

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

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Introduction

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

Materials and Methods

This study started in 2002 and 2003 on eight Iowa State University Research and Demonstration Farms including the Southeast Research Farm (SERF), Crawfordsville, in 2002. Treatments include five tillage systems: no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP), and crop rotations with corn and soybean. In 2008, a continuous production system (C-C) was included after the 2007 corn crop year to replace one of the two blocks of C-C-S rotation. Therefore, the study has since continued with the following crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S), and the continuous corn (C-C) systems over the five tillage systems. The experimental design is a randomized complete block design with four replications. The plot size is 8 rows x 80 ft. Initial soil samples were collected in 2002 prior to implementing the tillage

treatments for C-S and C-C-S rotations and in 2008 for C-C baseline. Soil samples were collected from 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for total carbon and total nitrogen. Subsequently, soil samples have been collected bi-annually at the same depths and analyzed for total carbon and total nitrogen. Yields were determined from the center six rows of the corn plots and the center six rows of the soybean plots. The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen have been monitored biannually. Seasonal measurements of nitrogen use efficiency, soil bulk density, and infiltration rate are only conducted depending on availability of funding.

Results and Discussion

The results of soybean and corn yields in 2017 at the SERF are presented in Figures 1 and 2.

This year soybean yield is from the C-S rotation. Soybean yields with NT, ST, CP, and DR were not significantly different (Figure 1). Similarly, soybean yields with CP, DR, and MP were not significantly different. However, soybean yield with MP (68.6 bu/ac) was the highest (Figure 1).

Corn yields from the C-C-S and C-C rotations were not significantly different (Figure 2). However, the highest corn yields in the C-C-S (266.0 bu/ac) and C-C (262.5 bu/ac) rotations were with MP (Figure 2). The average corn yield across all tillage systems in the C-C-S system was 263.3 bushels/acre and 254.3 bushels/acre in the continuous corn (C-C). Overall, corn yield at Crawfordsville in 2017 was 258.8 bushels/acre.

Acknowledgements

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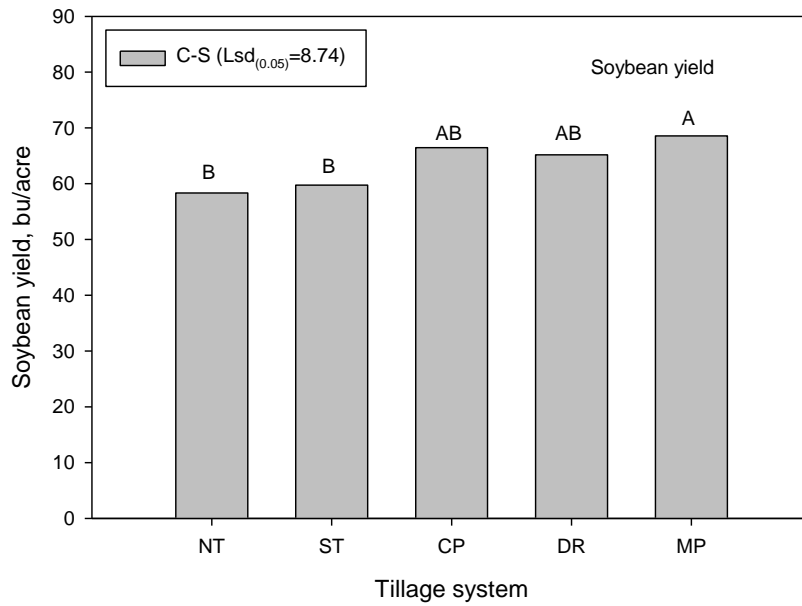


Figure 1. Soybean yield with five tillage systems in C-S rotation at the SERF, Crawfordsville, in 2017. Soybean yields with the same uppercase letter are not significantly different at P = 0.05.

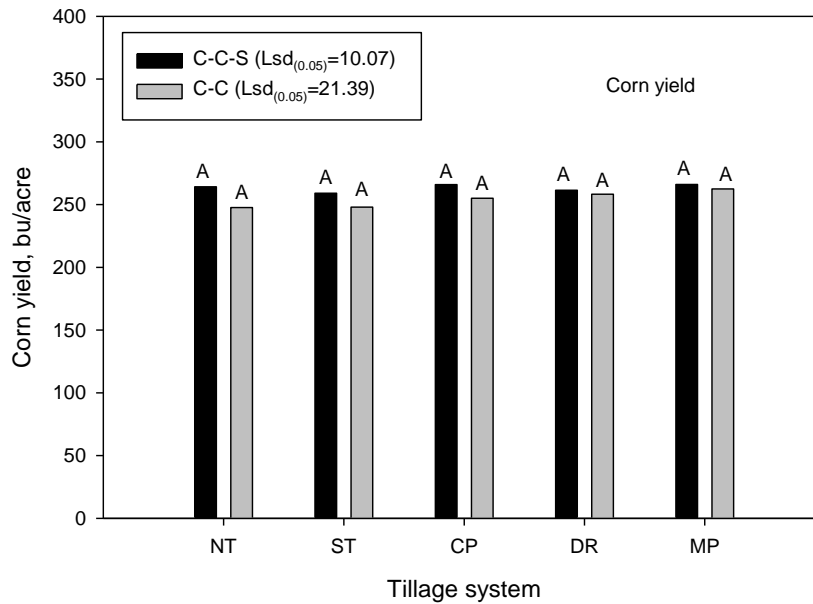


Figure 2. Corn yield with five tillage systems in two rotations (C-C-S and C-C) at the SERF, Crawfordsville, in 2017. Corn yields with the same uppercase letter within each rotation system are not significantly different at P = 0.05.