ACOUSTIC VELOCITY AND DRILL RESISTANCE BREEDING VALUES AND GENETIC PARAMETER ESTIMATESS FOR JUVENILE LOBLOLLY PINE OF THE US ATLANTIC COASTAL PLAIN

***Trevor D. Walker**, Fikret Isik, Steve McKeand, Austin Heine[1], Graham Ford and Andrew Sims*
NC State University, Raleigh, NC, USA

Historically, selection for wood properties has been lacking from US southern pine breeding programs due to the prohibitively high cost to measure these traits on a large number of trees. Relatively recent innovations with indirect measurement tools now enable non-destructive, rapid assessment of large numbers of standing trees. These innovations include tools that measure acoustic velocity (as a surrogate for wood bending strength) and drill resistance amplitude (a surrogate for wood density). The potential for these tools to rank families for selection from progeny tests has been demonstrated in previous studies; however, this study is the first to present results of assessments in an operational setting, including a large number of families (270) of deep pedigree origin (third generation parents), tested widely in the southeastern US.

Measurements were taken in seven-year-old loblolly pine (*Pinus taeda* L.) half-sibling progeny tests established as part of the 3rd-Cycle of breeding and testing for the Atlantic Coastal population by the NC State University Cooperative Tree Improvement Program. Eight progeny test sites were sampled, two sites each from four multi-environmental progeny test series. Each test site contained approximately 70 families, represented in single-tree plots in a randomized complete block design with 20 experimental blocks per site. The Fakkop TreeSonic was used to measure acoustic velocity and the IML PD-Series Resistograph was used to measure drill resistance amplitude. To avoid shaft friction (drillbit drag), the Resistograph profile was split in half and only the first half was retained.

Heritability estimates for acoustic velocity were high: narrow-sense heritability across multiple environments was 0.39 and the half-sib family-mean heritability was 0.89. Genetic correlations between velocity and growth traits (height, diameter, straightness) were low, except for a moderately strong genetic correlation (r_G = 0.60) with height to diameter ratio (i.e. tree slenderness). We conjecture that the genetic correlation between slenderness and wood stiffness is due to the requirement of stiffer wood for families that emphasize height growth over girth to avoid stem breakage. One family had an exceptional breeding value for acoustic velocity (4.3 standard deviations above the mean) and also had an outlying breeding value for height to diameter ratio. Genotype by environment interaction was minor (type-B genetic correlation of 0.84).

Drill resistance amplitude narrow-sense heritability was 0.28 and half-sib family-mean heritability was 0.67. Genetic correlations with growth traits were very low, with about one quarter of families being above average for both volume and drill amplitude. Interestingly, the family with the highest drill amplitude breeding value also had a very high volume breeding value, which was comparable to a widely-planted parent for volume production. Genotype by environment interaction for drill amplitude was negligible (type B genetic correlation of 0.94). he genetic correlation between drill amplitude and specific gravity (measured on a subset of test sites) was very strong (r_G = 0.97).

The local checklot consistently ranked very near the average for both acoustic velocity and drill amplitude, corroborating selection on growth traits has not negatively affected wood properties. These results suggest a large amount of gain is possible for wood stiffness and density for loblolly pine families of the Atlantic Coastal Plain region in the US by using rapid assessment tools.

Contact Information: Trevor D. Walker, NC State University, 1019 Biltmore Hall, Raleigh, NC, USA 27695-8002,
Email: trevor_walker@ncsu.edu