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Organic versus Conventional Farming Systems

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Abstract

Driven by a consumer demand-driven market, organic agriculture has become a major industry in the last decade. A study began in 1977 to demonstrate two alternative farming systems and was modified in 1999.

Disciplines

Agricultural Science | Agriculture

Organic versus Conventional Farming Systems

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Introduction

Driven by a consumer demand-driven market, organic agriculture has become a major industry in the last decade. A study began in 1977 to demonstrate two alternative farming systems and was modified in 1999.

Materials and Methods

The original organic system was a corn-oat-alfalfa (C-O-A) rotation, with the alfalfa seeded the previous year as a companion crop with the oats. A second organic C-O-A rotation without livestock manure was used as a comparison to show the advantage of livestock manure as a nutrient source. In 1999, the organic C-O-A rotations were converted to three new organic crop rotations: a corn-soybean-oat-alfalfa (C-SB-O-A) rotation, a soybean-oat/annual ryegrass (SB-O/AR), and a corn-annual alfalfa (C-A). Soybeans were added because of the organic market premium for soybeans and the nitrogen (N) credit from the legume crop. The annual ryegrass, seeded after oat harvest, is used as a “soil-building” crop. The annual (nondormant) alfalfa is grown with an oat companion crop and is used as a “green manure” legume crop for the N credit to be used by corn. The conventional crop rotations, continuous corn (C-C) and corn-soybean (C-SB) rotations remained; however, livestock manure injected in the spring is compared with anhydrous ammonia (NH₃) injected in the spring for the C-C rotation and the C-SB rotation. The conventional rotations receive herbicides, insecticides, and commercial fertilizer as determined by soil analysis. Two corn and soybean (conventional and food grade) varieties are compared in each farming system. Corn residue is chisel plowed in

the fall, soybean residue is field cultivated in the spring, and alfalfa is moldboard plowed after a fall application of dry livestock manure. Organic corn and soybeans are rotary hoed prior to emergence followed by three cultivations, weather permitting. The last pass is with wings/hillers attached to the cultivator to bury more weeds in the row. Conventionally grown crops are only cultivated once.

Results and Discussion

Soil-test data from 2000, 2002, and 2005 are shown in Table 1. The entire area was limed at a rate of 3.5 tons/acre in 1982. The C-C rotation was limed again in 2002 due to the annual acidifying effects of the NH₃ application, which had lowered the pH to 6.2. The addition of dry livestock manure in the organic system has brought soil test levels into the “optimum” range and good crop yields are being produced in ideal growing seasons. Yield results by crop and rotation are shown in Table 2. Organic corn yields were reduced in 2005 due to frequent rainfall in late June, which did not permit a midseason cultivation. High populations of northern corn rootworms due to extended diapause lowered yields as well. Organic soybean yields were lower in 2003 and 2005 due to soybean aphids and also due to an August drought in 2003. Organic corn yields across rotations were 2.8 bushels/acre less than conventionally grown continuous corn and 22.6 bushels/acre less than conventionally grown corn in a C-SB rotation. Yields of C-C grown with manure as the fertilizer source were only 3.6 bushels/acre more than the yields with commercial fertilizer. The C-SB corn yield was 13.9 bushels/acre more than C-SB-O-A. On average, conventionally grown soybeans yielded 8.1 bushels/acre more than the organic systems.

Conventional soybeans yielded 10.1 bushels/acre more than HP204 food grade soybeans, but higher-yielding food grade soybeans are now available. Soybean yields in the C-SB-O-A rotation were 5.6 bushels/acre more than in the SB-O/AR rotation due to less

weed pressure in the longer crop rotation. Organic crops can gain the highest premium, but have more risk associated with timing of operations, pests, and environmental conditions during the growing season, which ultimately impacts final quality, yield, and income per acre.

Table 1. Soil-test results from organic and conventional farming system plots.

