

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

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Mahdi Al-Kaisi, professor
David Kwaw-Mensah, research associate
Department of Agronomy

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 2015. Treatments include five tillage systems: no-till (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 a continuous corn (C-C) system. The experimental design is a randomized complete block design with four replications. Each plot size is 30 ft wide (12 rows) and 100 ft long. 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 to establishing the experiment, soil sampling was done at the same soil depth biannually. 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

The results for corn and soybean yields are presented in Figures 1 and 2, respectively. For the corn-soybean rotation (s-C), corn yields with NT, CP, ST, DR, and MP were not significantly different from each other. For the continuous corn, corn yields with ST, CP, DR, and MP also were not significantly different. Overall, corn yields in the s-C system averaged across all tillage systems (242.1 bu/acre) were 4.0 percent more than the average yield (232.5 bu/ac) in the C-C system. The average corn yield in 2015 across all tillage treatments and crop rotations was 237.3 bushels/acre.

Soybean yields in the c-c-S system were not significantly different across tillage systems. In the c-S system, soybean yields with NT, CP, DR, and MP were not significantly different from each other. The average soybean yield (67.2 bu/acre) in the c-c-S system was 9.0 percent more than the average yield (61.1 bu/acre) in the c-S system. Overall, soybean yield across all tillage treatments and rotations in 2015 was 64.2 bushels/acre.

Acknowledgements

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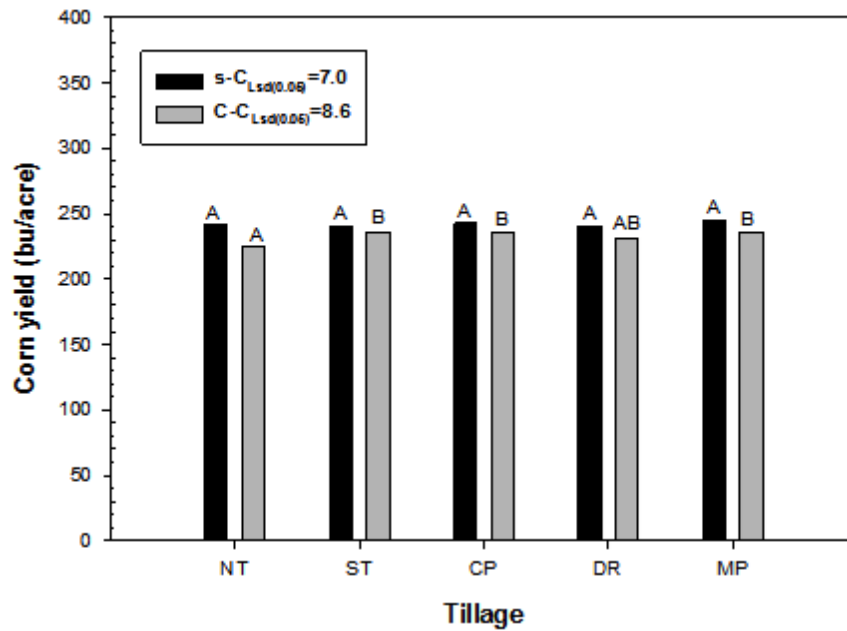


Figure 1. Corn yield in two rotations (s-C and C-C) with five tillage systems at the ISU Northeast Research Farm in 2015. Corn yields within a rotation with the same uppercase letter are not significantly different at $P = 0.05$.

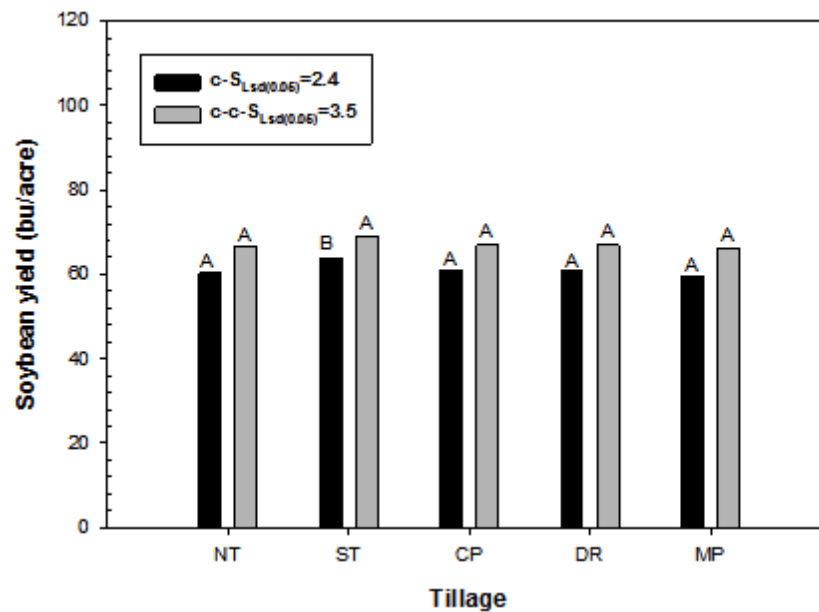


Figure 2. Soybean yields in two rotations (c-S and c-c-S) with five tillage systems at the ISU Northeast Research Farm in 2015. Soybean yields within a rotation with the same uppercase letter are not significantly different at $P = 0.05$.