Plantation Management Research Cooperative
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

Continuing Project

Weyerhaeuser

Throughfall Reduction Impacts on Loblolly Pine Plantations Pre- and Post-Thinning

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Presented by Lainey Paulus (M.S. Student)

Justification

- Loblolly pine is the most commercially important species in the Southeast US
- Recent climatic data suggests drier conditions and warmer temperatures in the growing season (Marvel et al. 2023)
  - There is uncertainty of how drought will affect Southeast forests, responsible for 60% of timber harvests in the US (McNulty et al. 2019)
- Silvicultural practices such as thinning can reduce competition for water resources (McNulty et al. 2019)

Objectives

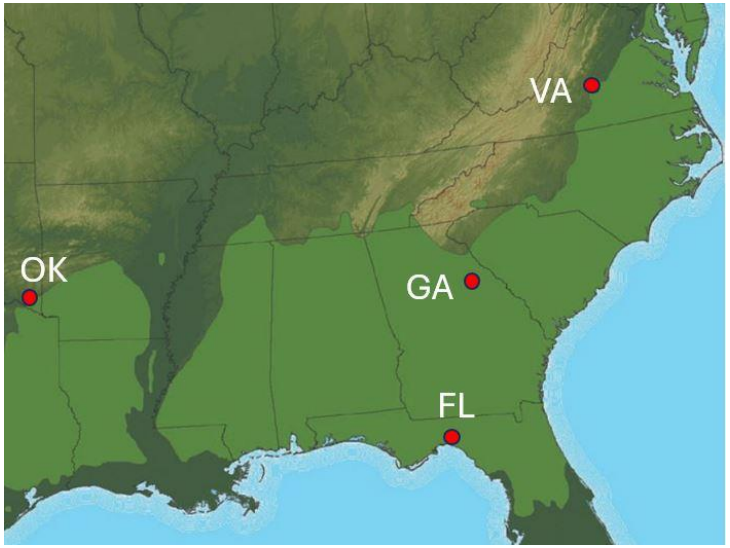
The objective of this study is to examine the impact of fertilization and long-term throughfall exclusion on the growth of loblolly pine (*Pinus taeda*).

It is hypothesized that:

1. Long-term throughfall exclusion will result in a decrease in growth in loblolly pine in terms of diameter, height, and stem volume
2. Fertilization will compensate for the reduced moisture from throughfall exclusion
3. Long-term throughfall exclusion will result in a change in wood properties

Methods

- Leveraging the previous Pine Integrated Network: Education, Mitigation, and Adaption Project (PINEMAP) installation in the Georgia Piedmont
  - PINEMAP was established to evaluate the effects of climate, soils, and management approaches on carbon sequestration rates in loblolly pine
- Tier III sites established an experimental design with the following treatments:
  1) Control
  2) Fertilization (one-time of 200 lbs/ac N, 25 lbs/ac P, 50 lbs/ac K, 20 lbs/ac micronutrient blend)
  3) Throughfall Exclusion
  4) Fertilization + Throughfall Exclusion
- Georgia site originally operationally planted in 2006, with initial treatments established in 2011, thinning to be completed in fall 2025



Methods

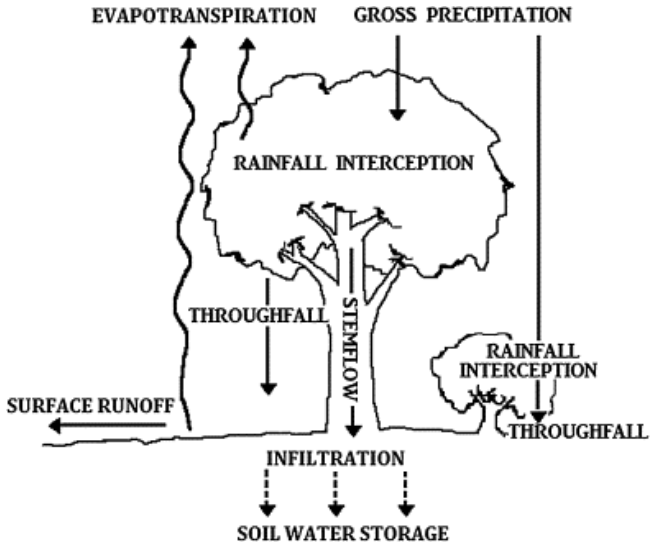


Photo from Inkiläinen et al., 2013, adapted from Levia and Frost, 2006.

