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 carbon and soil productivity in the long-term, including the physical, biological, and chemical soil quality indicators. Additionally, tillage systems and crop rotation control weed and soilborne diseases. There is a 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 different tillage systems and crop rotations on soil quality and productivity.

Materials and Methods

This study at the Armstrong Research Farm, Lewis, Iowa, is one of seven long-term tillage studies established in 2002 and 2003 at Iowa State University Research and Demonstration Farms across Iowa. At the Armstrong Research Farm, experimental treatments include five tillage systems and three crop rotations in a randomized complete block experimental design replicated four times. Tillage treatments include no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). The three crop rotation treatments are corn-soybean (C-S), corn-corn-soybean (C-C-S), and corn-corn (C-C) rotation systems. Initial soil sampling for baseline soil data was done in 2001 at 0–6, 6–12, 12–18, and 18–24 in. soil depths and analyzed for total carbon and total nitrogen. Subsequent soil sampling has been done every two years at the same soil depth through 2018. Plot sizes are 50 ft wide (20 rows) and 65 ft long. Yields are determined from the center four rows of each plot. Depending on the availability of funding, additional seasonal measurements of nitrogen use efficiency and water infiltration rate have been conducted.

Results and Discussion

The results of corn yield with five tillage systems and three crop rotation systems in 2018 are in Figure 1.

Corn yields with five tillage systems (NT, ST, CP, DR, and MP) in each of the three crop rotation systems (C-S, C-C-S, and C-C) were not significantly different (Figure 1). The average corn yield across all tillage systems in the C-S, C-C-S, and C-C rotation systems were 170.3 bushels/acre, 154.8 bushels/acre, and 98.0 bushels/acre, respectively. The average corn yield in the C-S rotation system (170.3 bu/ac) was 9.1 percent higher than the average in the C-C-S rotation system (154.8 bu/ac) and 42.4 percent higher than the average in the C-C rotation system (98.0 bu/ac). Overall, the average corn yield in 2018 at the Armstrong Farm was 140.1 bushels/acre.

Acknowledgements

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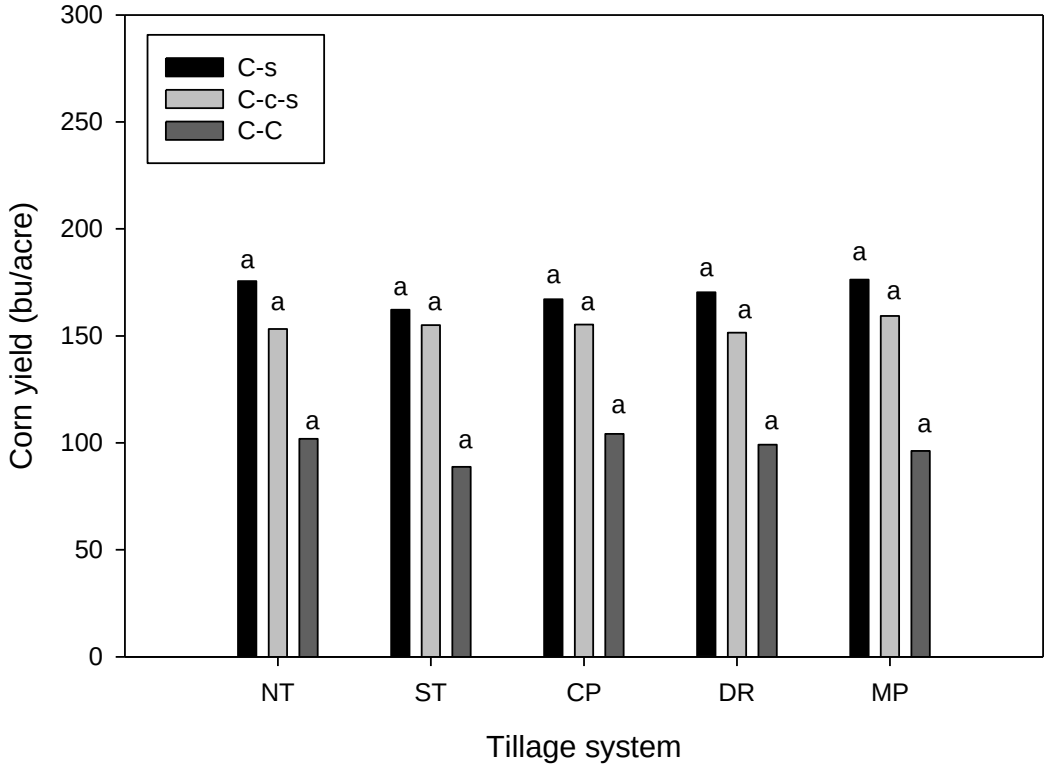

Figure 1. Corn yields with five tillage systems in three crop rotation systems (C-S, C-C-S, and C-C) at the Armstrong Research Farm, Lewis, Iowa, in 2018. Corn yields with the same letter in the same rotation and different tillage systems are not significantly different at P = 0.05.