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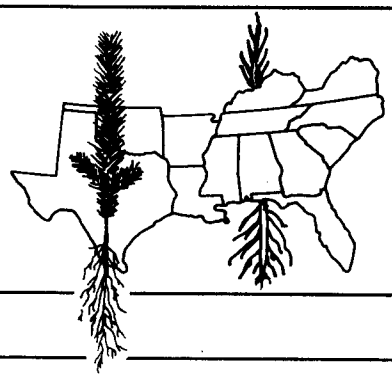

RESEARCH REPORT 97-6

INFLUENCE OF NITROGEN AND PHOSPHORUS ON THE PHYSIOLOGY AND GROWTH OF DIFFERENT HALF-SIBLING LOBLOLLY AND SLASH PINE FAMILIES

by
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INTRODUCTION

Nurseries sow pine seed by individual families as standard practice. While much is known about the growth performance of individual families after outplanting, little is know as to whether each family may respond differently to nutrient availability. The relative efficiencies of families may be the reason for their superior growth performance. Knowledge of the fertilizer use efficiencies of families could improve the effectiveness of nursery and/or field fertilization practices by specifically tailoring fertilizer recommendations to each family. Also, families might be selected to better match the nutritional characteristics of a planting site.

The objectives of this study were (1) to determine if nitrogen and phosphorus use efficiencies varied by family, and (2) to determine if fundamental physiological processes are responsive to nutrient manipulation and whether the response varies by family.

METHODOLOGY

Stratified seed from four open-pollinated half sibling families of slash and loblolly were sown on July 20, 1995, in four gallon pots containing a mixture of sand, perlite, and vermiculite (50-40-10, sand-perlite-vermiculite by volume) in an environmentally controlled greenhouse at Auburn. Beginning September 1, 1995, seedlings received weekly fertilizer applications of a complete soluble fertilizer to insure no nutrient stress occurred until the initiation of fertilizer treatments. On March 1, 1996, when the seedlings were six months old, weekly fertilizer treatments were initiated and consisted of a 400 ml solution of high and low combinations of N and P fertilizer.

Hi-N	Hi-P	264 ppm N + 50 ppm P
Hi-N	Lo-P	264 ppm N + 0 ppm P
Lo-N	Hi-P	44 ppm N + 50 ppm P
Lo N	Lo-P	44 ppm N + 0 ppm P

Seedlings were randomly chosen to receive each treatment, and each treatment was applied to one seedling per family per block. There were ten blocks containing four families per species for a

total of 320 seedlings. All seedlings were harvested by block between Sept. 23 and Oct. 25, 1996 after receiving fertilizer treatments for 7 months and nutrient translocation was likely complete.

Height and diameter was taken monthly beginning in February 1996. Light-saturated net photosynthesis (P_{net}), stomatal conductance (g_L), water use efficiency (WUE), leaf dark respiration (R_{leaf}), soil respiration (R_{soil}), and chlorophyll fluorescence (Fv/Fm) were examined by block for three day periods in May, June, July, and August 1996. During harvest, height, diameter branch number, number of flushes (fully expanded and total number), live crown height, and live crown width were determined. Seedlings were seperted into foliage, stem, branch, fine roots (≤2mm), and coarse roots (>2mm). Dry weights were obtained for each component and three randomly chosen blocks were ground and stored for nutrient analysis. Root:shoot ratios and total biomass were determined for each seedling.

RESULTS

As reported for red pine, net photosynthesis (Pmax), stomatal conductance (g_{H20}), leaf dark respiration (R_D), chlorophyll fluorescence (Fv/Fm) and growth were responsive to primarily N rather than P manipulation in both loblolly and slash pine. Low N treatment decreased foliar N concentration, Pmax, Fv/Fm, water use efficiency and growth, and increased R_D and g_{H20}. Although foliar P concentrations were responsive to P treatment, only root mass and diameter of loblolly pine were reduced by low P treatment. Greater growth in response to high N was accomplished through increased leaf photosynthesis and greater leaf area.

Few statistical interactions between treatment and family source were observed for either species. Thus, most responses to N and P treatment did not vary with family or family differences did not vary with treatment. However, an exception to this was fine root weight in loblolly and leaf weight in slash. One loblolly family produced greater fine root mass than the other families under low N and low P treatment. This family may be better able to access nutrients on nutrient poor sites over the long-term. Similarly, one slash family produced more leaf mass than the other families under low N-low P, which suggests that this family may produce more biomass on N and P poor sites.

Leaf physiological measures were not good indicators of family growth differences. Similar lack of correlation between leaf gas exchange and growth has been reported for jack pine and loblolly pine. The best growing families had greater leaf mass and this seems to be the main determinant of family growth differences. Positive correlation between leaf area and aboveground growth was reported for both slash and loblolly pine by other studies.

MANAGEMENT IMPLICATIONS

There is no evidence found that the families tested in this study respond differentially to either the type or amount of fertilization. Fertilization regimes specific to an individual family is therefore not warranted.