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 the 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 2016. 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 sampling was done at 0–6, 6–12, 12–18, and 18–24 in. soil depths and analyzed for total carbon and total nitrogen. 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

Corn and soybean yields are presented in Figures 1 and 2, respectively. In the C-C system, corn yields with MP (229 bu/acre) were significantly different than yields of DR (216 bu/acre) and NT (210 bu/acre). Similarly, corn yields in the C-c-s rotation with MP (236 bu/acre) and CP (234 bu/acre) were significantly different than yields of DR (228 bu/acre), and NT (225 bu/acre). In the C-s rotation, corn yields with NT (215 bu/acre) were significantly different than yields of all other tillage systems. Average corn yield in the C-C, C-c-s and C-s rotations were 219 bu/acre, 231 bu/acre and 228 bu/acre, respectively. Across all tillage and rotation systems, average corn yield in 2016 at Nashua was 226 bushels/acre.

Soybean yields from the c-S rotation with different tillage systems were not significantly different. Average soybean yield in 2016 across all tillage systems at Nashua was 70 bushels/acre.

Acknowledgements

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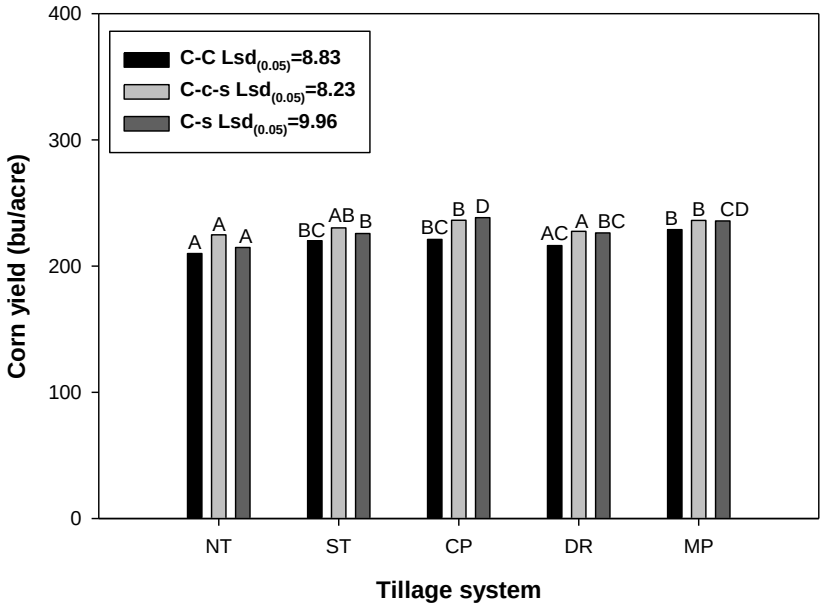

Figure 1. Corn yields in 2016 with five tillage systems and three rotations (C-C, C-c-s and C-s) at ISU Northeast Research Farm, Nashua, IA. Corn yields with same uppercase letter in the same rotation are not significantly different at P = 0.05.

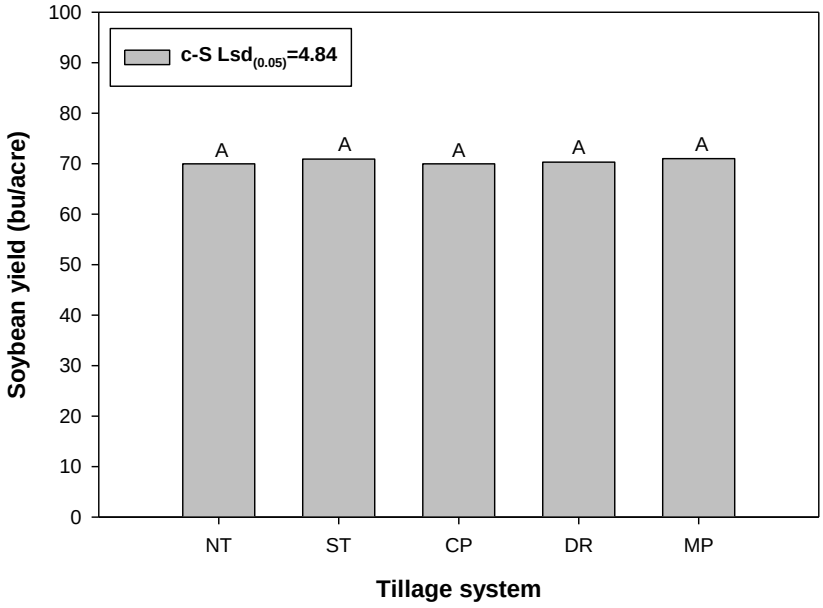

Figure 2. Soybean yields in 2016 with five tillage systems in c-S rotation at ISU Northeast Research Farm, Nashua, IA. Soybean yields with the same uppercase letter are not significantly different at P = 0.05.