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

Abstract
Tillage system and crop rotation significantly affect long-term soil productivity and soil quality components such as soil carbon and other soil physical and chemical properties. In addition, both tillage and crop rotation affect weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soil and climatic conditions in the state. The objective of this study is to evaluate the long-term wide range of effects of different tillage systems and crop rotations on soil productivity.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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

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Introduction

Tillage system and crop rotation significantly affect long-term soil productivity and soil quality components such as soil carbon and other soil physical and chemical properties. In addition, both tillage and crop rotation affect weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soil and climatic conditions in the state. The objective of this study is to evaluate the long-term wide range of 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 included five tillage systems (no-till, strip-tillage, chisel plow, deep ripper, and moldboard plow) and two crop rotations of corn-corn-soybean and corn-soybean across the five tillage systems and several soil associations. Initial soil samples were collected from sites that were ready to implement tillage treatments during the spring of 2002. Sites that did not implement tillage treatments in spring of 2002 were planted to bulk corn and were soil sampled in fall 2002 prior to implementing tillage treatments. The soil samples collected from all sites for depths 0–6, 6–12, 12–18, and 18–24 inches will be analyzed for total carbon and total nitrogen. The experimental design was a randomized complete block design with four replications. Plot size ranged from 30–50 ft in width (depending on the location) and was approximately 90 ft long.

Yield will be determined from the center rows (number of rows will vary by location). The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen will be monitored biyearly, or more frequently. Seasonal measurements such as nitrogen use efficiency, soil bulk density, infiltration rate, etc., may be conducted on selected sites (depending on availability of funding).

Results and Discussion

Results of first year (2002) yields of corn and soybeans for the Armstrong research farm are summarized in Figures 1 and 2. Corn yields show no significant differences between all tillage systems. The moldboard plow tillage system seemed to have a yield advantage over the other tillage systems. Low corn yields were observed for all tillage systems (107 to 88 bushels/acre) due to dry weather conditions.

Soybean yield response to different tillage systems was not significant (Figure 2). Soybean yields ranged from 36.5 bushels/acre to 34.5 bushels/acre. First year tillage systems do not seem to make a significant difference in corn or soybean yields.

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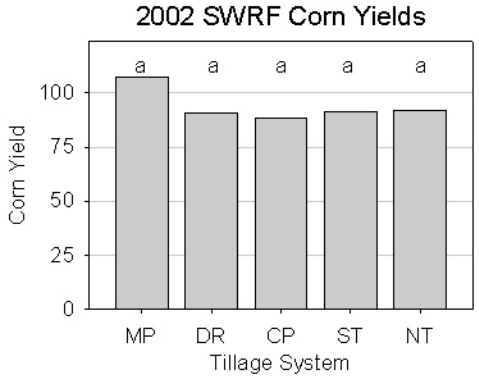

Figure 1. Effect of tillage system on corn yield in 2002 at Lewis, IA.

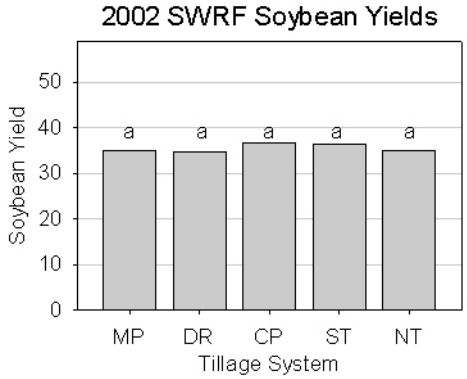

Figure 2. Effect of tillage system on soybean yield in 2002 at Lewis, IA.