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Silvicultural Research In the News

North Carolina Forest Service
To protect, manage, and promote forest resources for the citizens of North Carolina

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Summary of the Current State of Knowledge of Forest Fertilization in the Southeast

North Carolina has over 2.5 million acres of loblolly pine plantations. Most of these stands are privately owned. Typically, non-industrial private forest landowners use less intensive silviculture activities to establish plantations (plant only, plant and release, or herbicide site prep and plant). These methods result in average annual growth rates of less than 5 tons per acre for loblolly pine. Research shows that by applying more intensive silviculture practices, including fertilization, plantation growth rates greater than 10 tons per acre per year are possible. Though intensive silviculture activities cost more, the resulting increased wood production may lead to increased returns. A paper, authored by Tom Fox, et.al., in The Southern Journal of Forestry, summarizes tree nutrition and forest fertilization in the southern United States.

Highlights discussed in the paper include:

- Low leaf area, due to low nutrient availability, especially nitrogen (N) and phosphorus (P), limits growth.
- Loblolly pine is very responsive to intensive silviculture. Better genetic families respond more than poor families at all levels of silviculture intensity.
- Wood production is increased by silvicultural prescriptions that use the best genetic material, employ quality site prep to ensure survival and early growth, apply fertilization and competition control throughout the rotation, and conduct thinning to manage stand density.
- At canopy closure the amount of N and P needed for maximum plantation growth often exceeds the soil supply.
- On P-deficient sites, P fertilization at time of planting can increase site index by 6-10 feet and may double volume growth.
- Mid-rotation fertilization tests located in loblolly pine plantations throughout the Southeast, report average growth gains of 1.6 tons per acre per year over an 8 year period after fertilization with N and P.
- To maintain optimal growth rates application of N, P, and other deficient nutrients [potassium (K), boron (B), calcium (Ca), manganese (Mn), and copper (Cu)] is needed every 8-10 years.
- Although most pine plantation respond biologically to fertilization, financial returns vary depending on growth response, products produced, stumpage price of the timber, fertilizer costs, and rotation length.

The abstract for the publication is below:

Abstract

The growth of many pine plantations in the southern United States is limited by soil nutrient availability. Therefore, forest fertilization is a common silvicultural practice throughout the South. Approximately 1.2 million ac of pine plantations were fertilized in 2004. In the last 10 years, considerable advances have been made in identifying the ecophysiological basis for stand growth and the response to fertilizer additions. Nitrogen (N) and phosphorus (P) are the nutrients that most commonly limit growth of southern pine. On wet clay soils in the lower Coastal Plain and on some well-drained soil in the upper Coastal Plain, severe P deficiencies exist. On these soils, P fertilization with 25–50 lb of P per acre at the time of planting produces a large and sustained growth response, on the order of 50 $ft^3\ ac^{-1}\ yr^{-1}$ (1.5 tn $ac^{-1}\ yr^{-1}$) throughout the rotation. On most other soils in the South, chronic deficiencies of both N and P exist. On these sites, soil nutrient availability often is adequate early in the rotation when tree demand is small. However, around the time of crown closure, N and P frequently become limiting. Fertilization with both N and P in these intermediate aged stands typically increases growth for 8–10 years. The growth response to a combination of 25 lb of P per acre plus 200 lb of N per acre averages around 55 $ft^3\ ac^{-1}\ yr^{-1}$ (1.6 tn $ac^{-1}\ yr^{-1}$) for an 8-year period. The amount of leaf area in the stand is the main factor determining the current growth rate of the stand and the potential growth response after fertilization. When stand leaf area index is less than 3.5, light capture by the stand is restricted and growth is negatively affected. In many of these stands, fertilization will increase leaf area because of increased soil nutrient availability and thus increase growth. The financial return after fertilization depends on the growth response that occurs, the cost of the fertilizer treatment, and the stumpage value of the timber produced. Using a growth response of 55 ft3 $ac^{-1}yr^{-1}$ over 8 years, a fertilizer cost of \$90 ac^{-1}, and stumpage values from the first quarter of 2006, the internal rate of return from midrotation fertilization of a loblolly pine plantation with N and P would be approximately 16%.

The full article is available through the following link: http://www.ipef.br/eventos/2009/graduatecourse/30-fox_et_al_2007.pdf

Citation

Thomas R. Fox, H. Lee Allen, Timothy J. Albaugh, Rafael Rubilar, Colleen A. Carlson; Tree Nutrition and Forest Fertilization of Pine Plantations in the Southern United States, Southern Journal of Applied Forestry, Volume 31, Issue 1, 1 February 2007, Pages 5–11, https://doi.org/10.1093/sjaf/31.1.5