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

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

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Abstract
Tillage system and crop rotation have a major long-term effect on soil productivity and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. In addition, both tillage and crop rotation affects weed and soil disease control. There is a 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 is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

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Mahdi Al-Kaisi, associate professor
Department of Agronomy

Introduction

Tillage system and crop rotation have a major long-term effect on soil productivity and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. In addition, both tillage and crop rotation affects weed and soil disease control. There is a 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 is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

Materials and Methods

This study was conducted on eight Iowa State University Research and Demonstration Farms in 2002. Treatments include five tillage systems (no-tillage, strip-tillage, chisel plow, deep rip, and moldboard plow) and two crop rotations of corn-corn-soybean and corn-soybean across the five tillage systems and several soil associations. The experimental design was a randomized complete block design with four replications. Initial soil samples were collected in 2002 prior to implementing the tillage treatments. The soil samples were collected from all sites for depths 0–6, 6–12, 12–18, and 18–24 in. and will be analyzed for total carbon and total nitrogen. Subsequent soil samples were collected in 2004 from all sites for depths 0–6, 6–12, 12–18, and 18–24 in. and will be analyzed for total carbon and total nitrogen. The plot size is 12 rows by 90 ft. Yield was determined from the center three rows of each corn plot and five rows of each soybean plot. Long-term effects of tillage and crop rotation on total soil carbon and total nitrogen will be monitored on a bi-yearly basis. Seasonal measurements such as nitrogen use efficiency, soil bulk density, and infiltration rate will be conducted on selected sites depending on availability of funding.

Results and Discussion

Generally, soybean yields regardless of the tillage system or crop rotation show no significant differences except in a few years (Table 1).

Tillage systems under corn-soybean rotation show yield differences, with no-till yields generally less than other tillage systems yields (Table 2). Generally, no-tillage showed a decrease in corn yield, in both corn-soybean and corn-corn-soybean rotations compared with other tillage systems (Table 2 and 3).

Continuous corn was established in 2008 and the corn yields show no differences across all tillage systems (Table 2). However, continuous corn yield in 2009 was lower than in 2008. The corn yields under no-till and strip-tillage were not different, but they were lower than the moldboard plow tillage system yields in 2009 (Table 2).

The average corn yield following soybean across all tillage systems was 37 bushels/acre greater than the continuous corn yield in 2009 (Table 2).

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