Basic growth relationships in thinned and unthinned longleaf pine plantations

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ABSTRACT - Compilation, editing, and formatting of seven long-term longleaf pine (*Pinus palustris* Mill.) growth and yield studies has been completed and development of a growth and yield prediction system for longleaf pine plantations is underway. The studies are located in Central Louisiana, East Texas, Southern Mississippi, Southern Alabama, and Northern Florida. Silvicultural treatments include various planting and post-thinning densities, pruning, and fertilization. Residual basal area thinning treatments ranging from 40 to 140 ft^2/acre (including unthinned control treatments) were applied as early as age 17 and repeated periodically for as many as 8 thinnings. Planting densities ranged from 250 to 2500 trees/acre. Stand ages within the database range from 4 to 63 years. Various growth and yield variables are compared in tables and graphs for the thinning and planting density treatments and locations. The results represent some of the growth and yield trends that will be modeled in detail to develop a comprehensive prediction system for this important species of the southern United States.

INTRODUCTION

Growth and yield continues to be one of the high priority research topics of industrial, nonindustrial, and government natural resource organizations. The Southern Research Station of the USDA, Forest Service, has installed and currently maintains several active long-term studies to measure and model the growth and yield of planted longleaf pine. This poster includes 6 studies installed by Forest Management Research located at Pineville, Louisiana, as well as a dataset obtained from T.R. Miller Company (designated 410). Most of the studies emphasize management by control of the pine density. Other treatments include pruning and mid-rotation fertilization. Initial planting densities ranged from 250 to 2500 trees per acre. Some plots were left unthinned, but most were selectively thinned to target basal areas from 40 to 140 ft^2 per acre between ages 17 and 25, and rethinned regularly to maintain their target densities. Many of the study plots are located in stands more than 50 years old where individual tree measurements have been repeated every 5 years for more than 30 years.

Data from these studies were utilized by Lohrey and Bailey, 1977, to develop a stand level prediction system for unthinned stands, and unthinned plantation data were also used to compare two diameter distribution modeling approaches in a study reported at this conference (Leduc et al. 1998). An interim publication reporting preliminary thinned stand modeling results is available (Thomas and Lohrey 1990). Several papers have been published providing equations to predict measures of tree component quantity (biomass and volume) or stem form in plantation-grown trees (Baldwin and Polmer 1981, Lohrey 1982, Baldwin and Saucier 1983, Thomas et al. 1995). Recently, papers utilizing these data have been written emphasizing the great value of longleaf pine products from thinned stands (Busby et al. 1993), the dendroecological history of some of these pine stands (Eriksson 1993), and minimization of the costs associated with restoration of longleaf pine ecosystems (Busby et al. 1996).

Intensive analyses of data for prediction systems in thinned as well as unthinned stands are in process. These relationships will be the foundation for the model fitting process that will eventually result in a prediction system for planted longleaf pine. The completed prediction system will be published as part of the COMPUTE series of growth and yield models (Baldwin 1989), and will include several management options.

RESULTS AND DISCUSSION

Study 302 was compared to study 410 to demonstrate the variability of the age at which trees in a stand reach 4.5 feet in height. The early growth of study 410 may help to explain its greater diameter and dominant height values. More early growth and yield data (ages 5-15) would be beneficial in explaining this early grass-stage variability beyond a simple site index value.

When the seven separate studies with various treatments (thinnings, prunings, fertilizations, etc.) are compared there is much confounding from this variety of treatments, but there does seem to be a clear relationship between site quality and trends in survival and volume yield. It will be necessary to account for the many differences included in these studies to obtain a meaningful model, but this diversity should help to make the end result more widely applicable.

In order to observe the treatment effect, a single study (313, Texas, medium site-quality) was extracted from the dataset. It has a series of target basal areas from 40 to 140 sq. ft. per acre in increments of 20. The lack of overlapping of plots into other 'zones' of basal area before the next measurement/thinning indicates an appropriate set of thinning treatments and will maximize modeling of stand responses to thinning treatments. As might be expected, cubic-foot volume is greatest in the highest density stands. Thinning treatments have little effect on height, but great effect on average diameter.

CONCLUSION

The range and quantity of data and silvicultural treatments involved in these seven studies provide a well rounded dataset for growth and yield of longleaf pine. Observation of the basic data trends across studies and treatments reveals some basic building blocks as well as interesting challenges to developing a prediction system.

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