PINEMAP GA Tier III site, age 5. Photo taken by Leslie Boby.

PINEMAP GA Tier III site, age 18. Photo taken by Lainey Paulus.

Thinning Plans

- 3rd row with selection using drive-to-tree feller buncher and grapple skidder
- Thin down to 75 sqft/ac to achieve sizable treatment effect

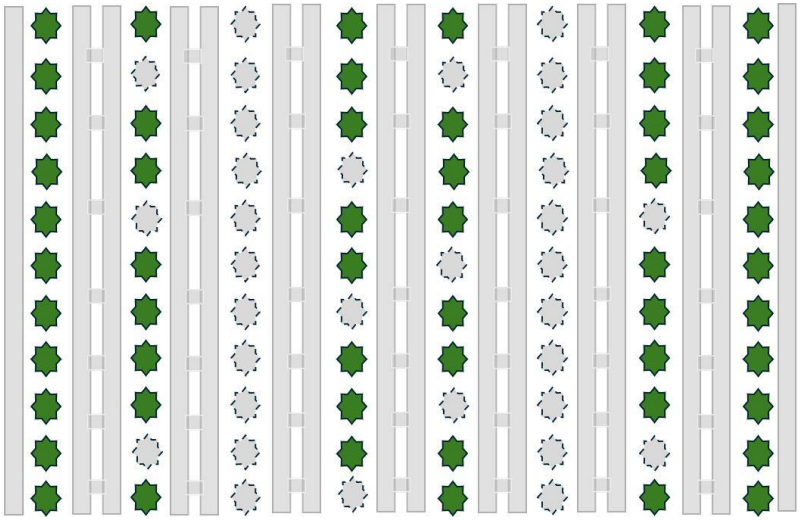


Diagram of 3rd row and selection thinning with troughs removed

Pre-Thin

- Take dormant season measurements
- Flag site for optimal thinning to hit BA target & reduce damage to residual trees
- Remove troughs

