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 2017. 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) in 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 five rows of each plot.

Results and Discussion

Soybean and corn yields at Sutherland in 2017 are presented in Figures 1 and 2, respectively.

Soybean yields in the C-S rotation were not significantly different with the different tillage systems (Figure 1). However, the highest soybean yield (65.8 bu/acre) was with CP, and the average soybean yield across all tillage systems was 63.0 bushels/acre.

Corn yields for all tillage systems in the C-C-S and C-C rotations were not significantly different (Figure 2). However, in the C-C-S and C-C rotations, the highest corn yields were 218.5 bushels/acre and 213.3 bushels/acre, respectively, associated with MP. In 2017, the average corn yield across all tillage systems in the C-C-S and C-C rotations were 208.7 bushels/acre and 205.09 bushels/acre, respectively.

Overall, corn and soybean yields in 2017 at Sutherland were 206.9 bushels/acre and 63.0 bushels/acre, respectively.

Acknowledgements

We would like to thank Terry Tuttle and his team for conducting and managing this study.

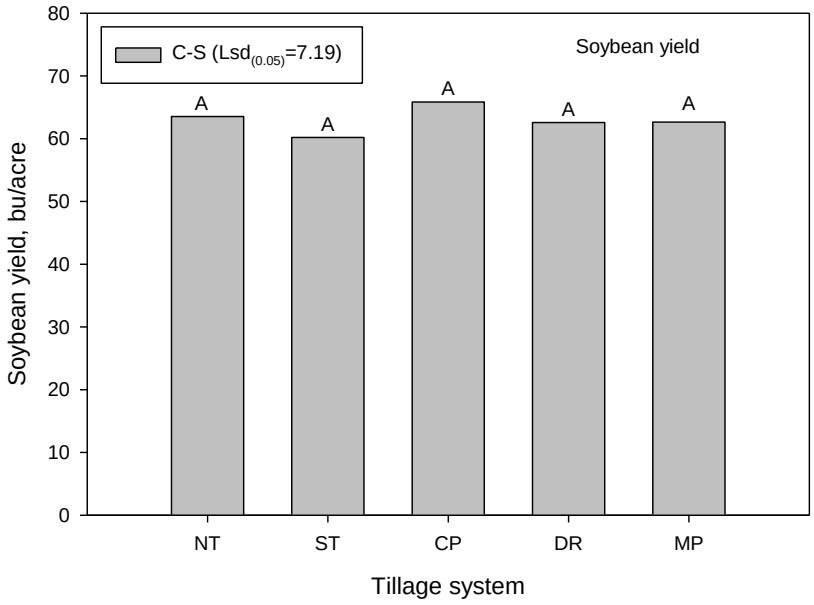

Figure 1. Soybean with five tillage systems in C-S rotation at the Northwest Research Farm. Soybean yields with the same upper case letter are not significantly different at P = 0.05.

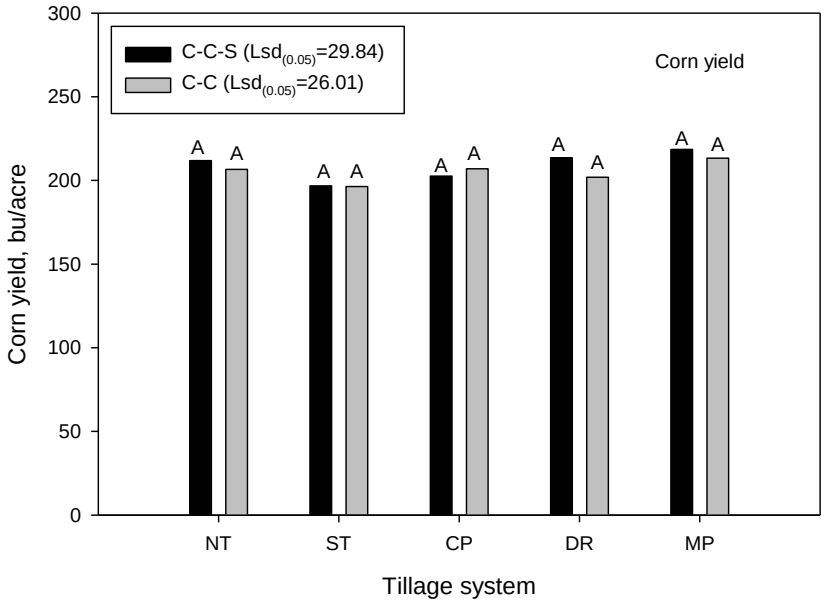

Figure 2. Corn yield in C-C-S and C-S rotations with five tillage systems at the Northwest Research Farm. Corn yields in a rotation system with the same upper case letter are not significantly different at P = 0.05.