CLONAL FORESTRY OFFERS THE OPPORTUNITY TO INCREASE YIELDS,

Introduction

Clonal forestry offers the opportunity to increase yields, enhance uniformity, and improve wood characteristics. Intensive silvicultural practices, including fertilization, will be required to capture the growth potential of clonal plantations. However, variation in nutrient use efficiency that exists among clones could affect growth responses, necessitating clone-specific silvicultural prescriptions. Our research objective was to determine the range of growth response to fertilization in clones of Pinus taeda (lobolly pine) and explore stem and foliar variables related to this response.

Methods

Our site is located on the upper Piedmont in Patrick County, Virginia, (38°40’ N, 80°10’ W) on a Hiwassee loam (very-fine, kaolinitic, thermic Rhodic Kanhapludult) and a Louisa loam (loamy, micaceous, thermic, shallow Ruptic-Ultic Dystrudepts). A split-plot experimental design was used with the whole plots being two levels of fertilization (with or without) and the split plot factor being 25 clones. Whole plot treatments were blocked and replicated four times. Trees were planted in May 2003, with the fertilizer (224 kg ha⁻¹ DAP and 184 kg ha⁻¹ ammonium nitrate) being applied by hand in a banded application in May 2004 and again in May 2006. Stem volume, crown width, stem sinuosity and forking were measured in 2007, after the 5th growing season. A crown ideotype was calculated by dividing stem volume by crown area, thus indicating approximately how much crown, or leaf area, was required to produce a unit of stem wood.

Results

A generalized linear mixed modeling approach was used (Proc GLIMMIX, SAS 9.2) to model categorical, binomial, and continuous data with the same statistical procedure. Block and fertilizer x block effects were included as random variables. For 95% year stem volume there was a statistically significant clone by fertilizer interaction (p > 0.01) (FIG 1). This interaction appears to be not only statistically significant, but of sufficient magnitude to be biologically and economically relevant as well. The improvement in volume after the 5th growing season due to fertilization was greater than 20% improvement in 32% of the clones. Another 40% of the clones had responses that ranged from negative to less than a 5% volume improvement. This interaction may be problematic for companies producing and testing clones, unless steps are taken to include fertilizer response in testing protocols. However, it also offers opportunities for precision silviculture, should information on clonal fertilizer response be available for individual clones. For instance, nonresponsive clones with high growth rates may be attractive if fertilizer prices dramatically increase in the future.

Conclusions

Our results suggest that different silvicultural prescriptions (i.e. fertilization) may be appropriate for different clonal plantations based on the physiology of the genotype deployed. A rapid screening technique for clonal response to fertilization may be necessary given the wide range of fertilizer responses found between clones in this field trial and the large numbers of clones being developed by forest industry. Physiological mechanisms other than leaf area increase, such as shifts in biomass allocation belowground or increased photosynthetic rates, are likely responsible for fertilizer volume response in some clones, although this hypothesis requires further testing.

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