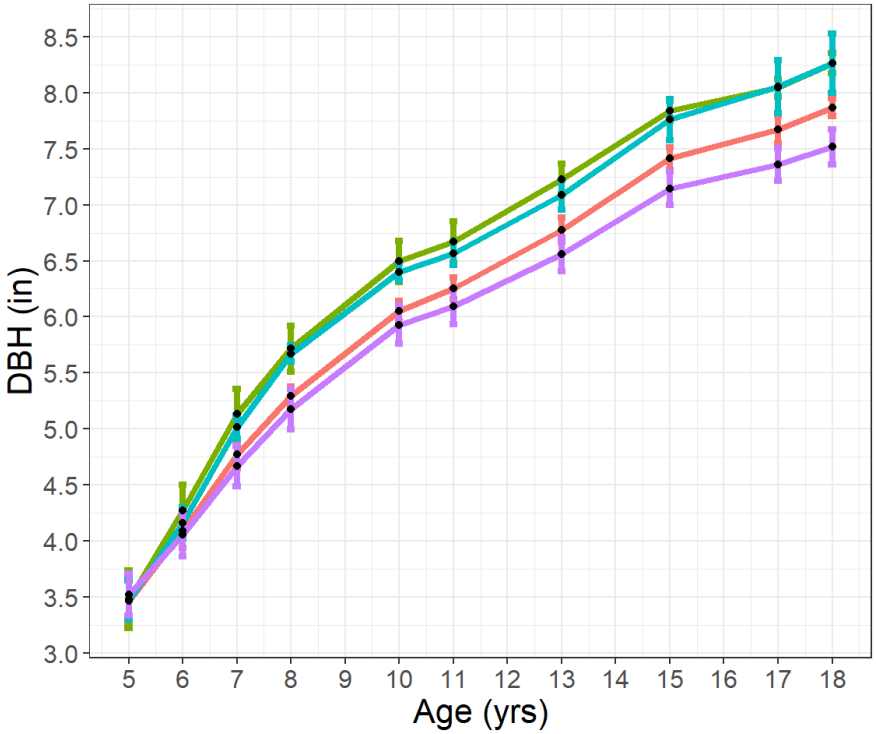
During Thin

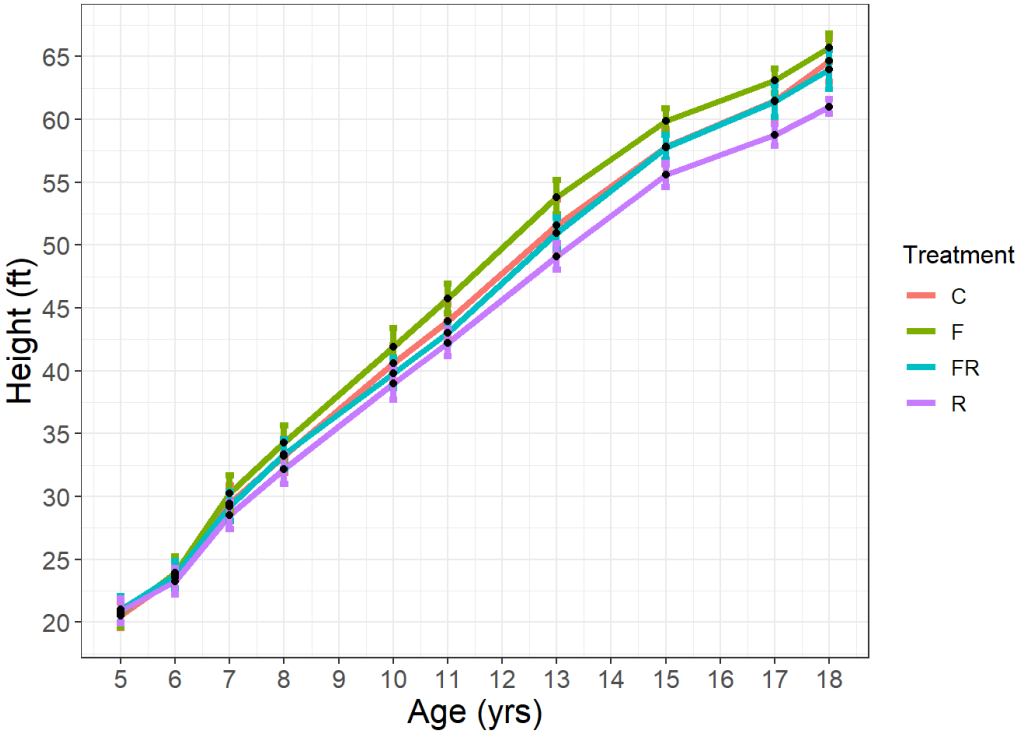
- PMRC and Weyerhaeuser staff on-site to supervise
- Evaluate wood quality by destructively sampling trees during thinning

Post-Thin

- Check all plots and trees for any damage
- Reconstruct troughs
- Reapply one-time fertilization
- Continue measurements

