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Mahdi Al-Kaisi
Iowa State University, malkaisi@iastate.edu

David Kwaw-Mensah
Iowa State University, dkwaw@iastate.edu

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Long-term Tillage and Crop Rotation Effect on Yield and Soil Carbon

Abstract
Tillage system and crop rotation have major long-term effects on soil productivity and soil quality components of soil carbon and other soil physical, biological, and chemical properties. Additionally, soil tillage and crop rotation controls weed and soil-borne 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 productivity and quality.

Keywords
RFR A1382, Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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Long-term Tillage and Crop Rotation Effect on Yield and Soil Carbon

RFR-A1382

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

Introduction

Tillage system and crop rotation have major long-term effects on soil productivity and soil quality components of soil carbon and other soil physical, biological, and chemical properties. Additionally, soil tillage and crop rotation controls weed and soil-borne 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 productivity and quality.

Materials and Methods

This study was started in 2002 and 2003 on eight ISU Research and Demonstration Farms including the ISU Southeast Research Farm, Crawfordsville, Iowa, in 2002. Treatments included five tillage systems: no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep ripper (DR), and moldboard plow (MP), and crop rotations with corn and soybean. In 2008, a continuous corn (C-C) production system was included after the 2007 corn crop year to replace one of the two blocks of corn-corn-soybean rotation. Therefore, the study has continued with the following crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S), and continuous corn (C-C) systems over the five tillage systems. Not every crop in each rotation is grown every year, therefore, in 2013 there only were soybeans in the C-S and C-C-S rotations. The experimental design is a randomized complete block design with four replications. The plot size is 8 rows × 80 ft.

Initial soil samples were collected in 2002 prior to implementing the tillage treatments for C-S and C-C-S rotations and in 2008 for C-C baseline. Soil samples were collected at 0–6, 6–12, 12–18, and 18–24 in. depths and analyzed for total carbon and total nitrogen. Subsequent soil samples have been collected bi-annually at the same depths and analyzed for total carbon (C) and total nitrogen (N). Yields were determined from the center six rows of the corn plots and the center six rows of the soybean plots. The long-term effects of tillage and crop rotation on total soil C and total N have been monitored biannually. Seasonal measurements of nitrogen use efficiency, soil bulk density, and infiltration rates are only conducted depending on availability of funding.

Results and Discussion

Results for corn and soybean yields in 2013 are shown in Figures 1, 2, and 3. In the C-C rotation, corn yields were not significantly different for all tillage systems (Figure 1). Corn yield in C-C across all tillage systems was 100.6 bushels/acre. The low corn yield across all tillage systems was the result of dry conditions during the growing season.

Soybean yields are summarized in Figures 2 and 3. Figure 2 shows a comparison across tillage systems. Figure 3 shows a comparison of rotations within each tillage system. Soybean yields in the C-S rotation are not significantly different (Figure 2). However, in the C-C-S rotation, yield with NT was significantly lower than other tillage systems (Figure 2). Also, yields with C-S and C-C-S rotations were not significantly different for NT and ST, but were significantly greater with C-C-S rotation in MP, DR, and CP (Figure 3). Overall, soybean yield in C-C-S across all tillage systems (57.9 bu/acre) was 10.5

percent higher than C-S (52.4 bu/acre) across all tillage systems.

Acknowledgements

We would like to thank Myron Rees and his staff for conducting and managing this study.

