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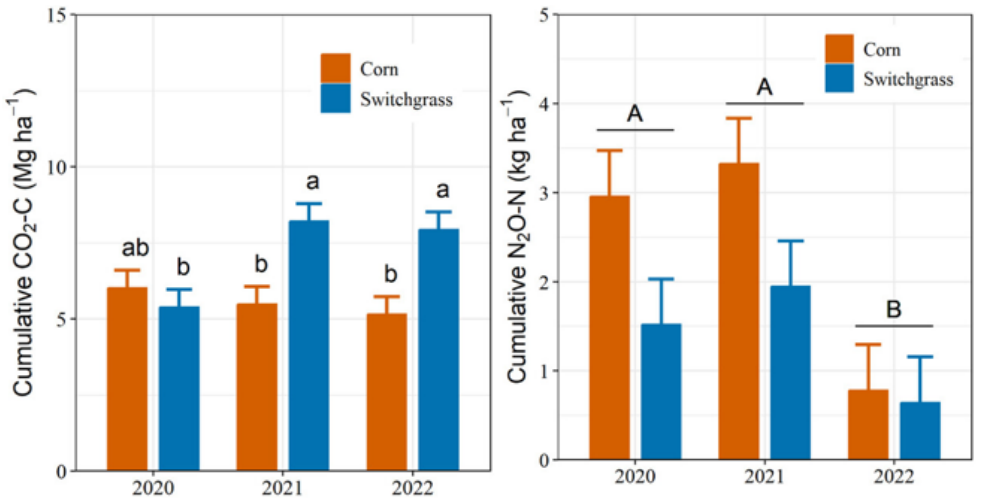
Field-scale Evaluation of Ecosystem Service Benefits of Bioenergy Switchgrass

Background/Objective

Purpose-grown energy crops, including switchgrass (*Panicum virgatum L.*), can provide feedstock for sustainable aviation fuel (SAF) production while enhancing ecosystem services. However, data on ecosystem service outcomes from advanced bioenergy switchgrass cultivars grown at scale remain limited. This study addresses this gap by reporting a suite of ecosystem service metrics for the "Independence" bioenergy switchgrass cultivar.

Approach

This study assessed carbon (C) sequestration, greenhouse gas (GHG) emissions, evapotranspiration (ET), water use efficiency (WUE), and NO_3-N leaching from the bioenergy switchgrass Independence cultivar compared to corn, at the University of Illinois Energy Farm (2020-2022) on ~0.4 ha plots. Both crops were managed under their respective best management practices for Illinois.



Cumulative CO_2-C and cumulative direct N_2O-N emissions from corn and switchgrass from 2020 (switchgrass establishment year) through 2022. Error bars = standard error of the mean.

Results

Switchgrass reduced NO_3-N leaching over time compared to corn, achieving 80% reduction by 2022. Emission trends showed lower direct N_2O emissions in switchgrass, but CO_2 emissions were >50% higher two years after establishment, likely due to root associated respiration. Changes in SOC were observed only in the 0-10 cm depth. Belowground biomass was >5 times greater in switchgrass over 0-90cm depths. Switchgrass and corn had comparable ET and WUE.

Significance/Impacts

These findings underscore the potential of commercial-scale, purpose-grown perennial bioenergy crops to contribute to energy production goals while enhancing belowground C storage, reducing GHG emissions, and minimizing NO_3-N leaching – without detrimental effects on hydrological processes.

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