Existing Knowledge Levels of Silvicultural Impacts on Wood Properties for Developing Engineered Wood

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Introduction

The advent of engineered wood products has resulted in the increased utilization of small diameter trees. This trend emphasizes the need for more research on the impact of silviculture on the development of wood properties especially early in a tree's life cycle. In addition, existing growth and yield knowledge is lacking for early stand growth. By understanding the characteristics of wood properties throughout the life of the tree, the raw material base for engineered wood products could be expanded and uses could be created for younger material. Engineered wood products such as OSB (Oriented Strand Board), Timtek (steam pressed scrim lumber), and LVL (Laminated Veneer Lumber), may be more effectively produced given better predictive models.

Objectives

•To determine where gaps exist in current research pertaining to small diameter pine management and wood property response to silvicultural practices.

•To determine which wood properties are most important in the manufacture of engineered wood products.

•To determine which growth and yield models have the capability to integrate silvicultural treatments and predict expected wood properties at harvest age.

Methods

•Develop a list of wood properties most important to the wood products industry through literature review and discussion with scientific experts.

•Research the effects of silvicultural practices such as site preparation, thinning, fertilization, harvest age, and genetic control, on those wood properties that are important to engineered wood products in loblolly pine (*Pinus taeda* L.).

•Evaluate and summarize existing growth and yield models by what inputs and outputs are incorporated into the model.

Important Wood Properties

•**Specific Gravity** is the single most important indicator of wood quality. It is a measure of the density of wood relative to the density of water. Wood specific gravity is controlled by the ratio of early wood to latewood in each growth ring. In general, denser wood is more desirable for wood products.

• **Shrinkage** of wood can be a major problem in wood products. Uneven shrinkage rates create warping and lower the structural integrity of wood products. Excessive shrinkage rates result from large microfibrillar angles, commonly associated with juvenile wood, which occur in the first 12 to 15 years after stand establishment.

•**Knots** in the wood create weak points, which have detrimental impacts on most wood products.

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How Silvicultural Practices Influence Wood Properties

•**Site Establishment** affects all the wood attributes of interest, because it sets the initial conditions of the stand. The most important consideration is number of trees planted. By planting a large number of trees (>800) per acre specific gravity is increased. Self pruning is also promoted earlier which leads to fewer knots, but decreases the growth per tree.

•**Thinning** can be used to counteract some of the negative effects of the site establishment chosen. By thinning at the proper times (15 years or older) and at the proper rates (use 2 or more thinnings that remove 30% or less of the trees per acre per thinning) specific gravity can be maintained at some desired level. The severity of thinning also effects the degree of self pruning which the tree undertakes.

Unthinned **Thinned**

•**Fertilization** promotes tree growth. Fertilization tends to exaggerate whatever properties the tree has before fertilization under good growing conditions, but has been shown to lower specific gravity by as much as 19%.

•**Genetic Control** offers the most promising scenarios. By selecting for the most desirable properties, the growing stock can be improved in whatever area is needed most, but it is difficult to change one trait without having some effect on the others. If trees with only the highest specific gravity, least shrinkage, and least knots were engineered, growth would likely have to suffer.

•**Harvest age** affects all three attributes of interest. Specific gravity is increased with age by offsetting the juvenile growth with more mature wood. Microfibrillar angle decreases asymptotically with age so that the older the wood is the less shrinkage it will exhibit. Also if the tree was allowed to properly self prune at early ages, wood put on the bole of the tree each additional year will be free of knots.

Growth and Yield Models

•No growth and yield models currently predict wood properties, but some attempts are being made such as Tasissa and Burkhart 1998.

•Models that take into account detailed stand establishment data, could be modified to estimate the extent of juvenile wood development and natural pruning.

•Models that allow thinning can be manipulated to show growth rates of trees after the juvenile period, which could further be used to estimate specific gravity as well as self pruning.

Table 1. Inputs and Outputs used to Evaluate Growth and Yield Models.

Inputs	Glover and Hool 1979	Burkhart 1971	Zhang et al. 1996	Lenhart 1988
Age	10-17	9-33	0-16	3-19
Site index	53-77	50-90		29-129
Density	BA, TPA	TPA		TPA
Management				
Dbh	X		X	X
Height	X		X	X
Crown ratio	X		X	X
Outputs				
Yield		X	X	X
Diameter Distribution		X	X	X
Survival	X			
Model Type	Whole Stand	Diameter Distribution	Individual Tree	Diameter Distribution

Closing Remarks

•The ability to predict wood properties would allow producers to make product-specific raw material, as well as allow for more cost efficient production of engineered wood products.

•Future Research

- •Map the pine genome in order to better understand ways to manipulate certain wood properties.
- •Develop a pine growth and yield model that can accurately predict wood properties especially during early stand growth.

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