Soil Organic Matter and Nutrient Responses to Cropping System Management

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WCS-FARM

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INTRODUCTION

Sustainable crop production requires management systems that maintain yield while improving soil properties. Practices such as crop rotation, tillage, nitrogen management, and cover crops can affect soil organic matter and nutrient availability. Comparing soil properties before and after treatment implementation can help identify early changes in soil fertility and soil health indicators.

OBJECTIVES

Determine how crop rotation, tillage, nitrogen management, and cover crops influence short-term changes in soil properties and corn grain yield after three years of management.

MATERIALS AND METHODS

Site and years: The study was conducted at the Bayer Crop Science Water Utilization Learning Center in Gothenburg, NE, from 2021 to 2024 and is still in progress..

Treatments:

- Treatments included three crop rotations: continuous corn, corn–soybean, and corn–soybean–wheat, with all rotation phases present each year.
- The experiment was arranged as a split-plot design with strip-plot overlays.
- Tillage was the main plot factor, crop rotation was the subplot factor, and cover crop and nitrogen rate were strip-plot factors.
- Nitrogen was applied as UAN 28% at the locally recommended pre-plant rate, with the enhanced treatment receiving an additional 60 kg N ha^{-1}.
- Soil samples were collected in 2021 and 2024 at 0–5 and 5–15 cm depths, and soil responses were calculated as 2024 − 2021.

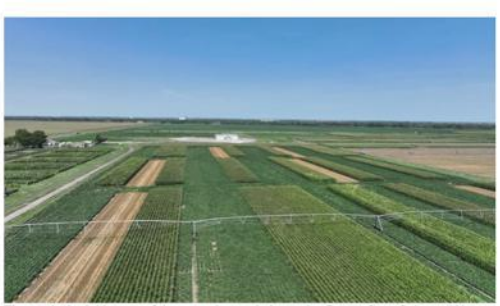

Figure 1: Aerial image of the experimental site at the Bayer Crop Science Water Utilization Learning Center (Gothenburg, NE) captured in 2024.

RESULTS

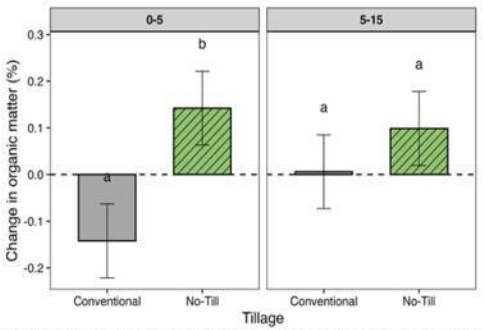

Figure 2: Change in soil organic matter by tillage and depth from 2021 to 2024. Bars represent estimated means ± SE; different letters indicate significant differences within each depth.

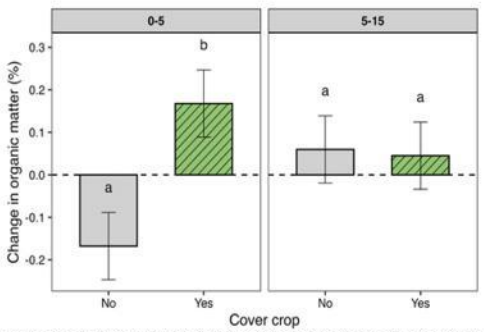

Figure 3: Change in soil organic matter by cover crop treatment and depth from 2021 to 2024. Bars represent estimated means ± SE; different letters indicate significant differences within each depth.

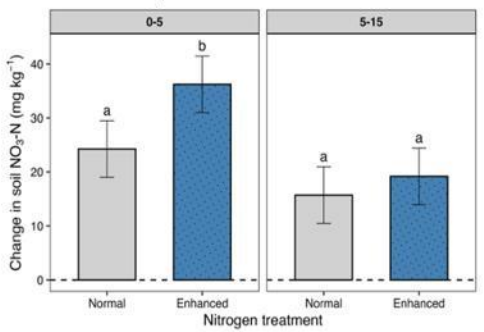

Figure 4: Change in soil NO_3-N by nitrogen treatment and depth from 2021 to 2024. Bars represent estimated means ± SE; different letters indicate significant differences within each depth.

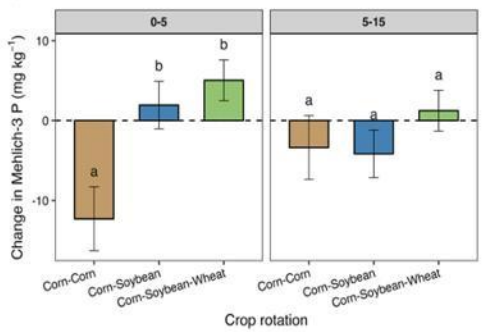

Figure 5: Change in Mehlich-3 P by crop rotation and depth from 2021 to 2024. Bars represent estimated means ± SE; different letters indicate significant differences within each depth.

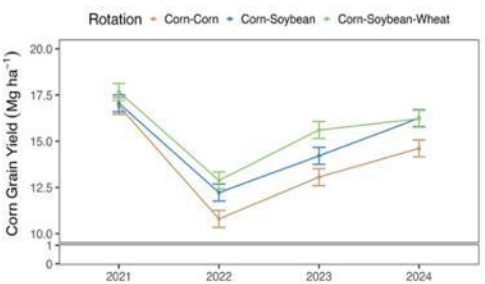

Figure 6: Corn grain yield (kg ha^{-1}) from 2021 to 2024 across crop rotation systems.

Soil variable	Effect	Comparison	Difference	p-value
OM	Rotation	(Corn-Corn) − (Corn-Soybean)	+0.25 percentage points	0.0065
OM	Rotation	(Corn-Corn) − (Corn-Soybean-Wheat)	+0.20 percentage points	0.0303
NO_3-N	Rotation	(Corn-Soybean-Wheat) − (Corn-Corn)	+12.65 mg kg^{-1}	0.0289
P	Cover crop	(Cover crop) − (No cover crop)	−5.18 mg kg^{-1}	0.0323
P	Nitrogen × depth	Enhanced − Normal at 0–5 cm	+9.18 mg kg^{-1}	0.0074

Table 1: Additional significant treatment effects not shown in figures. Differences are based on estimated marginal means.

SUMMARY

- After three years, management effects on soil properties were most evident in the 0–5 cm layer.
- No-till and cover crops increased soil organic matter in the 0-5 cm layer, but no differences were observed at 5-15 cm.
- No-till and cover crops increased soil organic matter in the surface layer, while enhanced N increased soil NO_3-N.
- Crop rotation also influenced Mehlich-3 P, with continuous corn showing the greatest decline.