative

Internships – NC Forest Service

- NC Forest Service
  Claridge Nursery
- Wayne Community College
  - Micah Woodard
- Special Project
  - Soil mapping in nursery

Picking Plums

Internship Experiences at NC Forest Service's Claridge Nursery
Woodard Legacy Fields: Diagnosing Problematic Soils

Micah Woodard[1], Rachel Cook[2]

Presenting: mawoodard2978@student.waynecc.edu

[1]Wayne Community College, Forest Management Program, Class of 2022. [2]Department of Forestry and Environment Resources, NC State University, Raleigh, NC

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Introduction

My summer working at Claridge Nursery for the North Carolina Forest Service was filled with learning the skills associated with **tree improvement** and what it takes to be an orchard manager. From cleaning mulberry seeds to painting trees, treating for southern pine beetles to pruning grafts and taking soil samples, I learned a great deal and began an ongoing experiment at Claridge Nursery: the **Woodard Legacy Fields.** This area in particular is interesting because it was severely impacted by hurricane Matthew in 2016. I worked to determine why seedling in this area are still suffering 6 years later.

Objectives

- **Compare soil samples in the problem area with those in currently thriving fields**
- **Develop management recommendations in order to increase yields**

Methods

The basis of my experiment involved taking multiple soil samples in the "Problem Area" (fields B,C,D,E) and taking control samples in current thriving fields (3G Section 2).

Sampling:

- 50 total soil samples were collected
- 40 were taken evenly throughout **B,C,D,E** (10 per field)
- 10 were taken in Section 2 of field **3G** (Section 2 is a part of the main field)
- Aerial imaging provided by the NCFS showed me where exactly the problem areas were in B,C,D,E based on underperforming seedling size
- Figures 1 shows from where the good and bad samples were taken

Figure 1: Map of samples taken in B,C,D,E

Planned Activities

Planned soil nutrient analyses

- Ammonium and nitrate nitrogen
- Potassium
- Calcium

Planned testing for fungal pathogens

- Currently awaiting results from sampling
- Dr. Cook and I theorize that the flooding from hurricane Matthew has altered the microbiome and introduced pathogenic fungal spores into the soil
- Figure 4 is an aerial image showing the extent of the damage caused by the hurricane at the site

Figure 2: Fungal Sample

Figure 3: Nutrient Samples

- **Current experiments**
- 5 experimental rows in 3G Section 2 (Figure 5) are planted with loblolly pine seedlings and are treated five times over the course of the summer with Proline fungicide to ensure their growth and vigor
- All 5 rows have been treated three times
- 3 rows will be treated as usual; **the remaining 2 beds will be inoculated to boost plant immunity**
- Results will be monitored following treatment, we will be looking at tree growth mainly, but also fungal communities
- Tissue samples will be collected from seedlings upon harvest to determine nutrient content, nutrient uptake and plant physiology

Figure 5: Map of 3G Section 2

Application & Goals

- At Claridge, 22 seedlings ft^{-2} (958,320 seedlings ac^{-1}) of loblolly pine can be planted
- Soil and site health matters, because maximizing seedling survivability affects the bottom line
- Fields B,C,D,E are a combined 31.1 acres, 3G Section 2 is only 19.3 acres
- B,C,D,E is 38% larger in acreage thus potentially yielding a greater number of seedlings, making diagnosing the problem soils critical
- Figure 5 illustrates the difference

Figure 5: Map of fields B,C,D,E and 3G Section 2

Acknowledgments: Support for this work was provided by the NSF Center for Advanced Forestry systems I/UCRC Program through the "Skills Training in Advanced Research and Technology" (START) program to train 2-yr college students, Claridge Nursery and the North Carolina Forest Service and the Forest Productivity Cooperative.