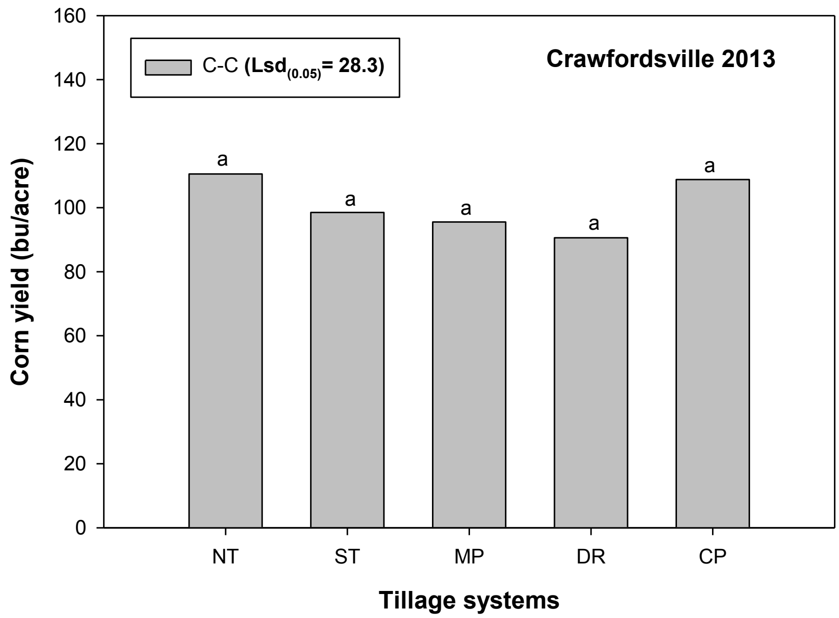

Figure 1. Continuous corn yield with five tillage systems at the SERF, Crawfordsville, in 2013. Corn yields with the same lowercase letter are not significantly different at P=0.05.

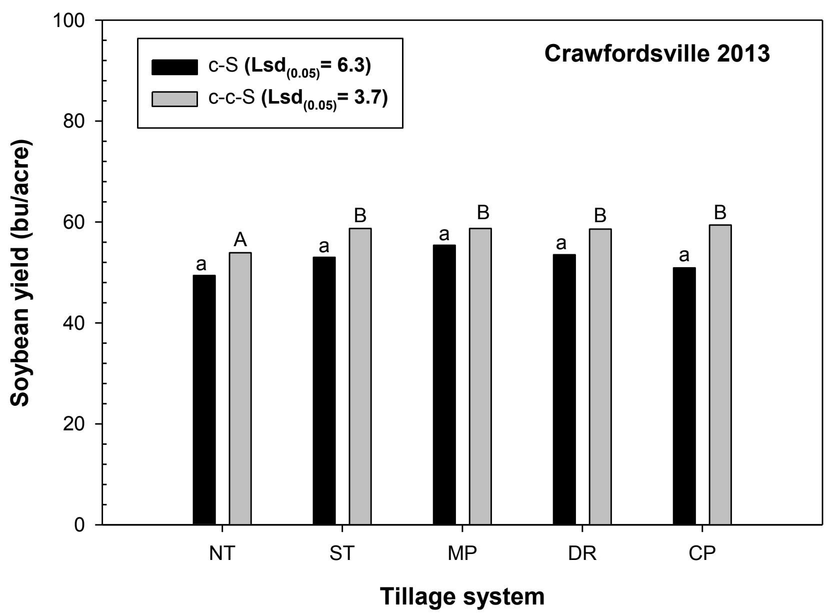

Figure 2. Soybean yield for five tillage systems in two rotations (C-S and C-C-S) at the SERF, Crawfordsville, in 2013. Soybean yields compared across tillage systems with the same lowercase or uppercase letters within each rotation system are not significantly different at P=0.05.

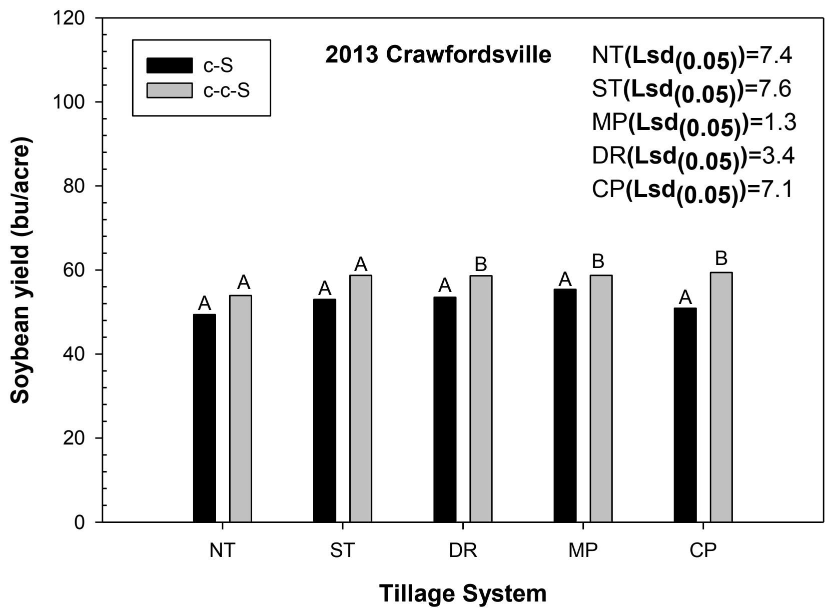

Figure 3. Soybean yield in two rotations (C-S and C-C-S) within five tillage systems at the SERF, Crawfordsville, in 2013. Soybean yields of rotations compared within each tillage system with the same uppercase letters within each tillage system are not significantly different at P=0.05.