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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 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.

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

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 is 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 the 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

The long-term tillage site at the Western Research Farm in Castana was planted to bulk corn in the spring of 2002. In the fall of 2002, the site was harvested, and the yield average for the site was 133.75 bushels/acre. After harvest, the site was soil sampled for background data for total N, P, K, C, and pH, prior to implementing the five tillage treatments in the fall of 2002. The following tillage treatments were implemented: no-till, strip-tillage, chisel plow, moldboard plow, and deep ripping. The site will be in a corn-soybean rotation. Next year's crop will be soybeans using the five tillage systems.

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