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 soil borne 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 study started in 2002 and 2003 at seven Iowa State University Research and Demonstration Farms. The study at the ISU Northwest Farm, Sutherland, Iowa, was established in 2003. The experimental design is a randomized complete block design 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. Baseline soil sampling was done in 2002 at 0–6, 6–12, 12–18, and 18–24 in. soil depths and analyzed for total carbon and total nitrogen prior to implementing the tillage treatments. A biannual soil sampling to determine the long term effects of tillage and crop rotation on soil carbon and total nitrogen has been maintained at the same soil depths after establishing the study. 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

The results of corn and soybean yields are presented in Figure 1 and Figure 2, respectively.

The average corn yield in 2015 was 202.6 bushels/acre across all tillage and crop rotation systems. In the continuous corn (C-C) system, corn yields in the NT, ST, CP, and DR tillage systems were not significantly different. Similarly, rotated corn yields (c-C-s) with ST, CP, and MP also were not significantly different. Corn yields with MP in the C-C and c-C-s rotation were the highest, 212.3 bushels/acre and 219.4 bushels/acre, respectively. However, corn yield with DR (183.2 bu/ac) in the C-C system was 2.9 percent lower than the NT yield (188.7 bu/ac). In the c-C-s system, corn yield with NT (193.1 bu/ac) was the lowest. Overall, the average corn yield in the c-C-s system across all tillage systems (208.3 bu/ac) was 5.7 percent higher than the average yield (196.9 bu/ac) in the C-C system.

Soybean yields with all tillage systems were not significantly different. The average soybean yield across all tillage systems in 2015 was 66.7 bushels/acre.

Acknowledgements

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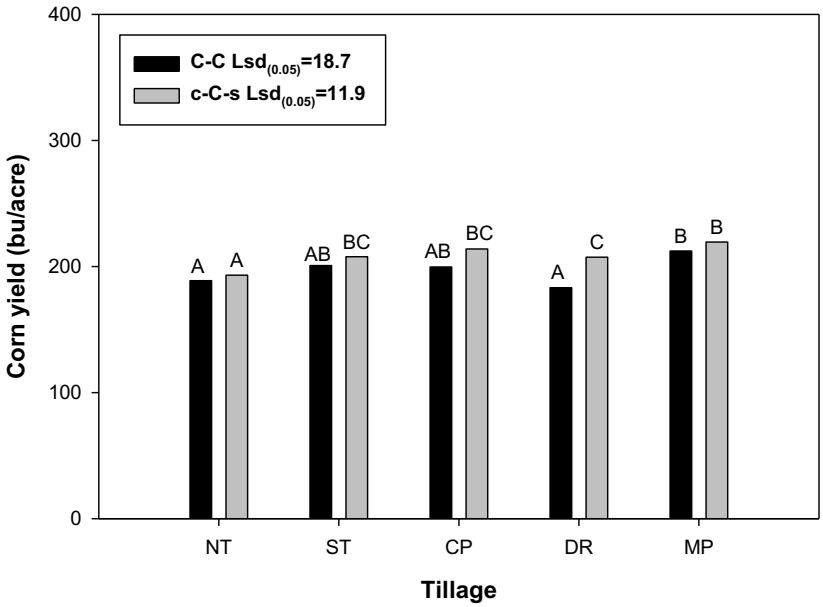

Figure 1. Corn yield in two rotations (C-C, c-C-s) with five tillage systems at the ISU Northwest Research Farm in 2015. Corn yields with the same upper case letter in the same rotation system are not significantly different at P = 0.05.

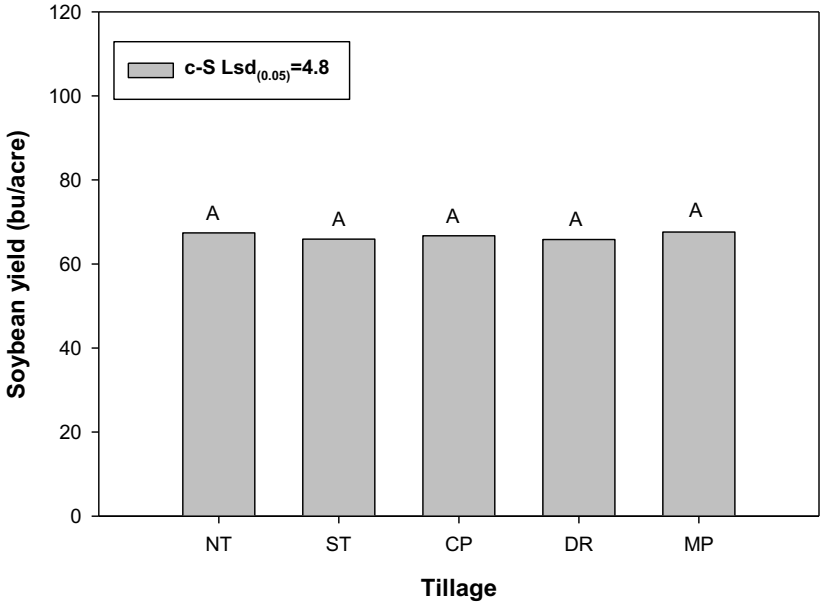

Figure 2. Soybean yield in corn-soybean rotation (c-S) with five tillage systems at the ISU Northwest Research Farm in 2015. Soybean yields with the same upper case letter are not significantly different at P = 0.05.