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

RFR-A1785

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 and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. Additionally, tillage and crop rotation both have effects on weed and soil disease control. There is need for well-defined, long-term tillage and crop rotation studies across the different soils and climate conditions in the state. The objective of this study was to evaluate long-term effects of different tillage systems and crop rotations on soil productivity.

Materials and Methods

This study began in 2003 on eight Iowa State University Research and Demonstration Farms including the Ag Engineering/Agronomy Farm, Boone, Iowa, and continued through 2013. Treatments include five tillage systems: no-tillage (NT), strip-tillage (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP) and various crop rotations with soybean across the five tillage systems. In 2008, a continuous corn rotation was added to the experiment after the 2007 corn crop year. Therefore, the study has continued since 2008 with the following rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S), and continuous corn (C-C) over five tillage systems. Initial soil samples were collected in 2003 prior to implementing the tillage treatments for C-S and C-C-S rotations and in 2008 for C-C baseline. Soil samples have been collected every two years. Soil samples are collected at depths of 0–6, 6–12, 12–18, and 18–24 in. and analyzed for total carbon and total nitrogen. The experimental design is a randomized complete block design with four replications. Each plot size is 12 rows wide (30 ft) by 90 ft long for the C-C-S and C-S rotations and 12 rows wide (30 ft) by 60 ft long for the C-C. Corn and soybean yields are determined from the center 4 and 6 rows of each plot, respectively. The long-term effects of tillage and crop rotation on soil total carbon and total nitrogen have been monitored bi-annually. Seasonal measurement of nitrogen use efficiency, soil bulk density, and infiltration rate depends on availability of funding.

Results and Discussion

The results of the 2017 season corn yields are summarized in Figure 1. The low corn yields recorded in the NT and ST plots in the C-C were the result of severe Canadian thistle weed infestation.

Corn yields in the C-C with NT (73.3 bu/acre), ST (74.8 bu/acre), and MP 103.4 bu/acre) were not significantly different. Similarly, the yield with CP (104.0 bu/acre) and DR (111.6 bu/acre) were not significantly different, but significantly higher than NT, ST, and MP yields (Figure 1). In the C-C-S rotation, corn yields with NT (150.0 bu/acre), ST (166.1 bu/acre), and MP (183.4 bu/acre) were not significantly different. Similarly, the yields with ST (166.1 bu/acre), CP (184.2 bu/acre), DR (187.4 bu/acre), and MP (183.3 bu/acre) also were not significantly different. In the C-S rotation, all corn yields were not significantly different (Figure 1). Overall, corn yield averaged across all tillage systems in the C-S rotation (183.4 bu/acre) was 5 percent higher than the yield in the C-C-S (174.2 bu/acre) and 45 percent higher than the yield in the C-C (93.4 bu/acre).

The seasonal average corn yield in 2017 in Ames was 150.3 bushels/acre.

Acknowledgements

Thanks to Mike Fiscus and his staff for their help in conducting this study.

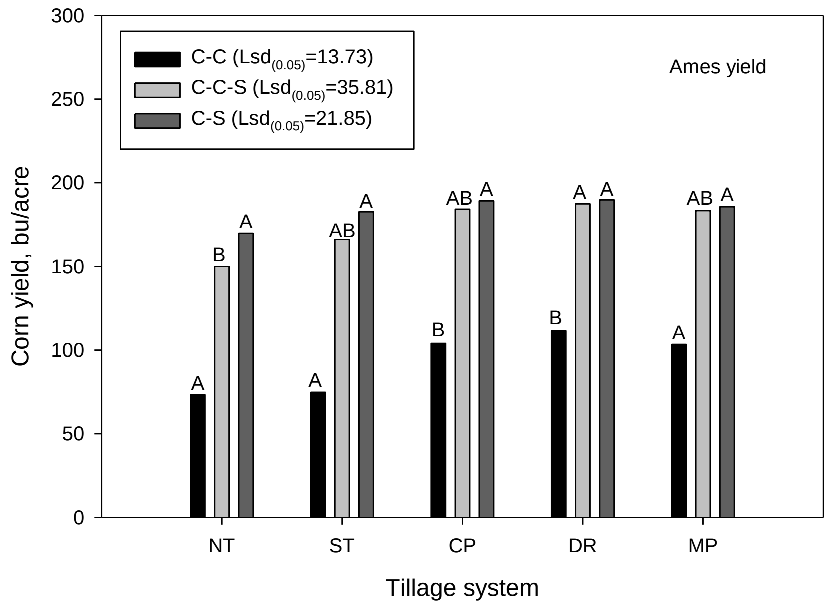

Figure 1. Corn yields with five tillage systems in three rotations (C-C, C-C-S, and C-S) at the Ag Engineering/Agronomy Research Farm (Boone) in 2017. Corn yields in each crop rotation with the same uppercase letter are not significantly different at P = 0.05.