Long-Term Tillage and Crop Rotation Effects on Soil Carbon and Soil Productivity in Northeast Iowa

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Introduction

Tillage and crop rotation systems have significant long-term effects on soil health and productivity and the soil quality components of soil carbon and other physical, biological and chemical properties of the soil. Furthermore, tillage and crop rotations 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 long-term effects of five tillage systems and crop rotations on soil quality and corn and soybean yields.

Materials and Methods

This study started in 2002 and 2003 at seven Iowa State University Research and Demonstration Farms including the Northeast Research and Demonstration Farm (NERF), Nashua, Iowa. The experiment at the NERF was established in 2003 and has continued through 2017. The experimental design is a randomized complete block with four replications. Each plot size is 30 ft wide (12 rows) and 100 ft long. Treatments include five tillage systems: no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP) and three crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S), and continuous corn (C-C). The C-C system was included in the experiment in 2008 after the 2007 corn year to replace one of two C-C-S blocks. Prior to establishing the experiment in 2002, baseline soil samples at 0–6, 6–12, 12–18, and 18–24 in. depths were analyzed for total C and total N. Subsequent soil sampling has been done every two years at the same soil depths to monitor the effects of tillage and crop rotation on soil health and productivity. Seasonal nitrogen use efficiency, soil bulk density, and infiltration rate measurements are done, depending on funding availability.

Corn and soybean yields are determined from the center 8 and 10 rows of each corn and soybean plot, respectively.

Results and Discussion

Results of soybean and corn yields at Nashua in 2017 are shown in Figures 1 and 2, respectively. Soybean yields in the C-S rotation were not significantly different (Figure 1). In the C-C-S rotation, except for MP (234.8 bu/acre), which had a significantly higher yield, corn yields with other tillage systems, NT (221.3 bu/acre), ST (225.2 bu/acre), CP (226.3 bu/acre), and DR (222.2 bu/acre), were not significantly different (Figure 2). In the C-S rotation, corn yields with NT (232.3 bu/acre), ST (237.1 bu/acre), DR (242.4 bu/acre), and MP (233.0 bu/acre) were not significantly different. In the C-C rotation, corn yield with NT (218.3 bu/acre) and DR (222.4 bu/acre) were not significantly different. Similarly, corn yields with ST (231.1 bu/acre), CP (231.9 bu/acre), and MP (218.3 bu/acre) were not significantly different. The average corn yields in the C-C-S, C-S, and C-C rotations were 226.0 bushels/acre, 237.8 bushels/acre, and 224.4 bushels/acre, respectively. Overall corn and soybean yields at Nashua in 2017 were 229.3 bushels/acre and 60.6 bushels/acre, respectively.

Acknowledgements

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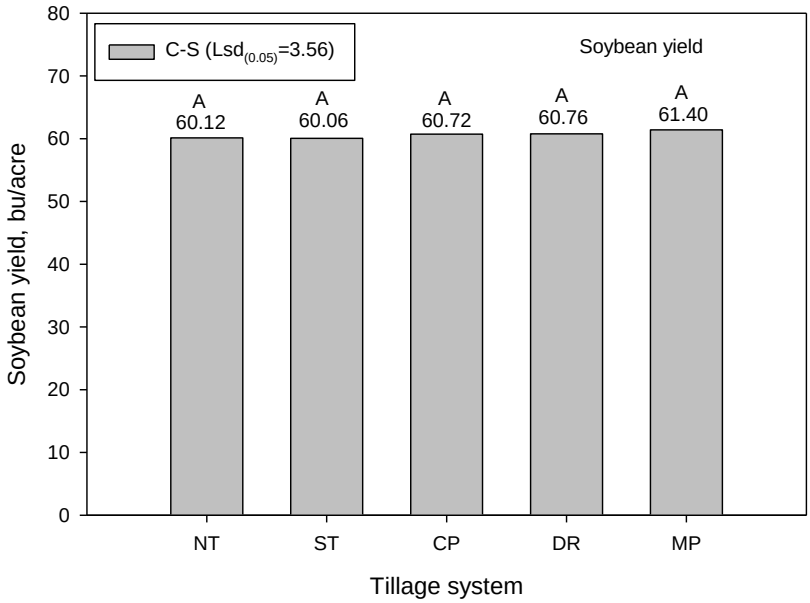

Figure 1. Soybean yields with five tillage systems and three rotations in C-S rotation at ISU Northeast Research Farm, Nashua, IA. Soybean yields with same uppercase letter are not significantly different at P = 0.05.

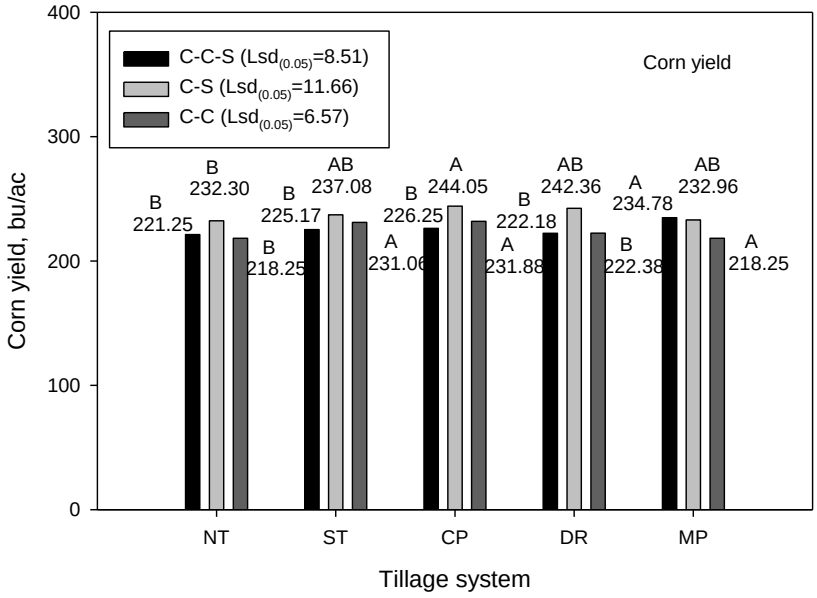

Figure 2. Corn yields with five tillage systems in C-C-S, C-S, and C-C rotation systems at ISU Northeast Research Farm, Nashua, IA. Corn yields in a rotation system with the same uppercase letter are not significantly different at P = 0.05.