Characterization of drought tolerance and water-use efficiency related traits in switchgrass

Yongqin Wang[1,2]* (yqwang@noble.org), Weihong Dong, Marcus Griffiths, Larry York, Michael Udvardi[1,2], Yun Kang[1,2], and **Gerald A. Tuskan**[2]

[1]Noble Research Institute, LLC. Ardmore, Oklahoma; [2]Center for Bioenergy Innovation, Oak Ridge National Laboratory, Oak Ridge, TN

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Project Goals: The Center for Bioenergy Innovation (CBI) vision is *to accelerate domestication of bioenergy-relevant, non-model plants and microbes to enable high-impact innovations at multiple points in the bioenergy supply chain.* CBI addresses strategic barriers to the current bioeconomy in the areas of 1) high-yielding, robust feedstocks, 2) lower capital and processing costs via consolidated bioprocessing (CBP) to specialty biofuels, and 3) methods to create valuable byproducts from the lignin. CBI will identify and utilize key plant genes for growth, composition and sustainability phenotypes as a means of achieving lower feedstock costs, focusing on poplar and switchgrass. We will convert these feedstocks to specialty biofuels (C4 alcohols, C6 esters and hydrocarbons) using CBP at high rates, titers and yield in combination with cotreatment, pretreatment or catalytic upgrading. CBI will maximize product value by *in planta* modifications and biological funneling of lignin to value-added chemicals.

In the CBI project, we will characterize drought tolerance and water use efficiency (WUE) related traits in a switchgrass genome-wide association study (GWAS) panel. Causal alleles controlling biomass yield and persistence under drought stress will be identified via GWAS analyses. Key genes and mechanisms underlying important sustainability traits will be further validated to facilitate subsequent genomic selection and maker-assisted breeding programs.

Switchgrass (*Panicum virgatum*) is a promising feedstock for biofuels in the United States. As for most crops, periodic drought often limits its productivity, especially in marginal lands where it is likely to be planted. In this CBI project, we aim to evaluate drought tolerance and WUE related physiological and biochemical traits of a switchgrass GWAS panel comprising 415 sequenced genotypes (Juenger *et al.*, 2016). Due to the outcrossing nature of switchgrass, we optimized a micro-propagation method via node culture (Alexandrova *et al.*, 1996), and have successfully propagated the majority of the switchgrass GWAS panel using this method.

In addition, experimental conditions were optimized by performing a preliminary phenotyping experiment using 12 switchgrass genotypes. Traits characterized included shoot and root biomass, water use efficiency, root architecture, root/shoot ratio, leaf area, leaf thickness, stomatal density, leaf cuticular wax, and leaf osmotic pressure. Among 100 lines that have been characterized so far, large genotypic variations were observed in all the traits. Once the entire GWAS panel has been phenotyped, GWAS analysis will be performed to identify quantitative trait loci (QTL) markers and key genes controlling biomass yield and persistence under drought stress. These results will facilitate subsequent genomic selection, maker-assisted breeding and biotechnology strategies to enhance sustainability in switchgrass production.

References

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The Center for Bioenergy Innovation is a U.S. Department of Energy Bioenergy Research Center supported by the Office of Biological and Environmental Research in the DOE Office of Science.