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DOE Bioenergy Center Special Issue. The Bioenergy Sciences Center (BESC)

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This issue of *BioEnergy Research* is the first of three special issues to feature work from the US Department of Energy (DOE) Bioenergy Centers. In June 2006, the DOE's Genomes to Life Program published a report, entitled "Breaking the biological barriers to cellulosic ethanol: a joint research agenda," that outlined research areas requiring significant investment in order to meet the target of making cellulosic ethanol cost-competitive by 2012. Words were converted to action in June 2007 when Energy Secretary Samuel W. Bodman announced the establishment of three new Bioenergy Research Centers. Each center was to receive $135 million over 5 years. The successful competitors for this funding were the Bioenergy Sciences Center (BESC) coordinated from the Oak Ridge National Laboratory (ORNL) in Tennessee, the Joint Bio-Energy Institute coordinated from the DOE's Lawrence Berkeley National Laboratory in California, and the Great Lakes Bioenergy Research Center coordinated from the University of Wisconsin at Madison. The concurrent provision of a $500 million grant from British Petroleum to fund the Energy Biosciences Institute, involving the University of California at Berkeley, the Lawrence Berkeley National Laboratory, and the University of Illinois, completed this unprecedented response to addressing the political, economic, and environmental challenges associated with moving away from an oil-based economy.

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As outlined in the following article by Davison et al. (pp. 177–178), BESC is multi-institutional consortium with a highly focused set of goals centered around overcoming the recalcitrance of lignocellulosic biomass to enzymatic and microbial saccharification. These goals will be achieved through multidisciplinary approaches, targeted toward gaining an understanding of how cell wall structure impacts saccharification efficiency, to the development of single microbes, or microbial consortia with improved abilities for biomass deconstruction. Central to BESC's research plan is the deployment of state-of-the-art, high-throughput biomass characterization platforms. The two plant species most studied by BESC, poplar (*Populus*) and switchgrass (*Panicum virgatum*), both have a long history with ORNL as target bioenergy crops. Switchgrass received further publicity through being mentioned in President George W. Bush's 2006 State of the Union address. The papers in this volume all come from the biomass improvement and characterization teams within BESC and provide a progress report of early, baseline work primarily on the above two species.

The review by Decker et al. (pp. 179–192) describes the problems associated with high-throughput characterization of biomass, and some of the approaches that BESC is taking to develop a pipeline for the analysis of large plant populations such as used in association mapping studies. The following paper by Foston et al. (pp. 193–197) highlights some of BESC's capabilities in low throughput, high resolution analysis of biomass components, in this case for studying the ultrastructure of cellulose. Similar level analysis of lignin ultrastructure/composition in genetically modified plants with verified improvements in recalcitrance is outlined in the article by Pu et al. (pp. 198–208).

BESC is employing bioinformatic analyses of current and emerging genome data as a key component of its efforts to better understand plant cell wall biosynthesis. The computational work includes establishment of a number of specific databases that encompass genomic data of relevance to cell wall research (Mao et al., pp. 209–216), along with detailed phylogenetic and in silico gene expression analyses to predict genes with potential involvement in determining biomass quality (Shen et al., pp. 217–232).

A major practical goal of BESC is to deliver poplar and switchgrass germplasms with reduced recalcitrance to saccharification. Because switchgrass is an outcrossing tetraploid or octoploid that has undergone little domestication, there is much variation in biomass properties in natural populations, and the manuscript by Mann et al. (pp. 246–256) describes variations in lignin content and structure in plants grown under different environmental conditions. Lignin is likely one of the major contributors to biomass recalcitrance, and Shen et al. (pp. 233–245) present a detailed picture of the developmental patterns of deposition of lignin and related phenolic compounds in greenhouse- and field-grown plants, thus providing baseline information for assessing the effects of future genetic manipulation of cell wall components. Another important trait in switchgrass is its ability to repartition nutrients, especially nitrogen and minerals, from the aerial parts to the root system during senescence; increasing the efficiency of this process will improve the sustainability of the crop, and new information on nutrient recycling in a range of switchgrass accessions is described by Yang et al. (pp. 257–266).

Although stable genetic transformation of switchgrass has been reported, it is still relatively inefficient and requires significant optimization if it is to be incorporated into a high-throughput pipeline for testing biomass quality genes. The last two papers in this issue, by Burris et al. (pp. 267–274) and Xi et al. (pp. 275–283), report ongoing improvements to tissue culture and transformation protocols for switchgrass from two of the groups that constitute BESC's switchgrass transformation pipeline.

I would like especially to recognize the four guest editors who worked so efficiently and under tight deadlines, to organize peer review of manuscripts for this special issue. They were:

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