

# Quantifying Soil Organic Matter Stock Distribution and Origin Following Over a Century of Maize-Based Cropping in the Former Tallgrass Prairie Region of Central USA

## Background/Objective

Tallgrass prairie conversion to maize-based agriculture in central North America has resulted in substantial loss of soil organic carbon (SOC) in less than two centuries. Agricultural management has evolved with knowledge and technology, but the evaluation of management impacts on SOC loss mitigation have been generally limited in soil depth and especially duration. This study utilized the Morrow Plots in Urbana, Illinois, one of the oldest agricultural experiments in the world, to address this knowledge gap.

## Approach

The Morrow Plots experiment includes three crop rotation treatments (continuous maize, maize-soybean, and maize-oat-alfalfa) subdivided into fertility management treatments (no fertility input, synthetic nitrogen/phosphorus/potassium (NPK), and manure). Soils sampled in year 145 of the experiment were analyzed to evaluate the effects of crop rotation and fertility management on SOC stocks and to quantify prairie-versus maize-derived SOC after continuous maize cropping since 1876 using stable carbon isotope ( $^{13}\text{C}$ ) natural abundance and an isotope mixing model.

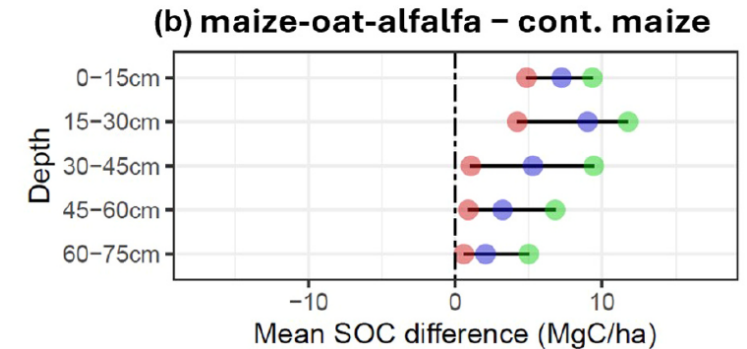
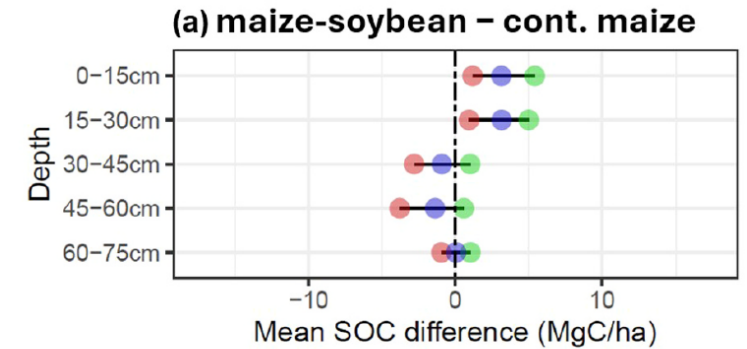
## Results

SOC by equivalent soil mass (ESM) was  $30.7 \text{ Mg C ha}^{-1}$  (+31.7%) higher under maize-oat-alfalfa than continuous maize, but similar between maize-soybean and continuous maize. NPK fertilization and manure did not influence ESM SOC. Maize-derived C ranged between 19.5-59.6% of SOC across depths, indicating the majority of SOC was still derived from prairie, even after 145 years of continuous maize cropping.

## Significance/Impacts

This work confirms the potential of diversified crop rotations for minimizing SOC losses from tallgrass prairie at the centennial scale and highlights the importance of relic prairie soil organic matter for future crop production in the US Midwest.

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SOC difference by depth for (a) maize-soybean minus continuous maize and (b) maize-oat-alfalfa minus continuous maize for all three fertility treatments. Blue dot represents the mean. Red and green dots represent 95% confidence interval.