Drought Caused a 33% Reduction in Switchgrass (*Panicum Virgatum L.*) Biomass with Minimum Effects on Net CO_2 Assimilation

Mauricio Tejera[1]*(mauri@msu.edu), **Berkley Walker**[1]

[1] DOE Great Lakes Bioenergy Research Center, Michigan State University, East Lansing, MI

https://www.glbrc.org/

Project Goals

Characterize physiological switchgrass response to drought and identify how that response impacts fermentation and ethanol production.

Abstract

Switchgrass (*Panicum virgatum* L.) is a perennial C_4 grass, widely considered as a bioenergy crop given its low-input requirements, cold tolerance, and high yields even in marginal lands. Marginal lands are prone to frequent drought events which could impact switchgrass biomass yield and quality. Changes in plant chemical composition under drought stress have been shown to inhibit downstream fermentation processes and ethanol production, however, the physiological base of these changes remains elusive. During the 2020 growing season we installed ~20m^2 rainout shelters to impose drought treatments and study how switchgrass diel carbon assimilation and allocation changed during growing season. Shelters successfully excluded rainfall and limited soil water content to only 10% of rainfed treatments. In addition, they caused a 33% biomass yield reduction ($P = 0.084$). Surprisingly, the drought treatment had smaller effects on switchgrass leaf water potential (LWP), diurnal course of CO_2 assimilation and stomatal conductance. Over the five sampling dates throughout the season, switchgrass CO_2 assimilation was ~15% higher ($p < 0.05$) in rainfed treatments only in mid and late summer. This discrepancy between whole-plant (biomass yield) and leaf-level (CO_2 assimilation) changes could suggest that i) switchgrass plants adjust other aspect of their physiology under drought (e.g., tillering, leaf area) or ii) the small changes at the leaf-level have larger impacts when accumulated over the growing season. At the end of the growing season, we conducted a leaf-level ^{13}C-CO_2 labeling event to compare carbon allocation to different metabolic pathways in drought treatment and rainfed plants. We found no differences in the labeled molecule profile between treatments ($P < 0.1$) and recently assimilated carbohydrates were mainly directed to central metabolism. Altogether, these results help characterize switchgrass response to drought at multiple levels, and identify pathways that are upregulated under drought conditions, with implication on ethanol fermentation.

Funding statement: This material is based upon work supported in part by the Great Lakes Bioenergy Research Center, U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research under Award Number DE-SC0018409.