GENETIC VARIATION IN LOBLOLLY PINE FOR EFFICIENY IN HYDROLYTIC CONVERSION TO ETHANOL

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In recent years interest in alternative and renewable fuels has increased considerably. These fuels can help to alleviate environmental issues and serve as replacements for fossil fuels. Ethanol is one alternative fuel already being developed and used that can be made from a variety of feedstocks, including woody plant matter (i.e., lignocellulosic biomass). Woody plant matter can be a good alternative energy source in the Southeastern U.S. due to its wide availability and its ability to grow on marginal sites. As one of the most productive tree species in the Southeastern U.S. as well as being the most planted, loblolly pine (*Pinus taeda* L.) is a logical species of interest for the development of biomass production in the region.

The use of loblolly pine biomass for ethanol production presents some challenges; enzymatic hydrolysis of polysaccharides from softwood pulp typically produces lower yields of fermentable sugars than similar treatment of hardwood pulp. Many chemical and physical wood properties are subject to genetic control, and variation in these properties may well affect the efficiency of ethanol production. In this experiment, 17 clonal varieties of loblolly pine, chosen for a diverse range of chemical and physical wood properties, were tested to characterize variation in yield of fermentable sugars from enzymatic hydrolysis of pulps produced by two different pretreatments. Wood samples from three pooled ramets of each clone were tested, using enzymatic hydrolysis after dilute acid and alkaline pretreatments, to produce data on sugar yields for each clone. Sugar yield is directly correlated with ethanol yield since the sugar is fermented to produce ethanol. The dilute acid pretreatment and enzymatic hydrolysis using 20 filter paper units (FPU) of enzyme produced an average of 210 mg sugar/g wood, with a standard deviation of 20 mg. The alkaline pretreatment and enzymatic hydrolysis using a higher level of enzyme (40 FPU) as well as mechanical beating produced 520 mg sugar/g wood with a standard deviation of 35 mg. A cluster analysis based on near-infrared (NIR) spectra of ground wood samples from multiple ramets of each of the clones was used to divide them into groups. NIR spectra reflect chemical and physical wood properties, so the clustering should have produced groups of clones that are similar for some combination of these traits. The NIR clustering was a significant predictor of sugar yield for the alkaline pretreatment. Given the high heritabilities of most chemical and physical wood properties, these results suggest that it should be possible to identify superior genotypes for biofuel production using NIR analysis.