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Improved Yields of Biomass

A small-cost Department of Energy (DOE) program aimed at producing liquid fuels from biomass has made significant progress, and prospects for further achievements are excellent. In the past, U.S. programs have emphasized obtaining alcohol from corn. This requires large inputs of energy and chemicals, often increases soil erosion, and results in no net energy, no decrease in oil imports, or amelioration of the greenhouse effect. In contrast, perennials such as fast-growing trees require small inputs, minimize soil erosion, could make substantial net energy contributions, and could be processed to produce liquid fuels. The major steps required to obtain competitively priced liquid fuels are to achieve low-cost biomass and subsequent low-cost conversion of it to liquids such as ethanol and methanol.

Optimal species for production of biomass at a particular locality is dependent on many variables, including climate and soil. DOE has been supporting a $4-million annual program involving a score of organizations (mainly universities). The program coordinated by the Oak Ridge National Laboratory has emphasized development of woody and herbaceous energy crops. Field trials with many species have been conducted at a wide range of sites, and research efforts have included genetic improvement programs through hybrid breeding and tissue culture.*

Noteworthy is progress that has been made in the Pacific Northwest by a team that includes scientists from the University of Washington and Washington State University. The group has emphasized research on black cottonwood, the fastest growing hardwood of the region. They have 2000 clones that are being tested in 25 field trials in British Columbia, Washington, and Oregon. They have produced hybrids that are better than parent stock by a factor of 1.5 to 2. Six years after planting, on the "better" sites the trees are as tall as 15 meters, with a diameter at the base of 25 centimeters. The cumulative harvest at 6 years reaches as much as 150 to 180 metric tons per hectare (dry weight).

Efforts to improve yields and to provide additional resistance to insects and pathogens continue. In these activities the favorable characteristics of the black cottonwoods are useful. These include great species diversity, high interspecific crossability, ease with which plants can be regenerated from tissues and cells, and ease of vegetative propagation. Rapid progress is being made in mapping DNA of the species.

The research results of the Washington scientists are having immediate practical applications. Success of the breeding program has interested some of the major forest products companies. Hardwood fiber blends well with that of conifers in the production of high-grade paper, towels, and tissue. Considerable areas of land are available that have low productivity for conventional farming but are suitable for cottonwood. Moreover, the rate of production of wood from fast-growing trees is much superior to that of the conifers of the region. The conifers, after planting, require as much as 30 years to reach their maximum rate of addition of mass, and even at that time the rate of addition is much less than that of cottonwoods. As of early 1991, the planted and planned area of hardwood plantation in the Pacific Northwest totaled about 24,000 hectares (60,000 acres).

Success of this program has led to financial support from many companies, overshadowing DOE funds. Some companies have established R&D programs. The effort to produce low-cost biomass now has the kind of momentum that will surely lead to further successes. The hybrids produced in the Pacific Northwest may not be suitable for other regions of the country, but the successful application of modern biology to a potential energy crop is a challenging precedent for other areas. Their efforts should receive expanded federal support.

The potential for energy crops in the United States is substantial. Part of it is in land that the federal government pays to keep out of cultivation. But many tasks must be accomplished before a successful biomass–liquid fuels program could be implemented. One of them, achieving efficient, low-cost conversion of biomass into liquid fuels such as ethanol, is a crucial goal that is being approached. Through advances in enzymology and microbiology, the projected price of ethanol from cellulosic biomass has been reduced by a factor of 3 during the past 10 years. At the present projected price, alcohol from woody sources could compete with gasoline priced at $1.50 at the factory gate. When another factor of 2.5 is reached, ethanol for motor fuel would be comeptitive without a subsidy.

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*See project summaries of the "Biofuels Feed Stock Development Program" from Oak Ridge National Laboratory, Environmental Sciences Division, P.O. Box 2008, MS 6352, Oak Ridge, TN 37831–6352.

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