Comparison of Organic and Conventional Crops at the Neely-Kinyon Long-term Agroecological Research (LTAR) Site, 2003

Kathleen Delate, assistant professor
Heather Friedrich and Andrea McKern,
research associates
Departments of Horticulture and Agronomy
Cynthia Cambardella, soil scientist
USDA National Soil Tilth Lab
Bob Burcham, ag specialist

Materials and Methods

The Neely-Kinyon LTAR site was established in 1998 to study the long-term effects of organic production in Iowa. Treatments at the LTAR site, replicated four times in a completely random design, include the following rotations: conventional Corn-Soybean (C-S), organic Corn-Soybean-Oats/Alfalfa (C-S-O/A), organic Corn-Soybean-Oats/Alfalfa-Alfalfa (C-S-O/A-A), and Soybean-Wheat (S-W). Variety selection and planting methods were as follows: Pioneer 34M94 corn was planted at a depth of 1.75 in. as untreated seed at a rate of 32,000 seeds/acre in the organic plots and as treated seed at a rate of 30,000 seeds/acre in conventional plots, on May 23, 2003. Schillinger 240F.Y soybeans were planted at a depth of 2 in. in organic and conventional plots at a rate of 200,000 and 185,000 seeds/acre, respectively, on May 28, 2003. 'Wesley' winter wheat was planted on October 17, 2002, at 90 lb/acre and red clover was frost-seeded into the wheat plots on March 26, 2003, at a rate of 15 lb/acre. On April 1, 2003, 'Reeves' oats were underseeded with Pioneer 54H91 leafhopper-tolerant alfalfa at a depth of 0.5 in. at a rate of 3.5 bushels/acre and 18 lb/acre, respectively. Following harvest of the organic corn plots in 2002, winter rye was no-till drilled at a rate of 1 bushel/acre on October 17, 2002. Hoop-house swine compost was applied to organic corn plots at a rate of 12 tons/acre on April 2, and 4 tons/acre to oat plots on March 31, 2003. Conventional corn plots were fertilized on May 27 with 28% urea at 150 lb/acre N. Soil in corn plots was sampled on June 19, 2003, and analyzed for late-spring nitrate content by the Iowa State University Agronomy Soils Laboratory, Ames, IA. Conventional corn plots received 1.75 oz/acre of Balance® on May 27, and on June 27 received Accent® at .67 oz/acre, Buctril® at 1 pt/acre, NIS® at 5 oz/acre, and AMS® at 2 lbs/acre. Conventional soybeans received applications of Prowl® (2.2 pt/acre) on May 30, and on June 27 received Pursuit® at 1.44 oz/acre, Select ® at 7 oz/acre, and AMS® at 2 lb/acre. Conventional soybeans also received one cultivation on July 22. Organic corn plots were harrowed on May 30, rotary hoed on June 6, 9, and 12, and cultivated on June 16 and July 1. Organic soybeans were harrowed on May 30, rotary hoed on June 6, 9 and 12, and cultivated on June 20, July 2 and 14. Corn stands were counted on June 11 and soybean plots on July 18. Weed counts were enumerated in corn plots on June 11 and July 9 and in soybean plots on June 18 and July 9 using square meter quadrants at three randomly selected areas within a plot. Corn borer populations were monitored on July 9. Soybean plots were sampled for bean leaf beetles on August 7. Soybean cyst nematode sampling was completed on September 24.

Alfalfa was mowed and baled on May 27, July 7, and August 4, 2003. Wheat and oat plots were harvested on July 25. Soybean plots were harvested on October 9. Corn plots were harvested on October 10. Samples were collected from each corn and soybean plot for grain quality analysis, which was conducted at the ISU Grain Quality Laboratory. (Corn analysis was not completed at the time of this report.)

Results and Discussion

There was a significantly higher corn plant stand in the conventional rotation on June 6, after two rotary hoeings in the organic plots (Table 1). There were significantly fewer grass weeds in the conventional C-S and organic C-S-O/A corn plots on June 11 (Table 1), and significantly fewer broadleaves in conventional corn plots. Similarly, on July 9, grass weeds were least in the conventional C-S and C-S-O/A corn plots, and broadleaves were least in the conventional corn plots. Late-spring nitrate levels in organic corn plots averaged 3.8 ppm NO_3-N compared with 5.4 ppm in the conventional plots (Table 1).

