Organic vs. Conventional Farming Systems

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Introduction

Organic agriculture has become a major industry in the last decade, driven by increasing consumer demand, price premiums, and improving market opportunities. In 1977, a study was started at the Northeast Research and Demonstration Farm to demonstrate two alternative farming systems.

Materials and Methods

The original organic system was two corn-oat-alfalfa (C-O-A) rotations with the alfalfa seeded as a companion crop with oats in the second year of the rotation. One of the C-O-A rotations received livestock manure, and the second did not. In 1999, the organic C-O-A rotations were converted to three new organic crop rotations: corn-soybean-oat-alfalfa (C-SB-O-A), soybean-oat/annual ryegrass (SB-O/AR), and corn-annual alfalfa (C-A). Soybeans were added because of the market premium and the N credit for the subsequent oat crop. The annual ryegrass, seeded after oat harvest, is used as a "soil building" crop. The annual (nondormant) alfalfa, which is grown with an oat companion crop, is used as a "green manure" N-supplying crop. Although the original organic rotations have been changed, the conventional crop rotations, continuous corn (C-C) and corn-soybean (C-SB), remain intact. Half of the C-C plots receive spring injected livestock manure, and the other half receive spring injected anhydrous ammonia. The conventional rotations receive herbicides, insecticides, and commercial fertilizer as determined by soil analysis. Two corn varieties and a conventional soybean and a food grade soybean variety are compared in each farming system. The corn stubble is fall chisel plowed, the soybean stubble is spring field cultivated, and the alfalfa is moldboard plowed after a fall application of dry livestock manure. Organic corn and soybeans are rotary hoed prior to emergence (weather permitting) followed by three cultivations, the last with hillers attached to the cultivator to bury more weeds in the row.

Results and Discussion

For yield, soil analysis, and economic results from the study during 1977 through 1998, refer to the 1998 Northeast Annual Progress Report. Soil-test data for samples collected in 1998, 2000, and 2002 are shown in Table 1. The entire area received lime at a rate of 3.5 tons/acre in 1982 and in the C-C rotation in 2002. The annual acidifying effects of the NH^3 application had lowered the pH to 6.25 for C-C, but the rest of the rotations averaged 6.7. The addition of dry livestock manure in the organic system has brought soil test levels into the "optimum" range, and respectable crop yields are being produced in ideal growing seasons. The spring injected liquid livestock manure on the C-C rotation has increased P/K soil-test levels to the "very high" range. Yield results by crop and rotation are shown in Table 2. The 3-year average excludes the 1999 data because it was a transition year and excessive rainfall during the growing season reduced crop yields, especially in the organic systems. Organic corn yields across rotations were 6.4 bushels/acre higher than conventional, continuous corn and 8.6 bushels/acre lower than conventional corn in the C-SB rotation. Yields of C-C grown with manure as the fertilizer source were identical to C-C with the use of commercial fertilizer in spite of differences in soil fertility. The C-SB corn yields were 15 bushels/acre more than C-C. The organically-grown, conventional soybean variety and the food grade soybean variety yielded 2.8 and 1.3 bushels/acre more than in the conventional farming systems. On the

average, conventional soybean varieties yielded 11.2 bushels/acre more than food grade soybeans. Organic crops can gain a higher premium, but have more risk compared with conventional crops. Timing of operations, pests, and environmental conditions during the growing season have a greater impact on final crop quality and yield.

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

System	2002	2000	1998
Organic	6.7 pH, 4.8% OM	6.6 pH, 4.46% OM	6.6 pH, 4.85% OM
C-SB-O-A rotation	15.9-24.3 (Opt-H) ppm B-P	10.6-16.0 (L-Opt) ppm B-P	8.3-14.0 (L) ppm B-P
	130-151 (Opt) ppm K	85-112 (VL-L) ppm K	109-153 (L-Opt) K
Organic	6.85 pH, 4.7% OM	6.8 pH, 4.3%OM	6.8 pH, 5.0%OM
SB-O/AR rotation	17.8 (Opt) ppm B-P	11.0 (L) ppm B-P	13.1 (L) ppm B-P
	134 (Opt) ppm K	92 (L) ppm K	167 (Opt) ppm K
Organic	6.8 pH, 4.9% OM	6.8 pH, 4.44%OM	6.8 pH, 5.0% OM
C-A rotation	22.5 (H) ppm B-P	19 (Opt) ppm B-P	13.1 (L) ppm B-P
	159 (Opt) ppm K	117 (L) ppm K	167 (Opt) ppm K
Conventional	7.0 pH, 3.7% OM	6.8 pH, 3.5%OM	6.0 pH, 3.93%OM
C-SB rotation	33.8 (VH) ppm B-P	43 (VH) ppm B-P	28.5 (H) ppm B-P
	132 (Opt) ppm K	160 (Opt) ppm K	145 (Opt) ppm K
Conventional	6.8 pH, 5.7% OM	6.2 pH, 5.4%OM	6.4 pH, 5.7% OM
C-C w/NH^3	25.5 (H) ppm B-P	26.5 (H) ppm B-P	36.5 (VH) ppm B-P
	162 (Opt) ppm K	125 (L) ppm K	200 (H) ppm K
	7.0 pH, 5.6% OM	6.3 pH, 4.95%OM	6.4 pH, 5.7% OM
C-C w/manure	55.5 (VH) ppm B-P	41.5 (VH) ppm B-P	36.5 (VH) ppm B-P
	215 (VH) ppm K	137 (Opt) ppm K	200 (H) ppm K

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

System	2002	2001	2000	1999 (wet)	00-02 avg.
Organic C-SB-O-M rotation					
Corn	183.0	156.0	164.5	70.5	167.8
Conventional soybean variety	50.7	35.0	59.0	38.8	48.2
Food grade soybean variety	38.9	26.1	47.7	30.3	37.6
Oats	114.6	65.9	63.8	82.3	81.4
Alfalfa	4.15	2.71	3.70	3.17	3.52
Organic SB-O/AR rotation					
Conventional soybean variety	49.7	25.7	57.3	54.4	44.2
Food grade soybean variety	34.0	20.6	45.5	38.3	33.4
Oats/annual rye	123.6	60.7	76.1	79.8	86.8
Organic C-A rotation					
Corn	182.8	141.1	176.3	59.0	166.7
Oats/annual alfalfa	108.4	81.0	—	—	94.7
Conventional C-SB rotation					
Corn	193.1	166.2	168.1	158.3	175.8
Conventional soybean variety	44.8	46.7	55.5	49.5	49.0
Food grade soybean variety	34.3	33.7	42.3	36.8	36.8
Conventional C-C					
Cont. corn (NH3)	184.4	141.8	156.2	127.5	160.8
Cont. corn (manure only)	194.8	125.1	162.7	—	160.9