Incorporating mid-rotation competing vegetation into the 3-PG model for loblolly pine plantations in the Southeastern US

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Introduction

Climate change not only affects the productivity and distribution of pine forests but also the understory plant communities. PINEMAP is using the 3-PG model to address variations in productivity due to its adequacy to model forests and parameters sensitive to climate change. However, 3-PG lacks the dynamics of the understory compartment, which can result in increased water and nutrient stress to the forest system, negatively affecting site resource use efficiency.

Objectives

1) Characterize the dominant mid-rotation competing vegetation species across the ecological regions of the SEUS
2) To incorporate the understory component into 3-PG model with its main compartments.
3) To parameterize and validate the model for the distinct competing vegetation types.

Incorporating competing vegetation into 3-PG

PINEMAP uses the 3-PG (Physiological Principles in Predicting Growth, Landsberg and Waring, 1997) model because its structure incorporates light, water and nutrient effects on tree growth (Figure 1) where competing vegetation interferes (Figure 2).

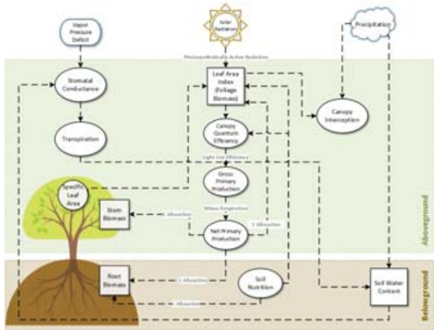

Figure 1: Conceptual model of physiological variables used in the 3-PG model, within a forest system.

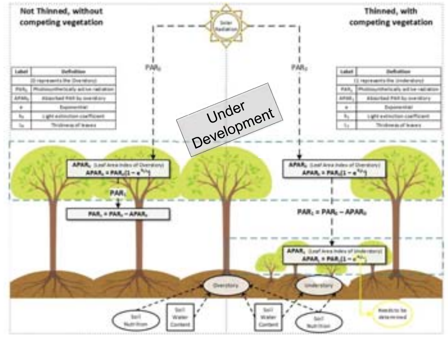

Figure 2: Proposed conceptual model of how to incorporate competing vegetation into the 3-PG model.

Characterizing the competing vegetation types

Classify the dominant species from an online survey provided to members of the PINEMAP Integrated Network. The dominant species will be classified by **habitats** (piedmont, coastal plain or flatwoods), by **type** (grass, broadleaves, woody or absent) and percent of **ground cover** (high, medium, low or absent). Assessment of the dominant understory species, on a coastal plain site, by quantifying biomass, specific leaf area, leaf area index and nutrient content in leaves (Figure 3).

Model Testing

I. Incorporate understory competition into the 3-PG model using the distinct physiologies of the woody, broadleaves and grasses.

II. Calibrate the 3-PG model using competition free treatments.

III. Parameterize the main understory competing vegetation types.

IV. Validate the new 3-PG model by comparing the outputs with previously collected data from pine plantations

i. FPC RW 17 and RW 22 Trials
ii. Vegetation was controlled
iii. Data will not be used in the calibration process

Figure 3: FPC RW22 without and with vegetation control. Source: Jose Stape and FPC

Timeline

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Summer 2013	Fall 2014	Spring 2014
• Conduct online survey • Field assessment • Evaluate other competition models	• Field assessment • Analysis field data • Revisit RW17	• Model Testing • Calibrate 3-PG model • Validate 3-PG model

Additional Resources

Albaugh, T.J., J.L. Stape, T.R. Fox, R.A. Rubilar, and H.L. Allen. 2012. Midrotation vegetation control and fertilization response in Pinus taeda and Pinus elliottii across the Southeastern United States. Southern Journal of Applied Forestry 36(1):44-53.

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Landsberg, J. J., and R. H. Waring. "A Generalised Model of Forest Productivity using Simplified Concepts of Radiation-use Efficiency, Carbon Balance and Partitioning." *Forest Ecology and Management* 95.3 (1997): 209-28.

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Acknowledgments

The Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP) is a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture, Award #2011-68002-30185.

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