

Long-term Tillage and Crop Rotation Effects on Soil Carbon and Soil Productivity

RFR-A14108

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Introduction

Tillage systems and crop rotation have a significant long-term effect on soil productivity and the quality components of soil carbon and soil biological, physical, and chemical properties. Additionally, both soil tillage and crop rotation control weed and soil-borne diseases. There is a need for a well-defined, long-term tillage and crop rotation study across the different soils 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 was established in 2002 on eight ISU Research and Demonstration Farms, including the ISU McNay Research Farm, Chariton, Iowa. Treatments include five tillage systems: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP) and three crop rotations with corn and soybean. The crop rotations are corn-corn-soybean (C-C-S), corn-soybean (C-S), and continuous corn (C-C). The continuous corn 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 C-C over the five tillage systems. Baseline soil sampling was done in 2003 prior to implementing the tillage treatments for the C-S and C-C-S rotations and in 2008 for C-C system. Subsequent soil sampling was done biannually at 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for

total carbon and total nitrogen. The experimental design for the study was a randomized complete block design with four replications. Each plot size was 12 rows by 100 ft. Corn and soybean yields were determined from the six center rows of each corn plot, and the five center rows of each soybean plot, respectively. The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen are monitored biannually. Seasonal measurements of nitrogen use efficiency, soil bulk density, and infiltration rate and are conducted depending on availability of funding.

Results and Discussion

Results of corn and soybean yields in 2014 are presented in Figures 1 and 2.

Corn yields in the C-C-S rotation were not significantly different. In the C-C rotation, corn yield with MP (92 bu/ac) was significantly lower than the yield with other tillage systems (Figure 1). In both the C-C-S and C-C rotation systems, ST showed the highest yield 138 bushels/acre and 122 bushels/acre, respectively. Average corn yield across all tillage systems in the C-C-S rotation (134 bu/ac) was 16 percent higher than the average in C-C (112 bu/ac).

Soybean yields were significantly different (Figure 2). Highest soybean yields were with NT (64 bu/ac) and ST (63 bu/ac). The lowest yield was with DR (47 bu/ac). Average soybean yield in 2014 was 55 bushels/acre.

Acknowledgements

We would like to thank Nicholas Piekema and his staff for managing this study

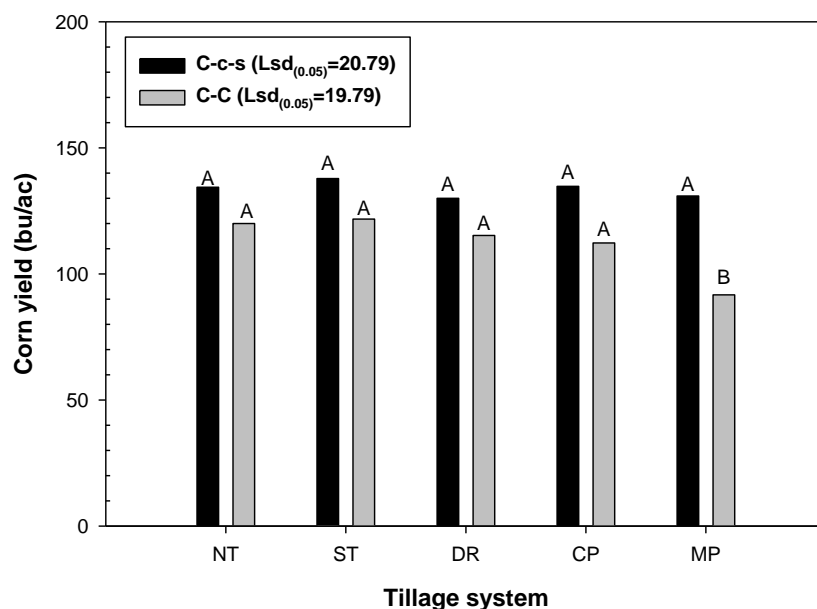


Figure 1. Corn yields with five tillage systems within two rotations (C-C and C-C-S) at the ISU McNay Research Farm in 2014. Corn yields for each rotation with the same uppercase letters are not significantly different at P = 0.05. NT = no-till, ST = strip-till, DR = deep rip, CP = chisel plow, MP = moldboard plow.

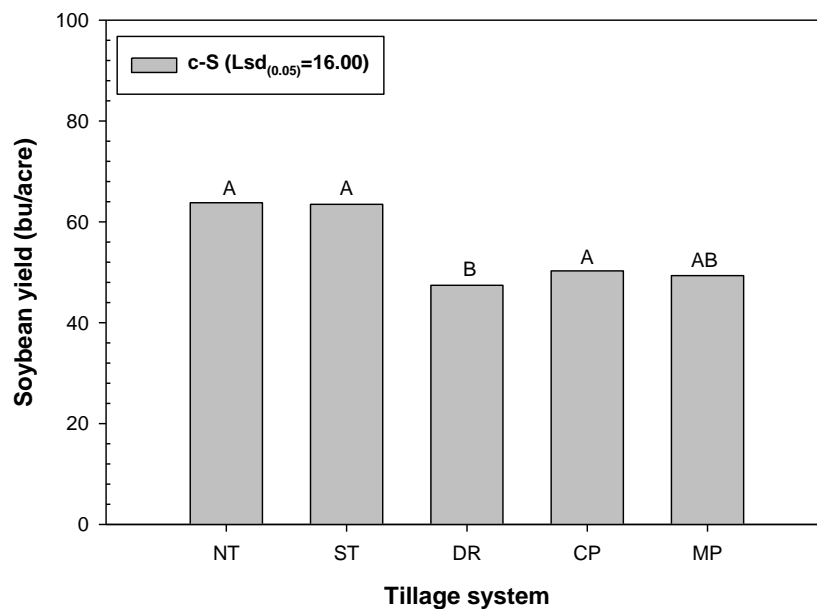


Figure 2. Soybean yields from five tillage systems at the ISU McNay Research Farm in 2014. Soybean yields with the same upper case letter are not significantly different at P = 0.05. NT = no-till, ST = strip-till, DR = deep rip, CP = chisel plow, MP = moldboard plow.