2004

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

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

Mark A. Licht
Iowa State University, lichtma@iastate.edu

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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 soil 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

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Mahdi Al-Kaisi, assistant professor
Mark Licht, program specialist
Department of Agronomy

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 soil 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 were 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 × 55 ft. Yield is determined from the center four rows of each plot. Long-term effects 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

Results of first year (2003) soybean yields for the Western Research Farm are summarized in Figure 1. Soybean yield response to different tillage systems under a corn-soybean rotation was not significant except for no-till soybean yield. Soybean yields ranged from 26.7 bushels/acre to 31.2 bushels/acre. First year tillage systems do indicate that no-tillage had a yield advantage over moldboard plowing, deep ripping, and chiseling plowing by 2.9–4.4 bushels/acre. Yields were likely realized due to soil moisture conservation from tillage systems with high residue percentages.

Acknowledgments

We would like to thank Wayne Roush for his time and labor for plot setup, planting, and harvesting.

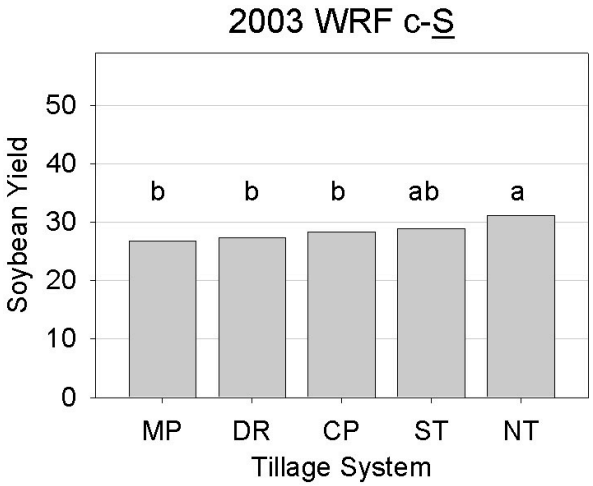

Figure 1. Effect of tillage system on corn yield in a corn-soybean rotation for 2003 at Castana, IA.