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

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Introduction

Tillage systems and crop rotation systems 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. Furthermore, 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 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 at seven Iowa State University Research and Demonstration Farms including the Northern Research Farm (NRF), Kanawha, which has continued through 2016. The experimental design is a randomized complete block with four replications. Plot sizes are 30 ft wide (12 rows) and 90 ft long. Treatments include five tillage systems: no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP), plus three crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S), and a continuous corn (C-C) system. Prior to establishing the study, baseline soil samples at 0–6, 6–12, 12–18, and 18–24 in. depths were analyzed in 2002 for total C and total N. Subsequent soil sampling

after establishing the experiment has been done every two years at the same soil depths and analyzed for total C and total N. Seasonal measurements, such as nitrogen use efficiency, soil bulk density, and infiltration rate have been conducted depending on availability of funding.

Corn and soybean yields were determined from the center 3 and 5 rows of the corn and soybean plots, respectively.

Results and Discussion

Corn and soybean yields in 2016 are presented in Figure 1 and Figure 2, respectively.

Corn yields with different tillage systems within each crop rotation of C-C and C-C-S systems were not significantly different (Figure 1). Average corn yield across all tillage systems in the C-C and C-C-S rotation systems were 135 bushels/acre and 192 bushels/acre, respectively. Overall, average corn yield in 2016 across all tillage and crop rotation systems at the NRF was 164 bushels/acre.

Soybean yields with different tillage systems were not significantly different (Figure 2). Average soybean yield in 2016 across all tillage and rotation systems at the NRF in 2016 was 61 bushels/acre.

Acknowledgements

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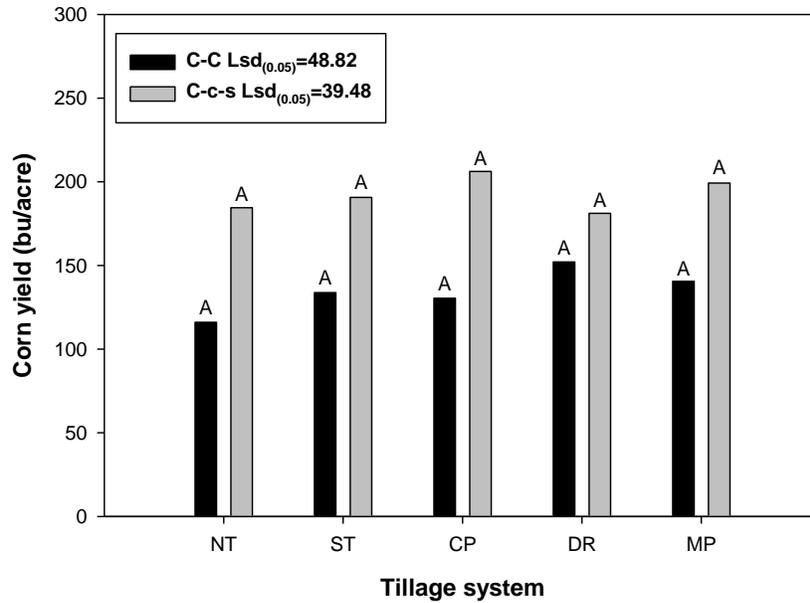


Figure 1. Corn yields in 2016 with five tillage systems and two rotations (C- C and C-C-S) at the ISU Northern Research Farm, Kanawha. Corn yields in the same rotation system with the same uppercase letter are not significantly different at P = 0.05.

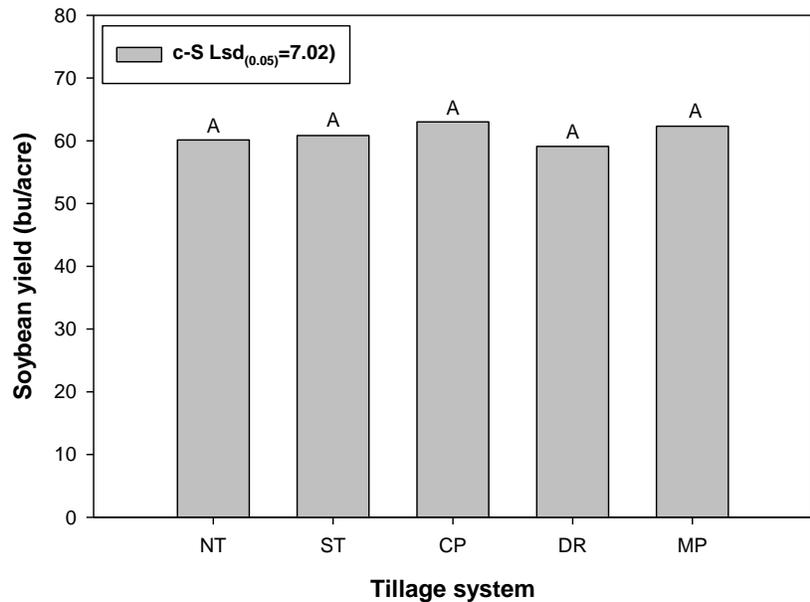


Figure 2. Soybean yield in 2016 with five tillage systems at the ISU Northern Research Farm, Kanawha. Soybean yields with the same uppercase letters are not significantly different at P = 0.05.