

Long-term Tillage and Crop Rotation Effect on Yield and Soil Carbon

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Introduction

Tillage systems and crop rotation have a significant, long-term effect 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 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 rotation on soil productivity and quality.

Materials and Methods

This study started in 2002 on eight ISU Research and Demonstration Farms including the Northern Research Farm, Kanawha. Treatments include five tillage systems: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP) and different crop rotations of corn and soybean. Crop rotations include corn-corn-soybean (C-C-S), corn-soybean (C-S), and continuous corn (C-C) across the five tillage systems. The experimental design was a randomized complete block design with four replications. The plot size was 12 rows by 90 ft. Initial soil samples were collected in 2002 prior to implementing the tillage treatments. The soil samples were collected from depths 0–6, 6–12, 12–18, and 18–24 in. and will be 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. Yields were determined from the center three rows of each corn plot and five rows of each soybean plot. The long-term effect of tillage and crop rotation on total soil carbon and total nitrogen have been monitored bi-annually. Seasonal measurements such as nitrogen use efficiency, soil bulk density, and infiltration rate have been conducted, depending on availability of funding.

Results and Discussion

The results of corn and soybean yields in 2014 are presented in Figures 1 and 2, respectively.

Generally, corn yields in C-C rotation were not significantly different. However, there were significant differences in corn yields in the C-C-S rotation. The highest yield (103 bu/ac) in the C-C-S rotation was with DR. Overall, the average corn yield in the C-C-S rotation across all tillage systems was 88 bushels/acre, which is 1.0 percent lower than the average yield in the C-C system (89 bu/ac). Average corn yield at Kanawha in 2014 was 89 bushels/acre.

Soybean yields showed significant differences (Figure 2) with ST showing the highest yield (54 bu/ac) and MP the lowest yield (49 bu/ac). Average soybean yield at Kanawha across all tillage systems was 52 bushels/acre.

Acknowledgements

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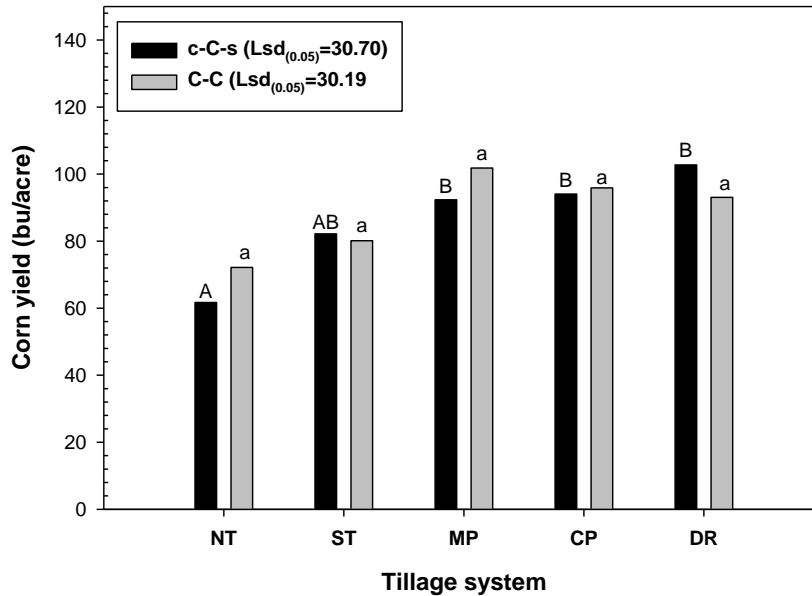


Figure 1. Corn yields in two rotations (C- C-S and C-C) with five tillage systems at the ISU Northern Research Farm in 2014. Corn yields for each rotation system with the same lowercase or uppercase letters are not significantly different at $P = 0.05$.

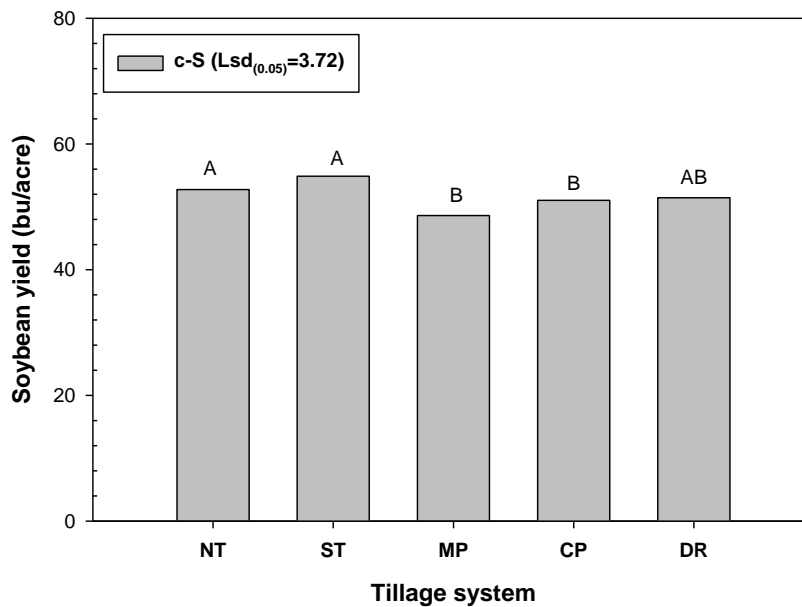


Figure 2. Soybean yield with five tillage systems at the ISU Northern Research Farm in 2014. Soybean yields with the same uppercase letters are not significantly different at $P = 0.05$.