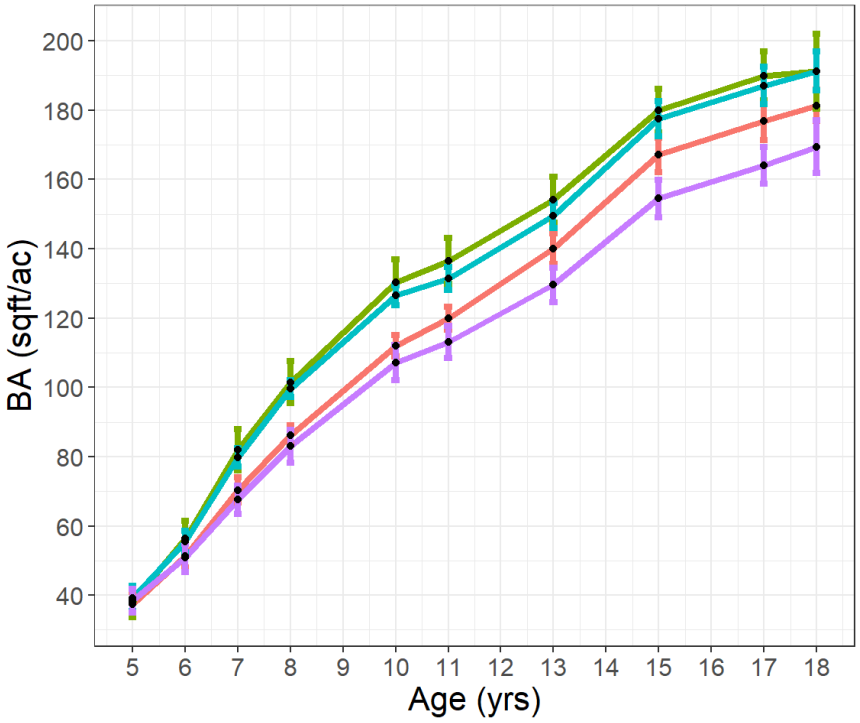
Major Findings

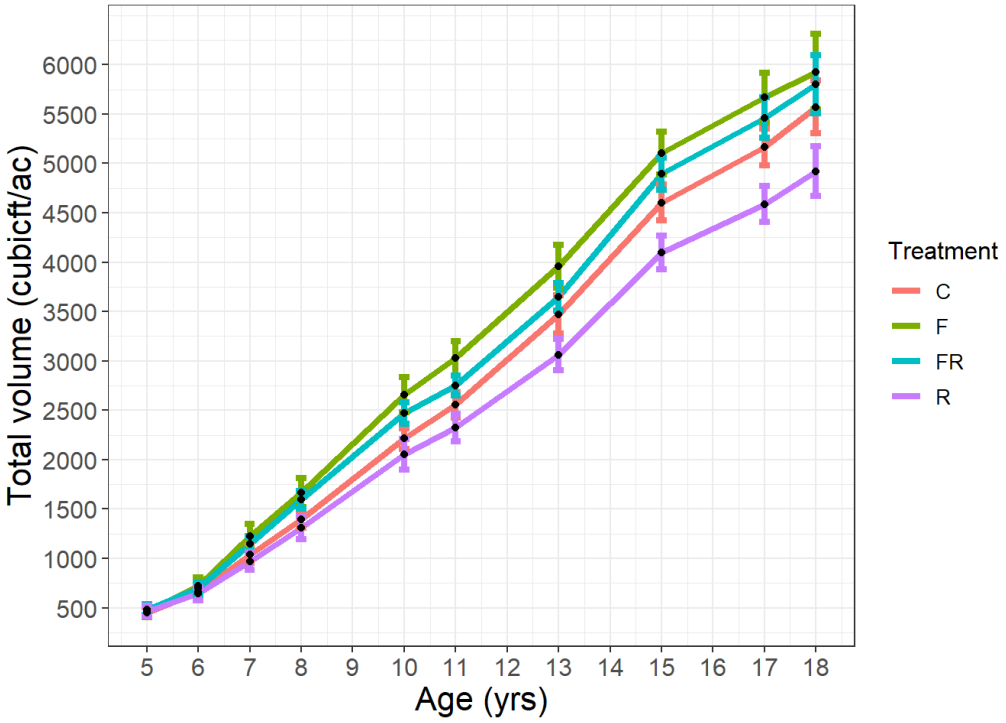




Significant reduction in DBH, no significant reduction in height although there is a slight trend for reduced height in R treatment

