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

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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 soil physical, biological, and chemical properties of the soil. Additionally, soil 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 study started in 2002 and 2003 at seven Iowa State University Research and Demonstration Farms including the Southeast Research Farm, Crawfordsville, Iowa, in 2002. Treatments include five tillage systems: no-till (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 corn 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 continued since 2008 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 20 ft (8 rows) by 80 ft. Baseline soil sampling was done in 2002 at 0–6, 6–12, 12–18, and 18–24 in. soil depths prior to implementing the tillage treatments and analyzed for total carbon and total nitrogen. Subsequently, soil sampling has been done bi-annually at the same depths and analyzed for total carbon and total nitrogen to monitor the effects of tillage and crop rotation on soil quality. Seasonal measurements of nitrogen use efficiency, soil bulk density, and infiltration rate are only conducted depending on availability of funding.

Corn and soybean yield were determined from the center six rows of the corn and soybean plots.

Results and Discussion

Corn and soybean yields are presented in Figure 1 and Figure 2, respectively. Statistically, corn yield in the C-C system with NT, ST, and CP were not different. Similarly, the yields with ST, CP, and MP, and those with DR and MP in the C-C system, were not different. In the c-C-s rotation, corn yield with NT and ST were not different. Also, the yields with CP, DR, and MP were not different. In the c-C-s system, corn yields with ST and CP also were not different. Overall, the average corn yield (196.6 bu/ac) in the c-C-s rotation was 1.9 percent higher than the average in the C-c system (192.9 bu/ac). The average corn yield in 2015 was 194.8 bushels/acre.

Soybean yields were not significantly different (Figure 2). However, the highest soybean yields were obtained with ST (74.4 bu/ac) and NT (73.6 bu/ac). The MP system had the lowest yield (72.3 bu/ac). The average soybean yield in 2015 was 73.8 bushels/acre.

Acknowledgements

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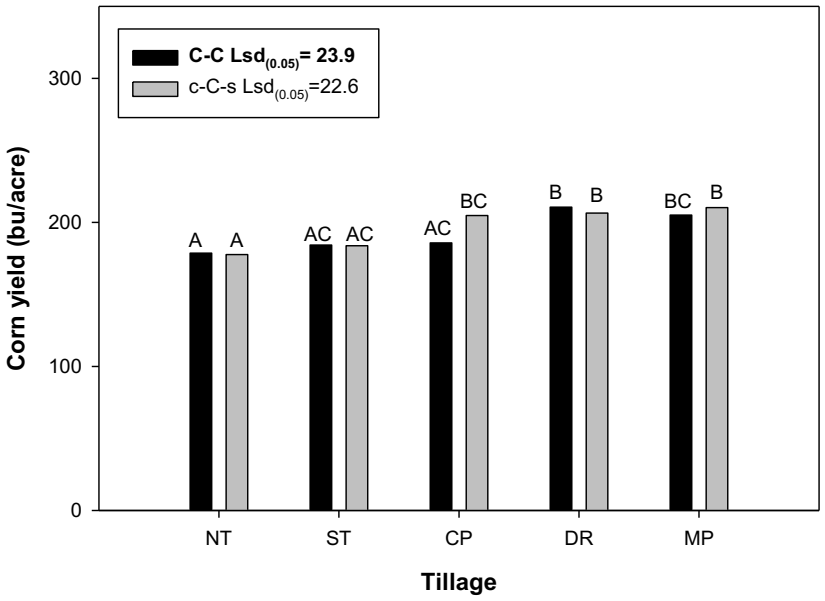

Figure 1. Corn yield with five tillage systems and two crop rotation systems (C-C and c-C-s) at the ISU Southeast Research Farm in 2015. Corn yields with the same uppercase letters in the same rotation system are not significantly different at P = 0.05.

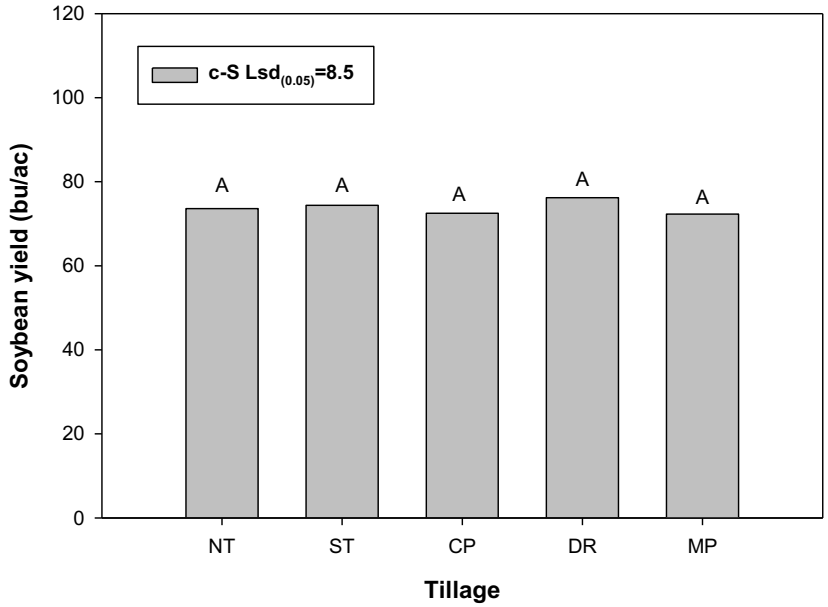

Figure 2. Soybean yield with five tillage systems in corn-soybean (c-S) at the ISU Southeast Research Farm in 2015. Soybean yields with the same uppercase letters are not significantly different at P = 0.05.