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

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Introduction

Tillage systems and crop rotation have significant long-term effect on soil carbon, soil health and productivity, and the physical, chemical and biological components of soil quality. 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 and climate conditions in the state. The objective of this study was to evaluate the long-term effects of five tillage systems and crop rotation 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, and has continued through 2020. The experimental design is a randomized complete block design with five tillage treatments per block, replicated four times. Tillage treatments include no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). The crop rotation systems are corn-soybean (C-S), corn-corn-soybean (C-C-S), and corn-corn (C-C) rotations. Each tillage treatment plot is 30 ft wide (12 rows) and 90 ft long. Prior to establishing the experiment, baseline soil samples were collected in 2002 at 0-6, 6-12, 12-18, and 18-24 in. depths and analyzed for total carbon and total nitrogen. Soil sampling after establishing the experiment has been done every two years at the same soil depths, and analyzed for total carbon and total nitrogen. Seasonal nitrogen use efficiency, soil bulk density, infiltration rate, etc., have been conducted depending on availability of funding.

Starting in 2014, corn and soybean yields were determined from the center 4 rows of corn and 6 rows of the soybean plots.

Results and Discussion

The results of corn and soybean yields in 2020 are shown in Figures 1 and 2, respectively.

Corn yields with different tillage systems in the C-C rotation system show yields with all tillage systems were not significantly different with average yield for NT, ST, CP, DR, and MP as follows: 132.6, 118.2, 119.5, 130.3, and 117.2 bushels/acre, respectively (Figure 1).

Corn yields in c-C-s rotation for all tillage systems also were not significantly different, where average yield for NT, ST, CP, DR, and MP was 84.1, 99.3, 109.0, 100.7, and 107.8 bushels/acre, respectively (Figure 1). The average corn yield in 2020 across all tillage systems for C-C was 123.6 bushels/acre, which was 23 percent higher than the average corn yield with c-C-s rotation (100.2 bu/ac). The average corn yield across all tillage systems for C-C and c-C-s rotations was 111.9 bushels/acre.

Soybean yields in the c-S rotation with NT, ST, CP, DR, and MP were not significantly different with average yields of 74.7, 74.3, 74.7, 68.2, and 75.4 bushels/acre, respectively (Figure 2). In 2020, the average soybean yield in the c-S rotation was 73.5 bushels/acre.

Acknowledgements

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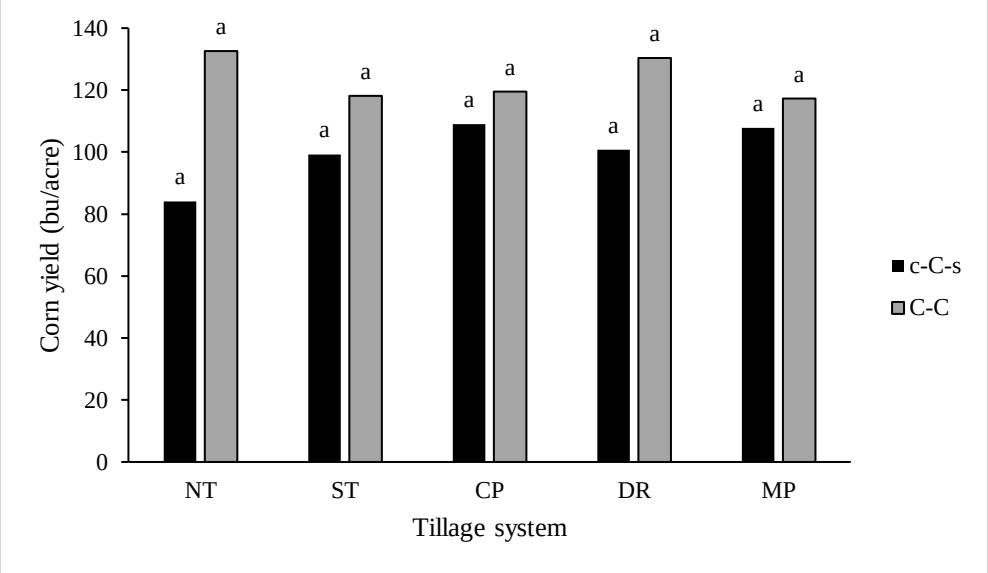

Figure 1. Corn yields in 2020 with five tillage systems in c-C-s and C-C rotations at the Northern Research and Demonstration Farm, Kanawha. Corn yields with the same letter in the same rotation are not significantly different at P ≥ 0.05.

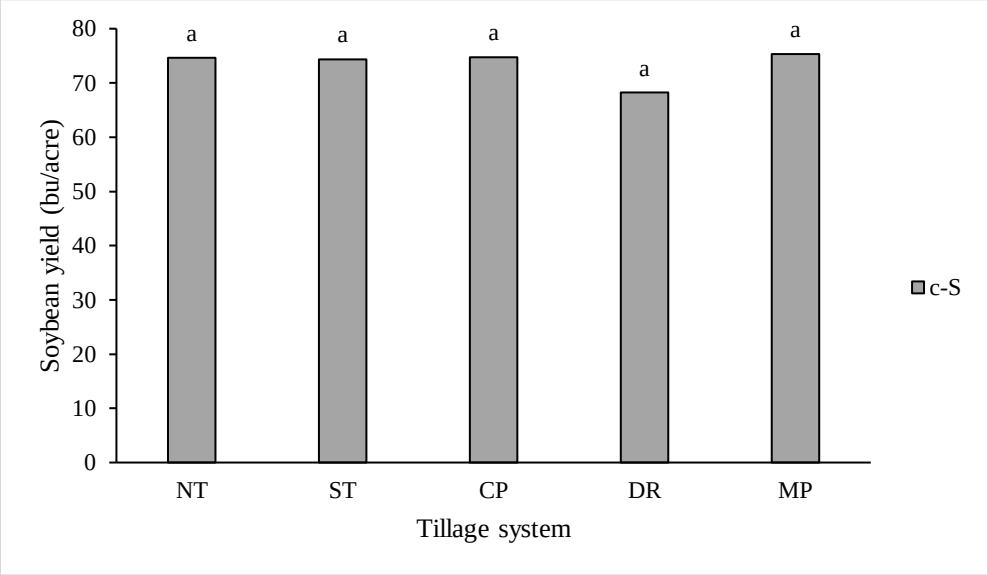

Figure 2. Soybean yields in 2020 with five tillage systems of C-S rotation at the Northern Research and Demonstration Farm, Kanawha. Soybean yields with the same letter are not significantly different at P ≥ 0.05.