Comparison of Organic and Conventional Corn, Soybean, Alfalfa, Oats, And Rye Crops at the Neely-Kinyon Long-Term Agroecological Research (LTAR) Site-1998

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Introduction

Organic farming has increased to a $4.2 billion industry in the U.S. and continues to expand approximately 20% annually (18). In Iowa alone, organic acreage for all crops has increased from 13,000 in 1995 to 120,000 in 1998. Organic corn production in 1997 was reported at 9,920 acres, and organic soybean on approximately 60,000 acres. (13). International demand for organic products, particularly from the Japanese and European markets, is also on the rise. Farmers interested in transitioning some or all of their land into organic production require information on best management practices for these systems. Once the transition is complete, comparable yields to conventional systems can be obtained (1,16,20,27). In addition, organic products garner a 20-300% premium price in the marketplace, with organic clear-hilum soybeans, for example, averaging twice to three times the price of conventional clear-hilum soybeans in 1998 (2). Soil health, maintained through crop rotations, organic matter additions (manure/compost), and cover crops (10,14,19,21), has been the basis of successful organic farming.

The Leopold Center for Sustainable Agriculture has identified the need for dedicated lands throughout Iowa where research on organic practices can be conducted over the long term. In the first year trials at the Neely-Kinyon Long-Term Agroecological Research (LTAR) Site, we examined the agronomic and economic performance of conventional and organic systems, using required practices for certified organic production (24).

Materials and Methods

Experimental Design

The Neely-Kinyon Farm Association dedicated a 17-acre block for this long-term study. One-third of the block had previously been in alfalfa (3 years) and the remaining two-thirds in a corn-soybean rotation (1997 crop-soybean). In order to equalize all plots as much as possible, the field was moldboard plowed, disked, and field cultivated for seedbed preparation on May 4, 11, and 13, 1998, respectively. Treatments were assigned in a completely randomized statistical design to the forty, quarter-acre plots constituting the experiment. The plot plan is shown below. Treatments were as follows: Conventional Corn-Soybean rotation; organic Corn-Soybean-Oats (with alfalfa); organic Corn-Soybean-Oats (with alfalfa)-Alfalfa; and organic Soybean-winter Rye (winter rye plowdown in the spring prior to soybean planting each year). All crops in all rotations will be planted each year. While the final treatment (soybean-rye) is currently discouraged (and with certain certification agencies, prohibited) (17), many farmers are interested in this rotation in order to continue production of the most lucrative organic crop, clear-hilum soybeans.

Results and Discussion

Plant Performance

First-year results from the Neely-Kinyon LTAR site were very encouraging. There were no statistically significant differences in yields between the organic and conventional corn and soybeans (P=.05) (Table 1). The greatest organic corn yield (177 bushels/acre) was produced on ground previously in alfalfa. Conventional corn yields ranged from 162 to 178 bushels/acre and organic yields ranged from 116 to 177 bushels/acre. Because of the variability among organic plots, significant differences were not obtained. Despite adjusting fertilization rates based on previous crop to provide similar nutrients to each system, plots previously in alfalfa produced greater yields overall. Organic corn averaged 174 and 127 bushels/acre on ground previously in alfalfa and soybean, respectively. Conventional corn averaged 173 and 166 bushels/acre on ground previously in alfalfa and soybean, respectively.

Table 1. Yield analysis from organic vs. conventional corn and soybeans.

Treatment	Rotation	Yield Bu/A	Standard Error
Conventional Corn	C-SB	169.5*	3.31
Organic Corn	C-SB-O	143.2	13.71
Organic Corn	C-SB-O-A	138.4	14.21
Ave. Conventional Corn		169.5	3.31
Ave. Organic Corn		140.4	9.24
Conventional soybeans	SB-C	48.4	1.46
Organic Soybeans	SB-O-C	48.2	1.74
Organic Soybeans	SB-O-A-C	49.5	1.40
Organic Soybeans	SB-R	51.5	1.33
Ave. Conventional Soybeans		48.4	1.46
Ave. Organic Soybeans		49.8	0.91

*There were no statistically significant differences in yields between systems, P=.05).

