IMPACTS OF WATER AND NUTRIENT AVAILABILITY ON LOBLOLLY PINE FUNCTION

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The impact of climate change on temperature and precipitation patterns in the southeastern United States are likely to have important effects on southern pine systems. A 2009 summary from the U.S. Global Change Research Program indicated that the southeastern U.S. will experience an increase in average temperature of 2.5 to 5 °C by the 2080s. Predictions for changes in precipitation for the Southeast, although less certain, generally indicate a 10- to 30-percent reduction in summertime precipitation. The objective of this research, part of a larger project on climate change and planted southern pine (Pine Integrated Network: Education, Mitigation and Adaptation Project, or PINEMAP, http://pinemap.org), is to quantify the impact of artificial drought conditions on loblolly pine (*Pinus taeda* L.) water relations and productivity in both fertilized and unfertilized plantations. The study uses a randomized complete block design containing two levels of fertilization and throughfall exclusion in a 2 by 2 factorial arrangement, replicated four times. Treatments include: fertilization with (kg/ha) 224 N, 28 P, 56 K, and a micronutrient blend to eliminate nutrient deficiencies, and exclusion of 33 percent of incoming throughfall. Measurements of productivity and tree water relations (including whole-tree sap flow and foliar water potential) will be used to characterize response to the treatments. The specific objectives are to: (1) quantify the impact of both 33 percent rainfall exclusion and fertilization treatments on loblolly pine productivity, whole-crown stomatal conductance, and whole tree hydraulic conductivity; (2) investigate the relationship between vapor pressure deficit, soil moisture, and stomatal conductance; and (3) provide water relations parameters for the Physiological Principles in Predicting Growth (3-PG) model.

Initial results after one summer of treatment applications show that the 30 percent reduction in throughfall did not significantly affect the growth or water use of loblolly pine plantations. The throughfall exclusion treatment did not significantly impact height growth ($p = 0.41$) or basal area production ($p = 0.36$). Mean daily transpiration was also not affected by throughfall exclusion ($p = 0.68$).

The application of fertilizer increased growth and water use of loblolly pine. Basal area growth was significantly higher in stands that received fertilizer ($p = 0.05$); however, there was no apparent impact of fertilization on height growth ($p = 0.84$). Plots that received fertilizer also had higher rates of mean daily transpiration although this relationship was not statistically significant.

The study will continue to be monitored to determine whether increased leaf area from fertilizer will impact the response of the stands to altered precipitation.

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