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 significantly affect soil productivity and quality in the long-term by affecting soil carbon and the soil physical, biological, and chemical properties. Additionally, 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 different tillage systems and crop rotations on soil quality and productivity.

Materials and Methods

This study was established in 2002 and 2003 on eight Iowa State University Research and Demonstration Farms including the Armstrong research farm in 2002. Five tillage systems and three crop rotations were adopted in a randomized complete block experimental design with four replications. Main plot tillage treatments are 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) across each tillage system. Initial soil sampling was done in 2001 prior to the study to establish the baseline soil data. Subsequently, soil sampling was 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 20 rows by 65 ft. Yields are determined from the center four rows of each plot. Long-term effects of tillage and crop rotation on total soil carbon and total nitrogen have been monitored every two years. Depending on the availability of funding, seasonal measurements such as nitrogen use efficiency, soil bulk density, and infiltration rate have been conducted.

Results and Discussion

Corn and soybean yields for 2017 at the Armstrong Research Farm are presented in Figures 1 and 2, respectively.

Corn yields in continuous corn (C-C) for all tillage systems were not significantly different (Figure 1). However, CP had the highest corn yield (128.0 bu/acre). The average corn yield in C-C was 115.3 bushels/acre.

Soybean yields in the C-S and C-C-S rotations are presented in Figure 2. In both crop rotations, there were no significant differences in soybean yields with all tillage systems. However, the highest soybean yields were with NT (53.8 bu/acre) in the C-S and NT (54.8 bu/acre) in the C-C-S. In 2017, the average soybean yield across all tillage systems in the C-S rotation was 51.0 bushels/acre and 53.3 bushels/acre in the C-C-S rotation. Average soybean yield at Armstrong was 52.2 bushels/acre.

Acknowledgements

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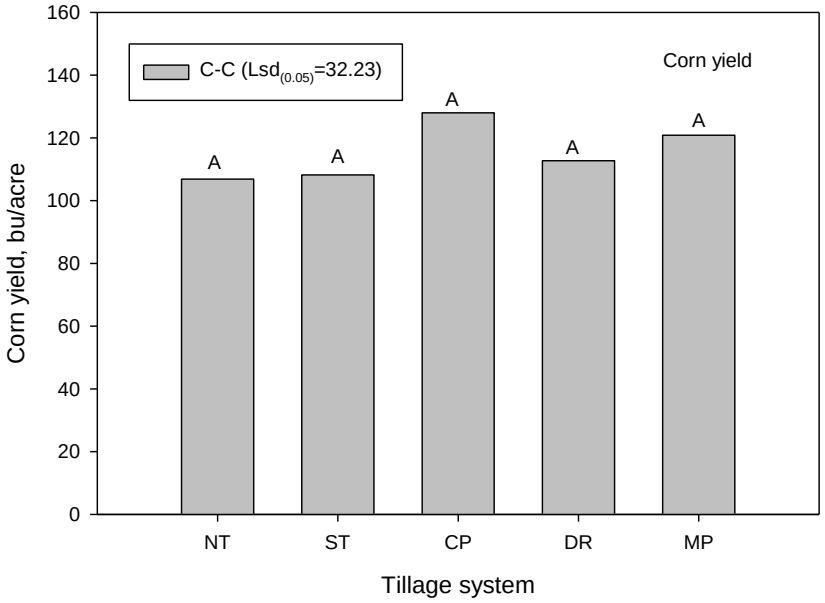

Figure 1. Corn yields with five tillage systems in continuous corn (C-C) at the Armstrong Research Farm. Corn yields with the same uppercase letter are not significantly different at P = 0.05.

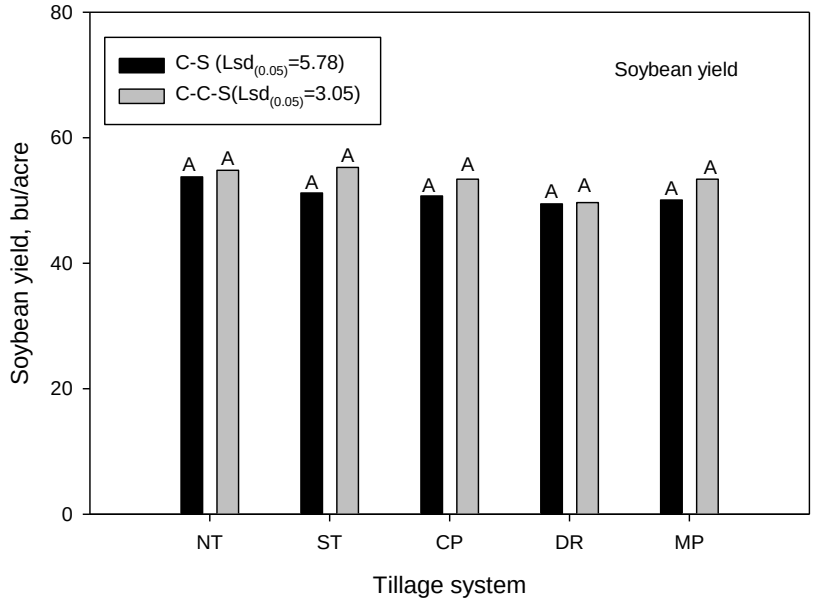

Figure 2. Soybean yields in C-S and C-C-S rotations with five tillage systems at the Armstrong Research Farm. Soybean yields within rotation systems with the same uppercase letters are not significantly different at P = 0.05.