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Comparison of Organic and Conventional Agriculture Systems on Crop Production

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Abstract
The majority of organic and conventional agriculture system comparisons are long-term experiments (>10 years). Therefore, it is imperative to understand short-term impacts on soil and environmental quality during the transition period from a conventional system to a three-year, USDA-NOP certified organic system. The objectives of this project were to investigate the effects of two agricultural systems (organic and conventional) on greenhouse gas emissions (CO2, CH4, N2 O), soil carbon dynamics, soil quality, and crop productivity

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Introduction

The majority of organic and conventional agriculture system comparisons are long-term experiments (>10 years). Therefore, it is imperative to understand short-term impacts on soil and environmental quality during the transition period from a conventional system to a three-year, USDA-NOP certified organic system. The objectives of this project were to investigate the effects of two agricultural systems (organic and conventional) on greenhouse gas emissions (CO_2, CH_4, N_2O), soil carbon dynamics, soil quality, and crop productivity.

Materials and Methods

In April 2010, the project was established at the Horticulture Research Station, Ames, Iowa (Clarion Loam) and continued until December 2012. In both the vegetable and row crops, conventional treatments included the use of urea fertilizer (46-0-0) and synthetic herbicides for weed control.

In the organic system, composted poultry manure (2-3-4) was used for fertilizer and weed control was by row cultivation (tillage treatments) or winter cover crop mulch (no-till treatments). Winter cover crops were planted in late September to early October and were terminated mid- to late-May via tillage (tillage treatments) or, rear-mount three-point roller crimper (no-till treatments). The project consisted of two separate experiments: vegetables and row crops.

Vegetable Experiment. Treatments included two agricultural systems (organic and conventional), two tillage treatments (till or no-till), and two cropping rotations (sweet corn-broccoli-squash and bell pepper-lettuce-broccoli) in a randomized complete block design with four replications.

Conventional vegetables in the till treatments used plastic mulch whereas organic vegetables used cover crop mulch for physical weed barriers and maintenance of soil moisture. Plot size was 20 ft × 25 ft containing one crop rotation split by tillage treatments. Vegetable crops were harvested manually throughout the growing season.

Row Crop Experiment. The agronomic experiment treatments included two agricultural systems (organic or conventional), two tillage treatments (till or no-till), and two cropping rotations (corn-soybean-corn and soybean-corn-soybean) in a randomized complete block design with four replications. Plot size was 20 ft × 50 ft containing one crop rotation with all crops at 30-in. row spacing split by tillage treatments. Row crops were harvested in the fall with a plot combine.

Project results in this report are limited to row crop yields.

Results and Discussion

Conventional corn yields across years and tillage treatments generally performed better than organic treatments. Corn yields were greater in organic, tilled treatments compared with organic, no-till. Soybean differences in 2010 were insignificant across treatments, but there were differences in 2011 and 2012. The drought conditions of 2012 significantly

lowered yields across all treatments compared with 2010 and 2011 yields.

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Table 1. Corn and soybean yields under the corn-soybean-corn and soybean-corn-soybean rotation at ISU Horticulture Research Station, Ames, Iowa.

Agricultural system	Tillage	Corn-Soybean-Corn			Soybean-Corn-Soybean		
		2010 Corn	2011 Soybeans	2012 Corn	2010 Soybeans	2011 Corn	2012 Soybeans
		bushels/acre					
Organic	Tilled	111.8	35.2	98.3	54.3	80.7	33.9
Conventional	Tilled	117.8	47.3	105.9	51.7	117.1	38.1
Organic	No-till	NA	31.7	49.0	NA	66.9	14.2
Conventional	No-till	97.9	40.7	112.0	50.4	80.5	37.5
LSD $_{P < 0.05}$		9.1	8.9	11.3	NS	8.7	7.4
Average		109.2	38.7	91.3	52.1	86.3	30.9