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

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Introduction

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

Materials and Methods

This study was established in 2002 and 2003 at seven Iowa State University Research and Demonstration Farms including the one at the Armstrong Research and Demonstration Farm (ARF), Lewis, Iowa, in 2002. Five tillage systems and three crop rotations were adopted in a randomized complete block experimental design with four replications. Main plot treatments for the study are five tillage systems: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). The crop rotations are corn-corn-soybean, (C-C-S), corn-soybean (C-S), and continuous corn (C-C). Baseline soil sampling was done in 2002 prior to establishing the study at the Armstrong Farm. Subsequently, soil sampling has been done biannually at 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for total carbon and total nitrogen.

The plot size is 50 ft (20 rows) by 65 ft. The long-term effects of tillage and crop rotation on soil total carbon and total nitrogen have been monitored biannually after establishing the study in 2002. Depending on the availability of funding, seasonal measurements such as nitrogen use efficiency, soil bulk density, and infiltration rate have been conducted. Yields were determined from the center four rows of each plot.

Results and Discussion

Corn and soybean yields for 2015 are presented in Figures 1 and 2, respectively.

Corn yields for all tillage systems in the C-c-s rotation were not significantly different. In the C-C system, corn yields with NT, ST, and DR, and with ST, CP, DR, and MP, were not significantly different (Figure 1).

The average corn yield at the ARF in 2015 was 226.6 bushels/acre. The average corn yield in the C-c-s system (265.4 bu/acre) across all tillage systems was 41.4 percent higher than the average (187.7 bu/acre) in the C-C system.

Soybean yields with all tillage systems were not significantly different (Figure 2).

The average soybean yield across all tillage systems was 81.4 bushels/acre in 2015.

Acknowledgements

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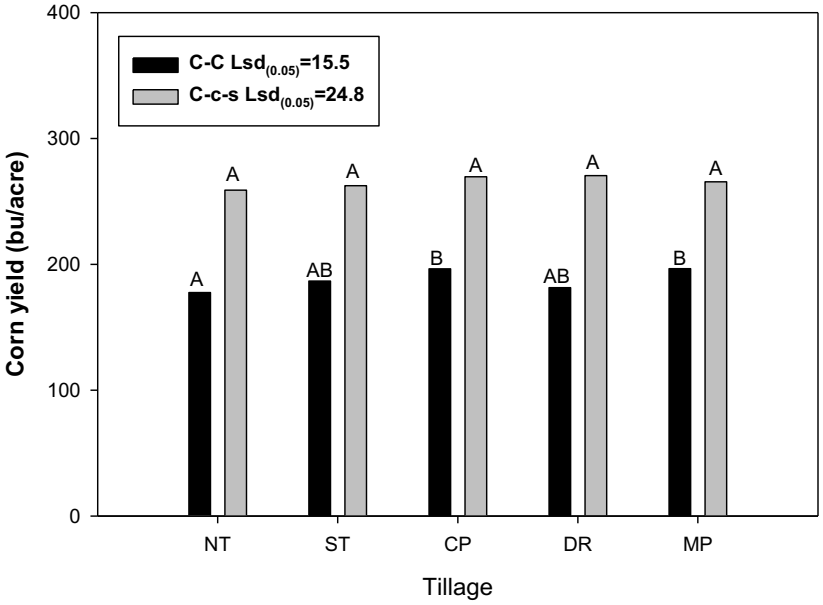

Figure 1. Corn yields with five tillage systems and two rotations (C-C and C-c-s) at the ISU Armstrong Farm in 2015. Corn yields for tillage systems with the same uppercase letter within each rotation system are not significantly different at P = 0.05.

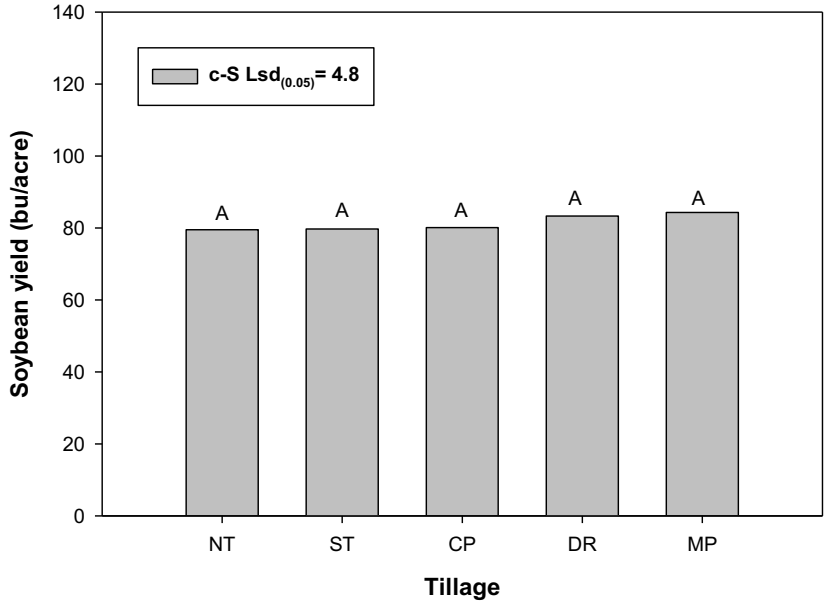

Figure 2. Soybean yields in c-S rotation with five tillage systems at the ISU Armstrong Farm in 2015. Soybean yields with the same uppercase letter for tillage systems are not significantly different at P = 0.05.