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CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

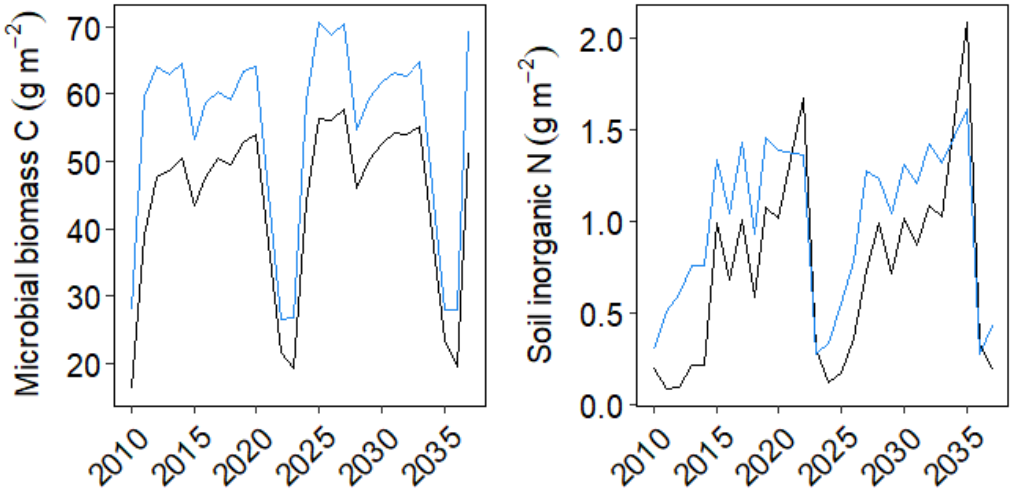
Modeling Plant Nutrient Acquisition Strategies Alters Projections of Carbon and Nitrogen Dynamics in Bioenergy Agroecosystems

Background/Objective

Plant nutrient acquisition strategies can shape ecosystem biogeochemistry and resilience. However, their role in shaping carbon (C) and nitrogen (N) dynamics in bioenergy agroecosystems is unclear. This work examines the ability of a microbially explicit model of plant N acquisition and soil organic matter (SOM) decomposition (FUN-BioCROP) to simulate the observed effect of differing nutrient acquisition strategies on soil microbial processes in the perennial bioenergy grass miscanthus vs. annual sorghum. Researchers tested the hypothesis that modeled soil microbial communities in miscanthus are more responsive to root C exudation than in sorghum.

Approach

Researchers examined the ability of the baseline FUN-BioCROP model to capture the effect of differing nutrient acquisition strategies on soil microbial processes in miscanthus and sorghum. They then altered microbial parameters to reproduce observed field effects for these two crops.



FUN-BioCROP model results for fertilized miscanthus showing annual average microbial biomass C and soil inorganic N simulated with baseline (black) and altered (blue) parameters.

Results

The baseline model was unable to reproduce empirical results showing a greater microbial response to rhizosphere C inputs in miscanthus vs. sorghum. Manual alteration of microbial parameters controlling decomposition rate and microbial demand for N relative to C was required to reproduce the observed field effects of root exudation in miscanthus vs. sorghum on microbial biomass and activity.

Significance/Impacts

This modeling work supports the hypothesis that miscanthus recruits a soil microbial community that differs from other bioenergy feedstocks in key traits that control its ability to respond to root exudates. Further testing this hypothesis would require significant data collection and modeling advances but could potentially transform our ability to predict impacts of different bioenergy crops on ecosystem C and N dynamics.

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