INHERITANCE OF WOOD PROPERTIES IN PINE

by

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Recently an increased interest in the genetics of wood properties of forest trees has been evident both by the researchers and members of the forest industries. The forthcoming TAPPI-sponsored discussion between geneticists and industry representatives is a good example. Although interest in this subject is high, factual knowledge is low. A survey of the literature indicates that for conifers, only few critical research results have been reported, although there is much circumstantial evidence presented. Studies have been made on inheritance of spiral grain, "abnormal" grain patterns, wood specific gravity, fiber characters and a few others. Results are scattered, however, and in some cases, rather inconclusive.

In the south, very little past work has been done on our pines regarding genetics of wood properties. Studies of only a few organizations have progressed far enough to enable the reporting of specific results, although a number of researchers are now either making intensive or incidental wood studies. Dr. Jackson's paper on tracheid length that we just heard, Echol's work on tracheid length inheritance and our work in Texas on wood specific gravity of loblolly pine are some that have been reported on. It is my understanding that Perry is soon to publish some work regarding specific gravity, as is Larsen. But overall, the results of work on genetics of wood properties for the southern pines are not plentiful.

It is the objective of this paper to discuss as yet unpublished information on work done in Texas and on one of the jobs we hope to do in North Carolina.

Dr. Jackson just discussed fiber length in slash pine. Several years ago fiber length studies were started on loblolly pine in Texas. Before we could proceed on genetic studies„however, we soon learned that more basic information about fiber variation from tree to tree and within a tree was necessary. Therefore, Paul kramer, head of the Forest Products Department of the Texas Forest Service, initiated an intensive study to analyze the tracheid length variation pattern in Texas loblolly pine. This study was more comprehensive than most others on this subject, and the results are now in press.

The Australians showed that there is considerable difference in initial tracheid length* from tree to tree and that this initial difference

*/ Length of tracheids in the first or second growth ring.

would continue to evident, throughout the life of the tree. If such holds true, it would suggest the possibility of selecting for tracheid length in very young trees. The Australians found, futhermore, that the tracheid length of a branch was similar to that of the initial tracheid length of the bole at the point where the branch was attached. This fact enabled sampling of young trees without destroying them, simply by analyzing a branch.

Unfortunately, for the 12 trees Kramer intensively studied, no high correlation was found between initial tracheid length and tracheid length of the tree when mature. However, he did find some correlation between the tracheid length of the fifth annual ring and mature wood tracheid length, and he found very high correlation between tracheid length at the tenth year and mature wood tracheid length. This finding suggests,then, that analysis of 10-year-old or slightly younger trees might serve for evaluating the results of selections or crosses, a very helpful concept in genetic studies. It appears that the curves of tracheid length between trees of loblolly pine (even-aged stand, same site, dominants and codominants) tend to become more or less parallel to each other at about 10 years of age, though some are relatively higher than others.

Time here does not permit even a complete summary of the several interesting results of Kramer's tracheid study. However a few of his findings were:

(1) The longest tracheids in each growth ring were found in the latter part of the summerwood. This result is similar to those published by several other workers.

(2) The commonly reported decrease in fiber length with increased growth rate within an individual tree was not found. Outside the core of juvenile wood (with the curve tending to break at 8 to 12 years) wide rings and narrow rings within the same tree had about the same tracheid length.

(3) No correlation could be found between growth rate from tree to tree and tracheid length of the tree, i.e., slow growth trees did not always have the longest tracheid and vice versa.

(4)" Trees grown under nearly identical environments, of the same age, and of similar phenotypes had very different tracheid lengths.

Perhaps the most widely studied wood characteristic is that of specific gravity. Many of you are familiar with our studies of this characteristic in loblolly pine. There is now in press an article describing some additional Studies that I will summarize here:

(1) The limb-to-bole specific gravity relationship holds on trees up to 12 years of age, i.e., there is a high correlation in the specific gravity between limb wood and bole wood at least in trees up to 12 years of age.

(2) The limb estimation method of determining specific gravity was checked on 4-year-old progeny from high and low specific gravity mother

trees, High correlations were found as reported in the original study of average specific gravity mother trees.

(3) It was found that progeny of an open pollinated high specific gravity mother tree produced higher bole and limb specific gravities than progeny from a low specific gravity mother tree. Unfortunately, progeny of only two parent trees (20 seedlings from each) were available, so the results cannot be regarded as conclusive although they certainly are encouraging.

(4) Progeny groups of 25 trees, 12 years of age, were analyzed from three isolated mother trees. Presumably the progeny were all the result of selfing, As shown for the open-pollinated trees above, the parents with the highest specific gravity produced progeny with the highest specific gravity.

(5) Limbs of 4-year-old grafts, whose scions originally came from trees with extremes of specific gravity, were analyzed. No significant differences in specific gravity of graft limbs were found. These grafts were from the same parent trees that produced the open-pollinated progeny discussed above, in which a pattern of inheritance seemed to be evident. Perhaps this lack of pattern in grafts but presence in progeny may point up the importance of the root system in the determination of specific gravity.

In North Carolina, we have underway a study similar to that on specific gravity in which we are going to work on the cellulose - lignin ratio, The first step is to make a field survey to find out how much variation there is from tree to tree within a species, the trees being similar as to age, form, growth rate and environment. Depending on results, genetic studies may be initiated to determine the inheritance pattern of the cellulose - lignin ratio. We hope, of course, to find a characteristic here with which the geneticist can work, but as far as I can find out, practically nothing is presently known about this relationship. It is encouraging, however, to read reports of poplar clonal studies in which large differences in cellulose content were found consistently evident between clones. Such studies on cellulose, though long term and complex, should help us know more about wood properties of trees in which we are interested.