System Rotation	2005	2002	2000
<u>Organic</u>	6.63 pH, 5.1% OM	6.65 pH, 4.8% OM	6.63 pH, 4.5%OM
C-SB-O-A	17.5 (Opt) ppm B-P 132.3 (Opt) ppm K	20.1 (Opt) ppm B-P 140.9 (Opt) ppm K	13.3 (L) ppm B-P 98.7 (L) ppm K
<u>Organic</u>	6.90 pH, 5.0% OM	6.86 pH, 4.7% OM	6.8 pH, 4.3%OM
SB-O/AR	26.3 (H) ppm B-P 143.3 (Opt) ppm K	17.8 (Opt) ppm B-P 134.0 (Opt) ppm K	11.0 (L) ppm B-P 91.8 (L) ppm K
<u>Organic</u>	6.88 pH, 4.9% OM	6.82 pH, 4.9% OM	6.8 pH, 4.4%OM
C-A	22.0 (H) ppm B-P 140.8 (Opt) ppm K	22.5 (H) ppm B-P 159.3 (Opt) ppm K	19 (Opt) ppm B-P 117.3 (L) ppm K
<u>Conventional</u>	6.84 pH, 4.0% OM	6.98 pH, 3.7% OM	6.75 pH, 3.5%OM
C-SB	19.8 (Opt) ppm B-P 130.5 (Opt) ppm K	33.8 (VH) ppm B-P 132.4 (Opt) ppm K	43 (VH) ppm B-P 160 (Opt) ppm K
<u>Conventional</u>	6.9 pH, 5.8% OM	6.8 pH, 5.7% OM	6.2 pH, 5.4%OM
CC w/NH ₃	17.0 (Opt) ppm B-P 145.5 (Opt) ppm K	25.5 (H) ppm B-P 161.5 (Opt) ppm K	26.5 (H) ppm B-P 125 (L) ppm K
<u>Conventional</u>	7.15 pH, 6.1% OM	6.98 pH, 5.6% OM	6.3 pH, 5.0%OM
CC w/manure	73.5 (2 × VH) ppm B-P 258.0 (VH) ppm K	55.5 (VH) ppm B-P 215.0 (VH) ppm K	41.5 (VH) ppm B-P 137 (Opt) ppm K

Table 2. Crop yields for organic and conventional farming systems.

System	2005	2004	2003*	2002	2001	2000	1999**	00–05 Average
<u>Organic C-SB-O-A rotation</u>								
Corn	159.2	185.4	134.1	183.0	156.0	164.5	70.5	163.7
Conventional soybean variety	36.4	47.5	24.4	50.7	35.0	59.0	38.8	42.2
Food grade soybean variety	34.7	37.8	19.9	38.9	26.1	47.7	30.3	34.2
Oats	91.8	95.0	117.8	114.6	65.9	63.8	82.3	91.5
Alfalfa	5.6	5.12	3.74	4.15	2.71	3.70	3.17	4.17
<u>Organic SB-O/AR rotation</u>								
Conventional soybean variety	37.8	34.4	17.3	49.7	25.7	57.3	54.4	37.0
Food grade soybean variety	31.4	24.1	13.7	34.0	20.6	45.5	38.3	28.2
Oats/annual rye	55.7	81.1	96.1	123.6	60.7	76.1	79.8	82.2
<u>Organic C-A rotation</u>								
Corn	103.5	132.9	142.0	182.8	141.1	176.3	59.0	146.4
Oats/annual alfalfa	67.5	75.2	100.8	108.4	81.0	-	-	86.6
<u>Conventional C-SB rotation</u>								
Corn	190.7	205.1	142.6	193.1	166.2	168.1	158.3	177.6
Conventional soybean variety	64.2	58.4	31.3	44.8	46.7	55.5	49.5	50.2
Food grade soybean variety	46.9	39.6	24.0	34.3	33.7	42.3	36.8	36.8
<u>Conventional C-C</u>								
Cont. Corn (NH ₃)	162.3	170.3	120.7	184.4	141.8	156.2	127.5	156.0
Cont. Corn (manure only)	163.2	172.4	139.4	194.8	125.1	162.7	-	159.6

¹Late season drought.

²Extremely wet growing season.