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

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Introduction

Tillage systems and crop rotation have a significant long-term effect on soil carbon, soil productivity and the physical, chemical, and biological indicators of soil quality and health. Additionally, soil tillage and crop rotation control weeds 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 productivity and quality.

Materials and Methods

This experiment began at the ISU McNay Research Farm, Chariton, Iowa, in 2002 and has continued through 2018. The experimental design for the study is a randomized complete block with four replications. Each plot size is 30 ft wide (12 rows) and 113.5 ft long. Treatments include five tillage systems: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). The three crop rotations are corn-corn-soybean (C-C-S), corn-soybean (C-S), and continuous corn (C-C). The C-C system was added to the experiment in 2008 after the 2007 corn year to replace one of the C-C-S blocks. The experiment has continued since 2008 with the C-C system. Prior to establishing the study in 2002, baseline soil sampling was done at 0–6, 6–12, 12–18, and 18–24 in. and analyzed for total C and total N. Since 2002, soil sampling has been done every two years at the same depths and analyzed for total C and total N. Seasonal measurements of infiltration rate and nitrogen use efficiency have been conducted depending on availability of funding. Corn and soybean yields were determined from the center 8 rows and all 12 rows of each plot, respectively.

Results and Discussion

The results of corn and soybean yields in 2018 at the McNay Farm are shown in Figures 1 and 2.

Corn yields in 2018 in the C-C rotation with different tillage systems NT (128.0 bu/ac), ST (135.5 bu/ac), CP (146.5 bu/ac), DR (149.7 bu/ac), and MP (145.7 bu/ac) were not significantly different. Similarly, corn yields in the C-C-S rotation system with NT (159.2 bu/ac), ST (165.6 bu/ac), CP (171.8 bu/ac), DR (165.1 bu/ac), and MP (167.2 bu/ac) were not significantly different (Figure 1). The average corn yields in the C-C and C-C-S rotation systems across all tillage systems were 141.1 bushels/acre and 165.8 bushels/acre, respectively.

Soybean yields in the C-S rotation, with NT (71.0 bu/ac), ST (73.0 bu/ac), CP (73.0 bu/ac), DR (72.4 bu/ac), MP (75.6 bu/ac), in 2018, were not significantly different (Figure 2).

Overall corn and soybean yields at McNay in 2018 were 153.5 bushels/acre and 73.0 bushels/acre, respectively.

Acknowledgements

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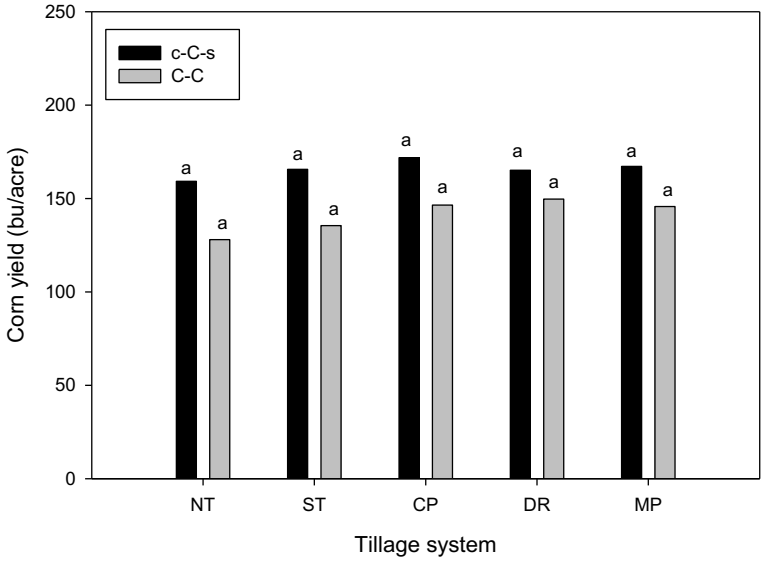

Figure 1. Corn yields with five tillage systems in two crop rotation systems (c-C-s and C-C) at the McNay Research Farm, Chariton, IA. Corn yields in a same rotation system of five tillage systems with the same letter are not significantly different at P = 0.05.
NT = no-till, ST = strip-tillage, CP = chisel plow, DR = deep rip, and MP = moldboard plow.

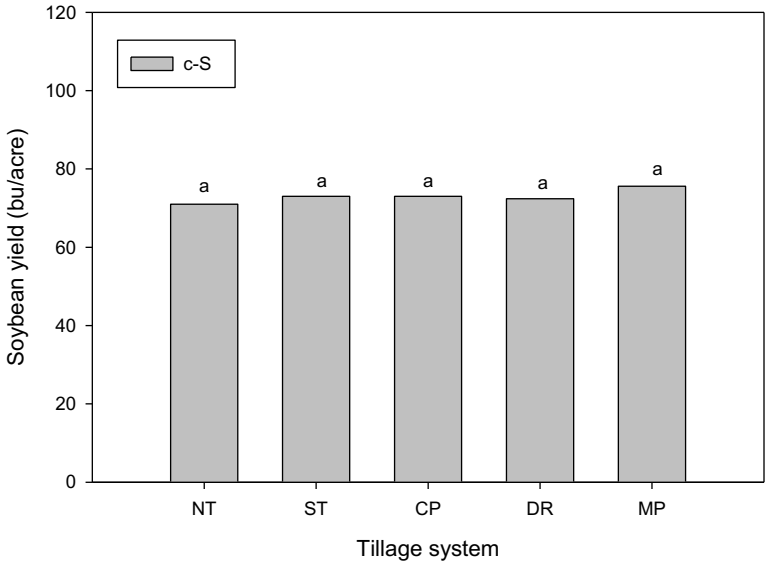

Figure 2. Soybean yields with five tillage systems in corn-soybean rotation (c-S) at the McNay Research Farm, Chariton, IA. Soybean yields with the same letter are not significantly different at P = 0.05.
NT = no-till, ST = strip-tillage, CP = chisel plow, DR = deep rip, and MP = moldboard plow.