Parent-Dependent Effects of the cad-n1 Mutant Allele on Height in Loblolly Pine Families

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The *cad*-n1 mutant allele encodes an inactive form of cinnamyl alcohol dehydrogenase, the enzyme that encodes the final step in the biosynthesis of lignin monomers in loblolly pine differentiating xylem. This mutant allele has dramatic effects on lignin composition and tree growth if present in the homozygous condition, and much more subtle effects if present in the heterozygous state with another allele that encodes normal levels of enzyme activity. Several authors have reported finding that trees heterozygous for the *cad*-n1 allele show differences in growth rate or wood properties, but not all studies that have tested for this effect have detected significant differences.

From a set of diallel progeny tests planted in the South Carolina Coastal Plain, we collected foliage samples from progeny of two parent trees, Parent A and Parent B, where Parent B is an offspring of Parent A. Both parent trees are heterozygous for the *cad*-n1 allele. The progeny were tested for the presence of the *cad*-n1 mutant allele, which was found in the expected 1:1 segregation ratio. Six-year height and volume data, standardized by replicate and site to minimize environmental contributions to variation, were used to compare performance of individuals that inherited the *cad*-n1 allele ("carriers") and those that did not ("non-carriers"). A combined analysis of all offspring of both parents shows no significant differences in height or volume between carriers and non-carriers. Separate analyses were conducted to compare height and volume between carriers and non-carriers by family, with the samples divided into offspring of crosses using the tested parents as pollen parent or as seed parent. Parent A was crossed to 13 other trees as a seed parent, and 8 other trees as a pollen parent; Parent B was crossed to 12 other trees as a seed parent, and 5 other trees as a pollen parent. A significant difference in height but not in volume was detected between carriers and non-carriers for the offspring of Parent A as seed parent, but not as pollen parent. The comparison among offspring of Parent B showed no significant differences in either height or volume, regardless of the direction of the cross.

A better understanding of the genetic basis for the difference in performance between parents within breeding programs can contribute to improved gains from selective mating of parents with complementary breeding values. Molecular genetic characterization of variation that underlies differences in breeding values is the first step toward this goal. Additional characterization of the effects of the cad-n1 mutant allele is needed to more fully describe the potential benefits and costs of using this variant in breeding for improved performance in loblolly pine.