NEW EFFORTS IN EASTERN COTTONWOOD BIOMASS PRODUCTION THROUGH BREEDING AND CLONAL REFINEMENT

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Abstract.–First generation biofuels (also known as traditional biofuels) primarily use corn to produce ethanol. Newer techniques and knowledge are now allowing ethanol production from renewable resources such as trees that have more complex molecular structures that inhibit access to sugars. Ethanol production is through an enzymatic process which uses cellulose, or pyrolosis which uses lignin from trees. When nonedible renewable resources, such as trees or agricultural crops, are converted into alcohol or some other energy source, they are termed advanced biofuels (second generation biofuels). In order to supply the demand for advanced biofuels, companies are looking for fast-growing species for the production of biomass. *Populus* species including eastern cottonwood (*Populus deltoids*) and hybrid poplars (*Populus* spp.) are key species. *Populus* breeding programs are developing new individuals to maximize biomass production under plantation settings. Dedicated energy plantations of select *Populus* species and hybrids, if shown to be economically viable, could provide a significant source of biomass for the southern United States. Although poplars have shown exceptional productivity (tons/acre/year) on suitable sites in the lower Mississippi Alluvial Valley (LMAV), the key will be to increase adaptability and yields across the south with minimal input over a 3- to 5-year period.

The majority of the previous *Populus* improvement work has focused on the collection of individuals (i.e., phenotypes) from young 1- or 2-year-old native stands or clones developed from open-pollinated seed under nursery type settings. Since the mid-1980s, cottonwood tree improvement work in the southern United States has dwindled. But, with the increased emphasis on biomass production for biofuel and bioenergy, eastern cottonwood and a variety of hybrid poplars are being re-examined.

In 2012, Mississippi State University began breeding efforts under a grant. Selected clones were used as the parental population, and the resulting progeny have been established in field trials to examine survival, growth, and disease resistance. In addition to these breeding efforts, clonal refinement tests were established in 2012 and 2013 to examine clonal performance of cottonwood clones on both alluvial and upland sites. In 2012, a test of 17 highly selected cottonwood clones was established near Stoneville, MS. In 2013, another 47 eastern cottonwood clones, including many untested clones, were selected and are being examined for growth, disease resistance, and rootability on two sites in Mississippi (Newton and Leland, MS). Results from these trials will be used to select the best clones for inclusion into larger block trials as well as to provide new selections for inclusion into the breeding program. Our goal is to produce clones that exhibit rapid growth, high survival rates, increased disease resistance, and wood characteristics suitable for use in the bioenergy and biofuels programs in the United States as well as worldwide.

In the spring of 2012, the first test site was established in Stoneville, MS with 17 *P. deltoides* clones in a random complete block design consisting of 10 blocks. All 17 clones were planted as 18 inch unrooted cuttings at a spacing of 6 feet x 9 feet. Prior

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to planting, all cuttings were soaked in Admire® Pro (Bayer CropScience, Research Triangle Park, NC) to control cottonwood leaf beetles during the first year. After planting, weed and grass competition was maintained on all sites by chemical and mechanical methods to ensure survival and growth. Height growth at the Stoneville test was assessed at 2-week intervals during the summer of 2012. Biweekly measurements were taken to determine intervals of growth that may be useful for early age selection. The constant inspection also allowed the determination of when disease and defoliation occurred as well the progression of the disease and/or insect damage. After the 2012 growing season, measurements on the site will be recorded annually.

In 2013, a clonal refinement test was established on two sites in Mississippi. Both sites were previously in agriculture, with one site located near the Leland, MS site which is in the LMAV. The second site was located near Newton, MS on an upland soil.

The test design for the 2013 clonal refinement test was a randomized complete block consisting of 12 blocks and 47 cottonwood clones which were arranged in two-tree row plots at a spacing of 6 feet x 9 feet. Both test sites will be measured annually for the first 5 years to determine the appropriate selection age. Traits measured will include total height and disease resistance at age 1 followed by diameter at breast height, total height, and disease resistance at ages 2 through 5 years. These measurements will be used to assess genetic variation, heritability, genetic and phenotypic age-age correlations, and genetic gain per unit of time for various sites across Mississippi.

The content of this paper reflects the views of the authors(s), who are responsible for the facts and accuracy of the information presented herein.