An Ecosystem-Scale Comparison of Sorghum, Maize, and Miscanthus as Three Bioenergy Crop Candidates

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Project Goals: The primary goal of our research team is to measure carbon, nitrogen, water, and energy fluxes from annual and perennial bioenergy crop systems across spatial and temporal scales. We achieve this using a suite of above and below ground measurement approaches, including eddy covariance flux towers, soil respiration chambers, and quantum cascade lasers for fluxes and regular survey sampling for pool quantification of each of these variables. Our efforts will provide a better understanding of how carbon, nitrogen, water, and energy partitioning change over time for annual and perennial crops, which is important for determining the long-term sustainability of bioenergy crop systems.

Abstract text. Perennial cellulosic crops have been the focus of bioenergy research and development due to sustainability advantages associated with their higher soil carbon storage and reduced nitrogen requirements compared to annual crops. However, perennial crops can take several years to fully establish and their sustainability benefits can be quickly negated if converted to other land uses. The development of a photoperiod sensitive, high yield energy *Sorghum bicolor* (sorghum) variety may offer an annual cellulosic crop alternative that could provide a better ecologically sustainable bioenergy source than its annual *Zea mays* (maize) counterpart and be more easily integrated into current crop rotation cycles. The University of Illinois has a rich history of using eddy covariance flux towers to quantify carbon, water, and energy fluxes over both maize and miscanthus (*Miscanthus x giganteus*) crop systems in the Midwest region of the United States. With support from CABBI, a new flux tower was installed in a sorghum field to compare against the existing maize and miscanthus records. We present results from the first growing season where all three crops were measured with the aim of characterizing ecophysiological similarities and differences in carbon, nitrogen, water, and energy flux between these three key bioenergy crop systems.

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