Long-term Tillage and Crop Rotation Effects on Soil Carbon and Soil Productivity

RFR-A1496

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 productivity, soil quality, soil carbon, and other soil physical, biological, and chemical properties. Additionally, tillage and crop rotations control weed and soilborne diseases. There is a need for a well-defined, long-term tillage and crop rotation study across the different soil types and climate conditions in the state. The objective of this study was to evaluate the long-term effects of different tillage systems and crop rotations on soil quality and corn and soybean yields.

Materials and Methods

This study was established in 2002 and 2003 on eight ISU Research and Demonstration Farms. The study at the Northeast Research Farm, Nashua, was established in 2003 and has continued through 2014. Treatments include five tillage systems: no-till (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). Crop rotations adopted at the Nashua site are corn-corn-soybean (C-C-S), corn-soybean (C-S), and continuous corn (C-C) over each tillage system. The experimental design is a randomized complete block design with four replications. Each plot size is 30 ft by 100 ft. In 2008, a continuous corn rotation was included in the study at Nashua after the 2007 corn crop year to replace one of two C-C-S blocks. Initial soil sampling for baseline data prior to implementing the tillage treatments was done in 2002 for the C-S and C-C-S rotations and in 2008 for C-C. Baseline data soil samples were collected at 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for total C and total N. Subsequently, soil sampling has been done bi-annually. Corn and soybean yields are determined from the center 12 and 10 rows of each corn and soybean plot, respectively. Seasonal nitrogen use efficiency, soil bulk density, and infiltration rate measurements are done depending on funding availability.

Results and Discussion

Results of corn and soybean yields in 2014 with five tillage systems are summarized in Figures 1 and 2. Corn yields in all rotations showed significant differences (Figure 1). Overall, yields in C-S were the highest and the yields in the C-C the lowest. In the C-S system, yields with MP (195.9 bu/ac) was significantly higher than other tillage systems. Although yields with ST, DR, CP, and MP in C-C rotation were not significantly different, each was significantly higher than NT (154.7 bu/ac) and the MP yield (181.1 bu/ac) was the highest. In the C-C-S system, yields with ST (167.4 bu/ac), DR (168.6 bu/ac), and CP (175.3 bu/ac) were not significantly different, but were significantly lower than MP (186.6 bu/ac). When averaged across all tillage systems, corn yields in C-S (189.1 bu/acre) were 9.3 percent higher than C-C-S (171.6 bu/ac) and 9.6 percent higher than C-C (170.9 bu/ac).

Soybean yields were not significantly different (Figure 2). Average soybean yield in 2014 was 64.2 bushels/acre.

Acknowledgements

We would like to thank Ken Pecinovsky and his staff for conducting and managing this research.

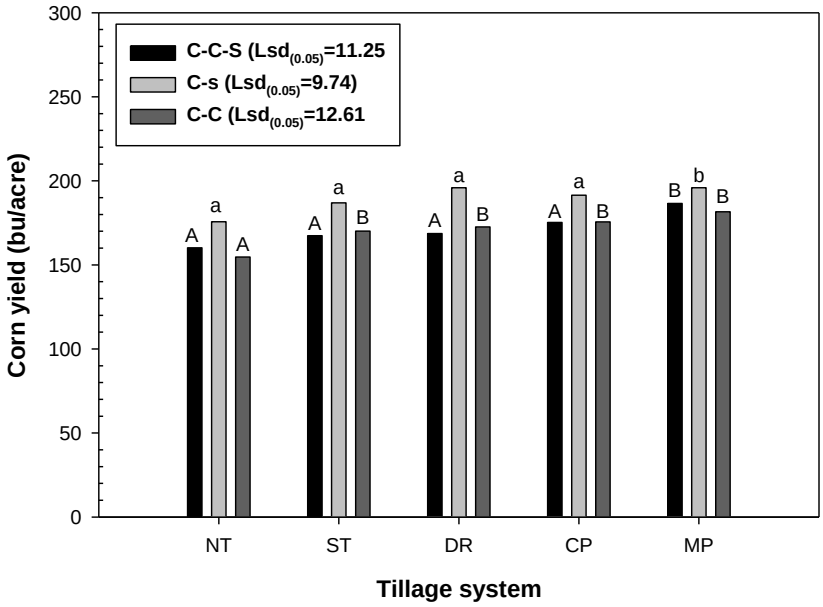

Figure 1. Corn yield in three rotations (C-C, C-s and C-C-S) with five tillage systems at the NERF (Nashua) in 2014. Corn yields of each crop rotation with the same lower or uppercase letter are not significantly different at p = 0.05.

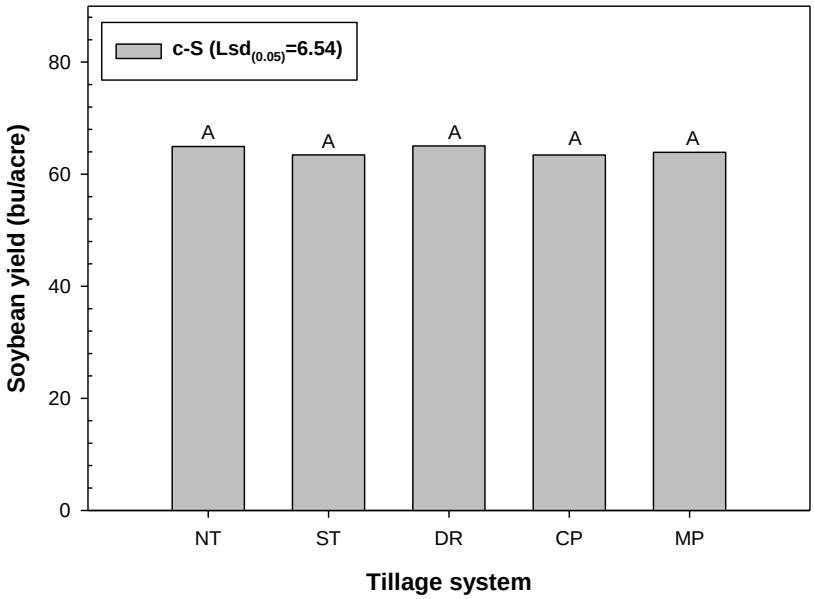

Figure 2. Soybean yields in C-S rotation with five tillage systems at the NERF (Nashua) in 2014. Soybean yields with the same uppercase letter are not significantly different at p = 0.05.