Major Findings



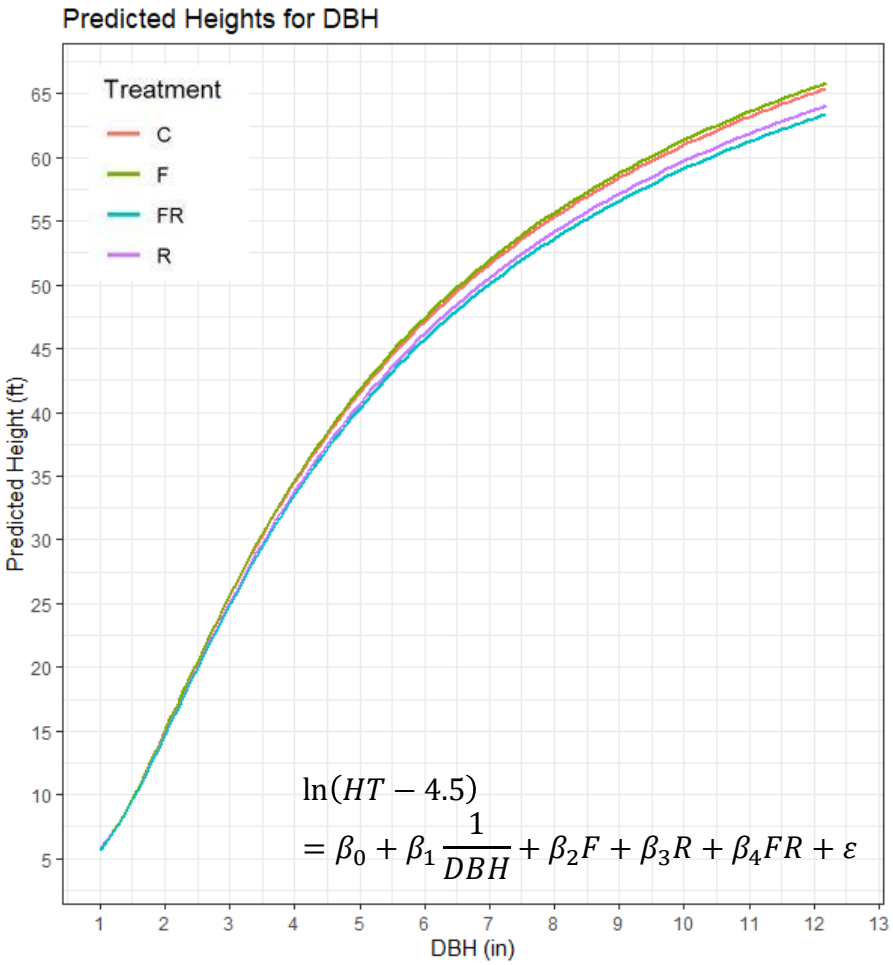


$$VOL = 0.18658 + 0.00250(D^2H)$$

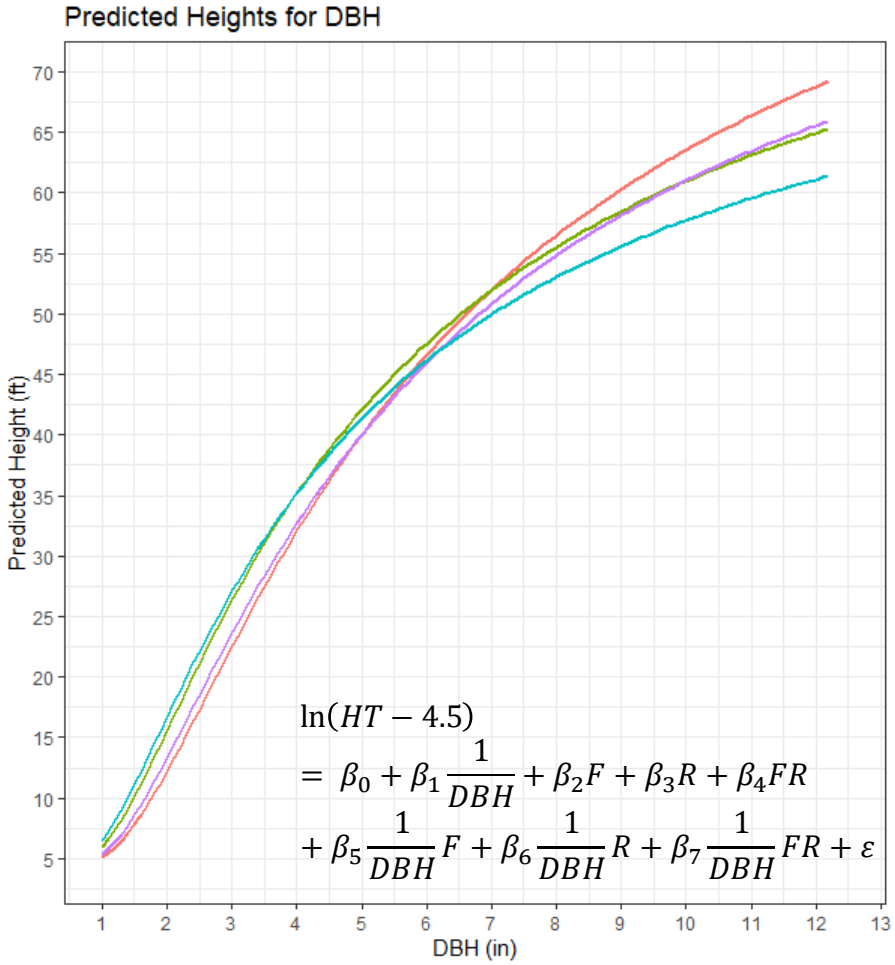
Total stem volume o.b. (cubic ft) from Amateis and Burkhart (1987)

Base equation: $\ln(HT - 4.5) = \beta_0 + \beta_1 \frac{1}{DBH} + \varepsilon$

Major Findings



Asymptote significant for R and FR



Asymptote significant for F, R, and FR
Only F and FR slope parameters significant

Deliverables

- Understanding the impact of reduced moisture and the interaction with fertilization on loblolly pine production in thinned stands
- Two MS students will work on this project
  - Student theses
- Peer-reviewed journal articles
- Presentations at regional and national conferences
- Presentations to forest industry members

Company Benefits

- Understanding the impact of reduced throughfall on loblolly pine growth as a proxy for potential future climate variability
  - May reduce growth, comparable to control, but fertilization helps mitigate this effect

- Insight into the impacts of reduced moisture in loblolly pine plantations both pre- and post-thinning
  - Thinning would allow more resources to residual crop trees and opening the canopy, potentially reducing the effect of throughfall exclusion

Recommendations

- Continue to monitor the site and measure the plots to evaluate the treatment responses over time
- Impose the thinning treatment this dormant season 2025/2026
  - Re-establish the throughfall exclusion troughs post-thin
  - Retreat with a one-time fertilization on the appropriate plots
- Destructively sample for wood quality on a subset of the felled trees from all treatment plots

Summary

- Future precipitation variability may cause reductions in growing season rainfall that could have an impact on the productivity of southern forests
- Loblolly pine is the most commercially important species in the Southeast US, so it is important to understand how it may be affected
- Throughfall exclusion significantly reduced diameter, basal area, and volume
  - Fertilization can potentially mitigate these effects
  - Thinning may be another tool to mitigate the effects of reduced throughfall

Acknowledgements

Previous PINEMAP researchers and collaborators
PMRC Member Companies
PMRC Field Crew
Weyerhaeuser

Sources

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McNulty, S., A. Baca, M. Bowker, S. Brantley, T. Dreaden, S. W. Golladay, T. Holmes, et al. 2019. Managing Effects of Drought in the Southeast United States. *In: Vose, James M.; Peterson, David L.; Luce, Charles H.; Patel-Weynand, Toral, eds. Effects of drought on forests and rangelands in the United States: translating science into management responses. Gen. Tech. Rep. WO-98. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 191-220. Chapter 9.* :191–220.