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

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Introduction

Tillage systems and crop rotation systems have significant long-term effects on soil carbon, soil health, productivity and other physical, chemical, and biological components of soil quality. Furthermore, tillage and crop rotation control weed and soilborne 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 long-term tillage study at the Northwest Research and Demonstration Farm, Sutherland, Iowa, started in 2003 and has continued through 2020. The experimental design is a randomized complete block 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) in four replications. In 2002, baseline soil samples at 0-6, 6-12, 12-18, and 18-24 in. depths were analyzed for total carbon and total nitrogen prior to implementing the tillage treatments. Subsequent soil sampling has occurred every two years at the same depths to determine the long-term effects of tillage and crop rotation on soil total carbon and total nitrogen. Seasonal measurement of nitrogen use efficiency, soil bulk density, infiltration rate, etc., depends on availability of funding.

Corn yields were determined from the center eight rows of each plot.

Results and Discussion

Corn yields with different tillage systems in all rotations for 2020 are shown in Figure 1.

In 2020, corn yields in the C-S rotation system, with NT (197.7 bu/ac), ST (199.3 bu/ac), CP (214.4 bu/ac), and DR (213.2 bu/ac) were not significantly different (Figure 1). Similarly, corn yield with CP (214.4 bu/ac), DR (213.2 bu/ac), and MP (223.7 bu/ac) in the C-S rotation systems were not significantly different (Figure 1). In the C-C-S rotation system, corn yields with NT (208.8 bu/ac) and ST (191.8 bu/ac) were not significantly different. Corn yields with CP (210.8 bu/ac), DR (212.0 bu/ac), MP (211.7 bu/ac), and NT (197.7 bu/ac) were not significantly different. The average corn yield in the C-C rotation for NT, ST, CP, and DR (196.3, 191.3, 191.3, and 196.2, respectively) were not significantly different, and NT, DR, and MP (213.1 bu/ac) were not significantly different (Figure 1).

In 2020, the average corn yield across all tillage systems in the C-S rotation system (209.7 bu/ac) was 1.3 percent higher than the average yield in the C-C-S rotation (207.0 bu/ac), and 6.3 percent higher than the average corn yield in the C-C rotation system (197.7 bu/ac). The average corn yield in 2020 at Sutherland was 204.9 bushels/acre.

Acknowledgements

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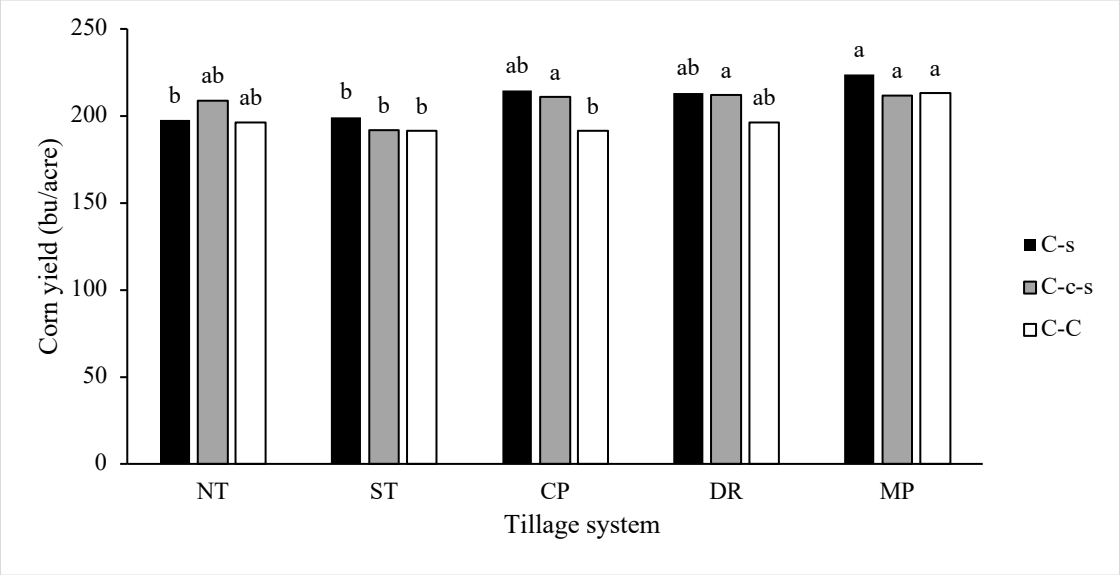

Figure 1. Corn yield in 2020 with five tillage systems and three crop rotation systems (C-S, C-C-S, and C-C) at the Northwest Research Farm, Sutherland IA. Corn yields with the same letter in the same rotation of five tillage systems are not significantly different at P ≥ 0.05.