Long-Term Tillage and Crop Rotation Effect on Yield and Soil Carbon in Southeast Iowa

RFR-A1878

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Introduction

Tillage system and crop rotation have significant long-term effects on soil health, productivity, and the soil quality components of soil carbon and other physical, biological, and chemical properties of the soil. Additionally, soil tillage 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 five tillage systems and three crop rotations on soil productivity and quality.

Materials and Methods

This study started in 2002 and 2003 at seven Iowa State University Research and Demonstration Farms including the Southeast Research Farm, Crawfordsville, Iowa, which has continued from 2002 through 2018. The experimental design is a randomized complete block with four replications. 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-soybean (C-S), corn-corn-soybean (C-C-S), and corn-corn (C-C) rotation systems. Each plot size is 20 ft wide (8 rows) and 80 ft long. In 2008, a continuous corn system (C-C) was included in the study after the 2007 corn crop year to replace one of the two blocks of C-C-S rotation. The study has continued since 2008 with the following crop rotations: corn-soybean (C-S), corn-corn-coybean (C-C-S), and the continuous corn (C-C) with the five tillage systems. Prior to implementing the tillage treatments in 2002, baseline soil samples were collected at 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for total carbon and total nitrogen. Since 2002, soil sampling has been done every two years at the same depths and analyzed for total carbon and total nitrogen. Seasonal measurements of nitrogen use efficiency and water infiltration rate have been conducted depending on availability of funding. Corn yields were determined by harvesting the center six rows of the corn plots.

Results and Discussion

The 2018 corn yield results at Crawfordsville are in Figure 1.

In C-S rotation, corn yields with NT (231.2 bu/ac), ST (234.2 bu/ac), CP (239.9 bu/ac), DR (242.4 bu/ac), and MP (247.4 bu/ac) were not significantly different (Figure 1). In the c-C-s rotation system, corn yields with NT (215.2 bu/ac) and ST (207 bu/ac), were not significantly different. Similarly, corn yields in CP (233.2 bu/ac), DR (223.8 bu/ac), and MP (227.2 bu/ac), were not significantly different (Figure 1). In the C-C rotation, system corn yields with NT (209.9 bu/ac), and ST (206.0 bu/ac), were not significantly different. Similarly, corn yields with CP (235.8 bu/ac), DR (240.1 bu/ac), and MP (241.9 bu/ac), were not significantly different (Figure 1). The average corn yield across all rotation systems for C-S (239.1 bu/ac) was 6.0 percent higher than the average yield across all rotations in the C-C (226.7 bu/ac) and 8.4 percent higher than the yield in the c-C-s (221.3 bu/ac) rotation system. In 2018, the average corn yield at Crawfordsville was 229.0 bushels/acre.

Acknowledgements

We thank Myron Rees and Cody Schneider for managing this study.

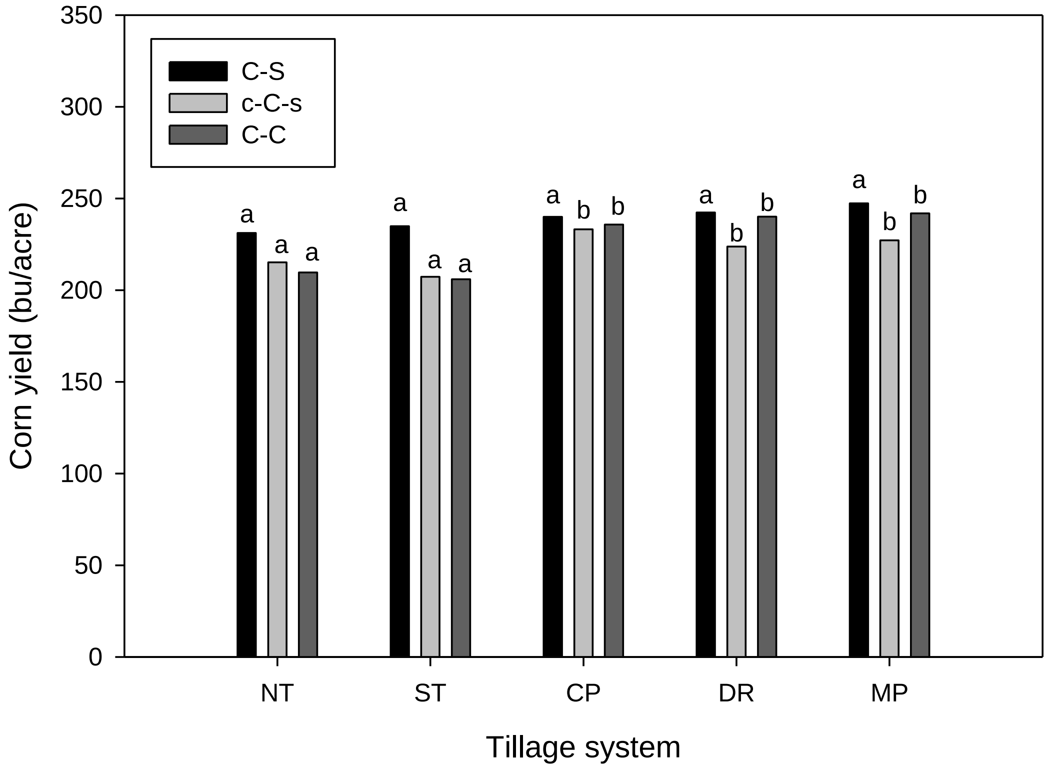

Figure 1. Corn yield with five tillage systems (NT, ST, CP, DR, and MP) and three crop rotation systems (C-S, c-C-s, and C-C) at the Southeast Research Farm, Crawfordsville, in 2018. Corn yields with the same letters in the same rotation system are not significantly different at P = 0.05.