Rotations:	C-SB	Corn-Soybean
	C-SB-O	Corn-Soybean-Oat (with alfalfa)
	C-SB-O-A	Corn-Soybean-Oat (with alfalfa)-Alfalfa
	SB-R	Soybean with Rye plowdown

Organic oat yields averaged 41 bushels/acre, and 43 square bales of straw/acre. Because of the excessive rainfall during the growing season, the test weight of the oats was less than required for food-grade milling (36 lb/bushel). The organic oats test-weighed 32 lb/bushel before screening (organic farmers usually screen oats to remove unfilled oats and increase test-weight), which reflected averages in the Greenfield area. The protein content of the oats was 14.5%, an excellent level for food-grade oat products (Iowa Oat Mills, Chelsea, IA).

Grain Analysis
Corn grain analyses for protein, oil and starch exhibited significant differences only for protein content, with the conventional corn having a higher content. Greater concentrations could have been due to the relative deficiency of nitrogen in the organic plots, although grain protein averages for the organic corn were similar to 1997 Iowa averages (12). However, it must be noted that 1997 averages were lower than normal. Soybean grain analysis demonstrated no significant differences between conventional and organic systems, with average protein approximately 39%. Again, these levels compared favorably to 1997 averages.

Economical Analysis
Cost of production studies for corn and soybean systems are presented in Tables 2-3. Costs represent actual costs incurred on the project. ISU projected costs of production for similar operations are approximately the same as our costs, despite individual differences in costs of specific operations (e.g., disking). Selling price for organic crops represented 1998 prices (F.O.B. or pick-up on the farm), as is the practice for many organic marketers (2). Prices also reflect the price obtainable for "certified organic" crops, or crops grown on land without synthetic chemicals for three years prior to harvest. Some of the crops grown at the LTAR site would have qualified for certified organic (on land previously in unsprayed alfalfa), while others would be considered "in transition." Selling price for transitional soybeans in 1998 averaged $10/bushel.

Table 2. LTAR soybean economic analysis, ISU Neely-Kinyon Farm, 1998.

Production Costs (actual cost per acre)	**Organic**	**Conventional**
Moldboard Plowing	$8.10	$8.10
Disking	4.00	4.00
Field cultivation (pre-plant)	4.00	4.00
Fertilization	0	0
Planting	9.00	9.00
Seed	31.60	22.00
Herbicide	0	10.38
Sprayer	0	2.50
Rotary Hoeing (2x)	4.00	4.00
Row cultivating (2x)	7.00	7.00
Hand-weeding	14.00	14.00
Combining	21.00	21.00
Hauling Grain to Market	0 (FOB per contract)	3.00
Total Cost per Acre	**$102.70**	**$108.98**
Returns	$850.00 50bu/A x $17.00/bu	$312.00 48 bu/A x $6.50/bu
Profit per Acre	**$747.30** Excluding price of land	**$203.02** Excluding price of land
Organic Increase in Returns	368%	

Table 3. LTAR corn economic analysis, ISU Neely-Kinyon Farm, 1998

Production costs actual cost	**Organic**	**Conventional**
Moldboard plowing	$8.10	$8.10
Disking	4.00	4.00
Field cultivation (pre plant)	4.00	4.00
Fertilization	8.00 (Manure spreader; compost@150#N/A)	28.80 (Anhydrous ammonia @ 180#N/A)
Planting	9.00	9.00
Seed	31.90	31.90
Herbicide	0.00	(Harness@2pts/A) 27.34
Insecticide	0.00	(Force1.5G @9lb/A) 17.91
Sprayer	0.00	2.50
Rotary hoeing (2x)	4.00	4.00
Row cultivating (2x)	7.00	7.00
Hand weeding	88.90	0.00
Combining	23.00	23.00
Hauling grain to market	0.00	7.00
Total Cost Per Acre	**$187.90**	**$174.55**
Returns	$560.00 (140bu/A x $4/bu)	$340.00 (170bu/A x $2.00/bu)
Profit Per Acre	**$372.10/A** (Excluding price of land)	**$165.45/A** (Excluding price of land)
Organic Increase in Returns	227%	

Results from the first year at the Neely-Kinyon LTAR site were very promising for organic crops. We expect to see greater differences in the systems, in terms of insect, weed and nematode populations, as rotational effects occur over time. It is also anticipated that soil quality will improve over time in the organic systems where longer crop rotations, and additions of organic matter from compost and cover crops, occur (8).

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