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Long-Term Tillage and Crop Rotation Effects on Soil Carbon and Soil Productivity in Northwest Iowa

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Introduction

Tillage system and crop rotation systems have significant long-term effects on soil health, productivity and quality, soil carbon, and other soil physical, biological, and chemical properties. Furthermore, tillage and crop rotation control weed and soilborne diseases. There is need for a well-defined, long-term tillage and crop rotation study across the different soil types and climate conditions in the state. The objective of this study was to evaluate the long-term effects of five tillage systems and crop rotations on soil productivity and quality.

Materials and Methods

This long-term tillage study started in 2002 at seven Iowa State University Research and Demonstration Farms including the Northwest Research Farm, Sutherland. The study at Sutherland was established in 2003 and has continued through 2016. The experimental design is a randomized complete block with four replications. Plot sizes are 60 ft (24 rows) by 100 ft with five tillage treatments: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP) and three crop rotations: corn-corn-soybean (C-C-S), corn-soybean (C-S), and continuous corn (C-C) across four replications. In 2002, baseline soil samples at 0–6, 6–12, 12–18, and 18–24 in. depths were analyzed for total carbon and total nitrogen prior to implementing the tillage treatments. Subsequent soil sampling has been done every two years at the same depths to determine the long-term effects of tillage and crop rotation on soil total carbon and total nitrogen. Seasonal measurement of nitrogen use efficiency, soil bulk density, and infiltration rate depends on availability of funding.

Crop and soybean yields were determined from the center 5 rows of each plot.

Results and Discussion

Corn and soybean yields for 2016 are presented in Figure 1 and Figure 2, respectively.

In the C-C system, corn yields with NT (224 bu/acre) were significantly different from CP (234 bu/acre) and MP (235 bu/acre) (Figure 1). In the C-S rotation, corn yields with different tillage were not significantly different. Average corn yields across all tillage systems in the C-C and C-S systems were 230 bushels/acre and 239 bushels/acre, respectively. Average corn yield in 2016 across all tillage and rotation systems at Sutherland was 234 bushels/acre.

Soybean yields were from the C-C-S rotation system. Yields with the DR (75 bu/acre) and MP (71 bu/acre) systems were significantly different (Figure 2). Average soybean yield in 2016 across all tillage systems at Sutherland was 74 bushels/acre.

Acknowledgements

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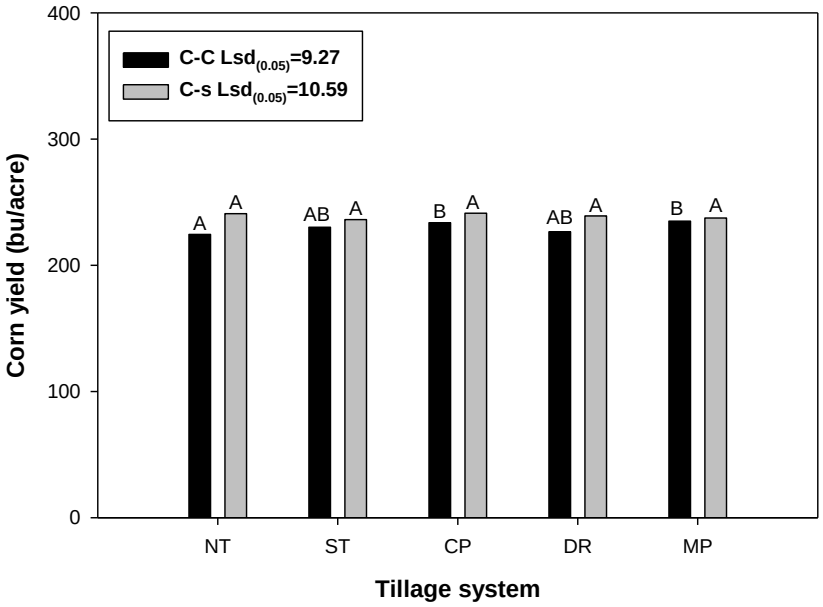

Figure 1. Corn yield in 2016 with five tillage systems and two rotation systems (C-C and C-S) at the Northwest Research Farm. Corn yields with the same upper case letter in the same rotation system are not significantly different at P = 0.05.

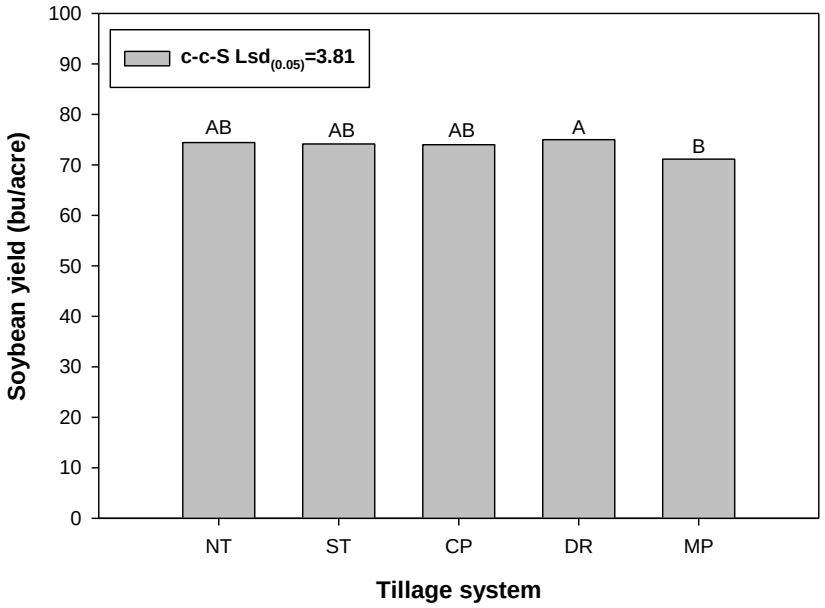

Figure 2. Soybean yield in 2016 with five tillage systems in corn-corn-soybean rotation (c-c-S) at the Northwest Research Farm. Soybean yields with the same upper case letter are not significantly different at P = 0.05.