BRC Science Highlight
October 2020

The Carbon and Nitrogen Cycle Impacts of Reverting Perennial Bioenergy Switchgrass to an Annual Maize Crop Rotation

Objective

As demand for bioenergy increases, land managers are likely to rotate between perennial and annual crops to meet market demands. Perennial biofuel crops, such as switchgrass, increase belowground soil organic carbon (SOC) and reduce nitrogen (N) losses compared to annual food crops, such as maize. However, the impacts of reverting from perennial to annual cropping systems remain poorly understood. In this study, researchers address this knowledge gap by measuring C and N dynamics over two years after reversion of mature switchgrass to a maize cropping system.

Approach

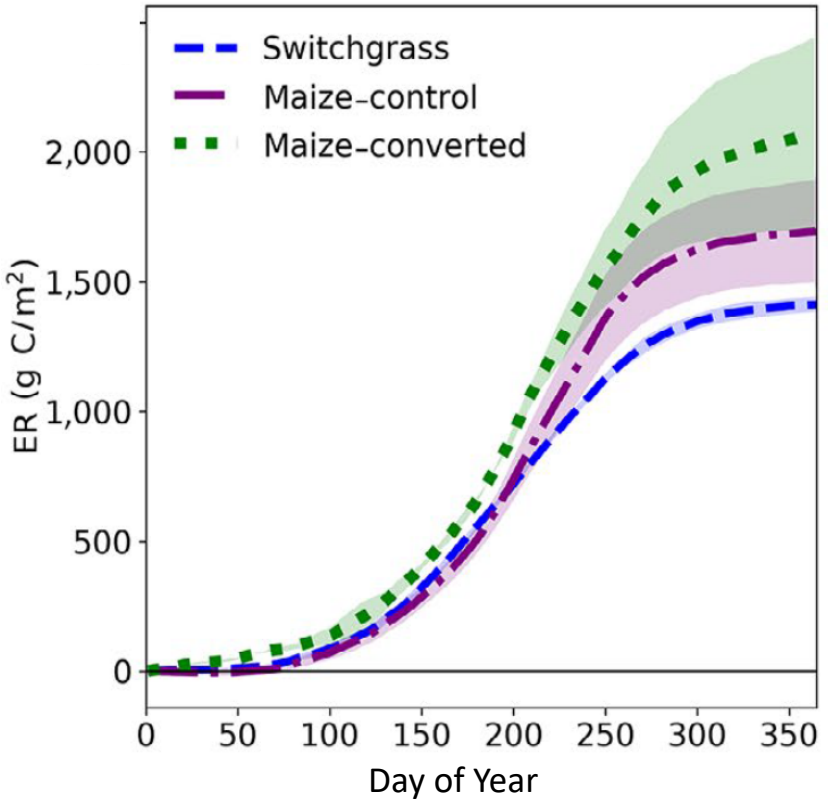
- Measured C and N pools and fluxes over two years in three land management treatments: maize-control, switchgrass, and maize-converted (converted from perennial switchgrass to annual maize).
- Used the DayCent model to project post-disturbance SOC equilibration time in maize-converted treatment.

Results

- The maize-converted treatment showed the highest ecosystem respiration (ER) (2,073 g C m^2 y^{-1}) compared to switchgrass (1412.7 g C m^2 y^{-1}) and maize control (1,699.16 g C m^2 y^{-1}) treatments.
- DayCent modeling predicted it would take approximately five years for SOC dynamics in maize-converted to return to the conditions of the maize-control treatment.

Significance

This work demonstrates that optimized management for SOC stock preservation is key for maintaining long-term ecological sustainability of bioenergy production under scenarios of transition between perennial and annual cropping systems. A valuable future step would be to expand the analysis to understand these dynamics at the landscape scale.



Mean and cumulative ecosystem respiration (ER) for maize control (2008-18), switchgrass (2018-16) and maize-converted (2017-19). Data from Illinois Energy Farm, Illinois, U.S.; shading indicates standard error of the mean.

*Moore et al. 2020. "The Carbon and Nitrogen Cycle Impacts of Reverting Perennial Bioenergy Switchgrass to an Annual Maize Crop Rotation." **Global Change Biology – Bioenergy**. DOI: 10.1111/gcbb.12743*

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