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

Abstract

Tillage system and crop rotation have a significant, long-term affect 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 have effects on weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soils and climatic 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.

Keywords

Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

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

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Introduction

Tillage system and crop rotation have a significant, long-term affect 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 have effects on weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soils and climatic 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 originated on eight Iowa State University Research and Demonstration Farms in 2002 and continued in 2003. Treatments include five tillage systems (no-till, strip-tillage, chisel plow, deep ripper, and moldboard plow) and two crop rotations (corn-corn-soybean and corn-soybean) across the five tillage systems and several soil associations. 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 inches and will be analyzed for total carbon and total nitrogen. The experimental design was a randomized complete block design with four replications.

The plot size is 8 rows × 80 ft. Yield is determined from the center three rows of each corn plot and 5 rows of each soybean plot. The long-term effect of tillage and crop rotation on total soil carbon and total nitrogen are monitored on a bi-yearly (or more) basis. Seasonal measurements such as nitrogen use efficiency, soil bulk density, infiltration rate, etc., were conducted on selected sites depending on availability of funding.

Results and Discussion

In 2003, the five tillage systems under corn-soybean rotation did not show a significant difference in corn yield, averaging 209 bushels/acre (Figure 1). However, for second year corn of the corn-corn-soybean rotation the no-tillage yield was significantly less than the other four tillage system yields, by 16–28 bushels/acre (Figure 2). A corn yield reduction was noted when comparing the corn-soybean rotation and the corn-corn-soybean rotation with an average yield loss of 63 bushels/acre (Figures 1 and 2). No-tillage soybean yields for 2003 were significantly different from deep rip, 38.7 and 42.2 bushels/acre, respectively (Figure 3).

However, it is too early to speculate about the tillage or the crop rotation effects on yield because these systems have only been in place 2 years.

Acknowledgments

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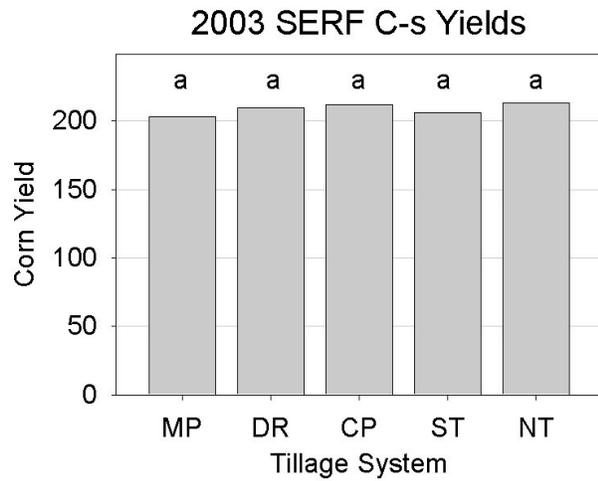


Figure 1. Effect of tillage system on corn yield in a corn-soybean rotation for 2003 at Crawfordsville, IA.

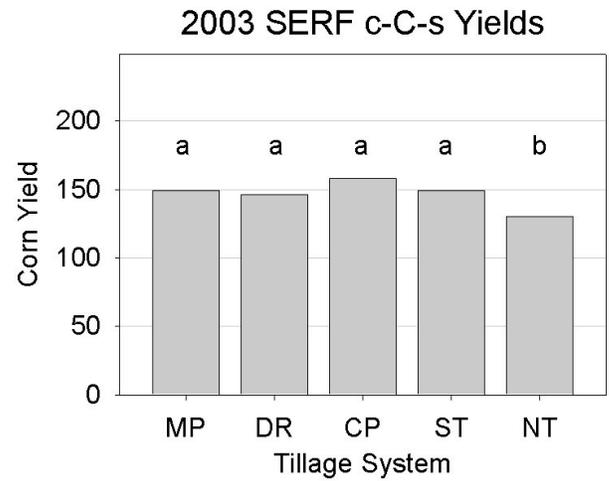


Figure 2. Effect of tillage system on corn yield in a corn-corn-soybean rotation for 2003 at Crawfordsville, IA.

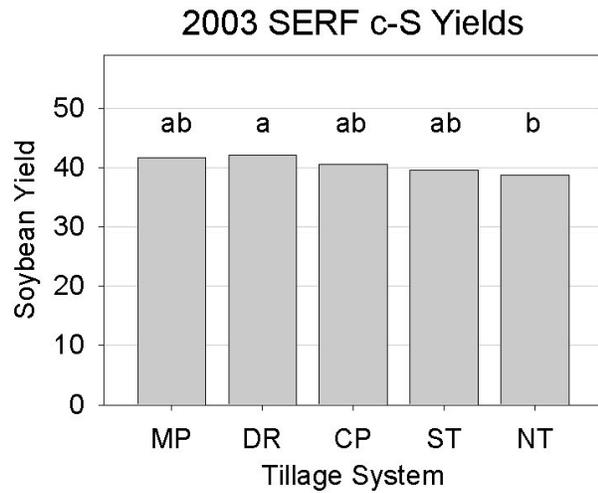


Figure 3. Effect of tillage system on soybean yield in a corn-soybean rotation for 2003 at Crawfordsville, IA.