# Genome-wide association studies of drought stress and water use efficiency related traits in switchgrass

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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.**

Abstract: Switchgrass (*Panicum virgatum*) is a promising feedstock for biofuels, but periodic drought often limits its productivity, especially in marginal lands where it is likely to be planted. To identify causal alleles controlling biomass yield and persistence under drought stress and screen for switchgrass genotypes with superior biomass production, water use efficiency (WUE) and drought tolerance, genome-wide association studies (GWAS) were performed using a switchgrass GWAS panel of 299 genotypes. Phenotyping experiments were conducted under greenhouse conditions with five biological replicates (two tillers per replicate) each for drought-stress and well-watered treatments per genotype. Three weeks after tiller transplanting, drought stress was applied by withholding watering, and drought stress levels were monitored with a soil moisture sensor. When the soil volumetric water content dropped to 5% (or at the wilting point), which usually occurred in two to four weeks after withholding water, phenotypic data on related traits were collected. For well-watered plants, phenotypic data were collected eight weeks after tiller transplanting. Traits characterized included leaf area, specific leaf weight, stomatal density, leaf cuticular wax, leaf osmotic pressure, shoot and root biomass/ratio, water use efficiency, and root architecture. Large genotypic variations were observed in all the traits characterized. GWAS analyses have been performed on leaf area, specific leaf weight, leaf cuticular wax and well-watered shoot biomass, and multiple significant associative markers were identified. Top candidate genes and quantitative trait loci (QTL) will be further evaluated to facilitate subsequent genomic selection, maker-assisted breeding programs and biotechnology strategies to enhance sustainability in switchgrass production.

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