Soybean plant stands were significantly less in the conventional C-S plots compared with the other rotations on June 18 (Table 2). Soybean grass and broadleaf weeds were greatest in the organic S-W rotation (Table 2). On July 9, grasses were still greatest in the S-W rotation but broadleaf weeds were significantly greater in the C-S and S-W plots compared with the C-S-O/A and C-S-O/A-A treatments (Table 2).

The drought during late summer 2003 affected both corn and soybean yields, but particularly soybeans (Table 3). Organic corn yields averaged 119.2 bushels/acre and organic soybean yields averaged 33.7 bushels/acre. There were no significant differences between organic corn yields in the rotation with two years of alfalfa (C-S-O/A-A) and the conventional C-S rotation. There was no significant difference between organic and conventional soybean yields.

There were no significant yield differences between oat rotations, averaging 105.8 bushels/acre and 1.35 tons/acre of oat straw. Wheat yielded 42.8 bushels/acre and 1.08 tons/acre straw (Table 3). Pest populations were lower than in 2002, with no corn borers observed on July 9. There was an average of 1.75 bean leaf beetles per 20 sweeps in the organic soybean plots and 4.0 in the conventional soybean plots, with a significantly lower average beetle population in the organic C-S-O/A-A plots (Table 4). Soybean seed staining was also less in 2003, with only 2.3% stained over all treatments. Soybean cyst nematodes were below economic threshold levels, with no significant differences among treatments.

Organic soybean protein content averaged 37.6% compared with 37.0% in the conventional soybeans. The sixth year of organic production (2003) marked the first year that significantly greater protein content was found in the organic soybeans (Table 5).

Acknowledgments

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Table 1. Corn stands and weed populations in corn plots at Neely-Kinyon LTAR, 2003.

Treatment	Corn stands plants/acre	Corn stalk Nitrate ppm NO_3-N	Late-spring Nitrate ppm NO_3-N	Corn weeds/m^2 June 11, 2003		Corn weeds/m^2 July 9, 2003	
				Grasses	Broadleaves	Grasses	Broadleaves
C-SB	29,000b	390.00b	5.35a	0.92a	1.67a	0.50a	1.08a
C-SB-O/A	26,333a	3015.50a	3.71b	5.67b	16.25b	3.33b	6.17b
C-SB-O/A-A	25,333a	2647.50a	3.90b	1.25a	13.83b	0.92a	8.33b
LSD (0.05)	2,390	1961.80	1.45	1.89	12.12	1.67	4.13

Table 2. Soybean stands and weed populations in soybean plots at Neely-Kinyon LTAR, 2003.

Treatment	Soybean stands plants/acre	Soybean weeds/m^2 June 18, 2002		Soybean weeds/m^2 July 9, 2003	
		Grasses	Broadleaves	Grasses	Broadleaves
C-SB	92,750a	4.17a	11.58a	0.58a	9.17b
C-SB-O/A	116,583b	8.58a	10.25a	0.33a	2.00a
C-SB-O/A-A	117,833b	1.42a	9.25a	0.83a	1.83a
SB-W	103,500ab	68.42b	22.08b	5.25b	5.00ab
LSD (0.05)	16,438	17.43	10.32	3.40	4.40

Table 3. Organic and conventional grain crop yields at Neely-Kinyon LTAR, 2003.

Treatment	Corn yield bu/acre	Soybean yield bu/acre	Oat yield bu/acre	Oat straw tons/acre	Wheat yield bu/acre	Wheat straw tons/acre
Conv. C-SB	137.72a	32.82	N/A	N/A	N/A	N/A
Org. C-SB-O/A	111.63b	32.11	109.73	1.38	N/A	N/A
Org. C-SB-O/A-A	126.68a	32.25	101.92	1.33	N/A	N/A
Org. SB-W	N/A	35.42	N/A	N/A	42.8	1.08
LSD (0.05)	12.51	NS	NS	NS	N/A	N/A

Table 4. Pest populations and stained soybeans at Neely-Kinyon LTAR, 2003.

Treatment	Corn borer damage	Bean leaf beetle population/ 20 sweeps	Stained soybean (%)	Soybean cyst nematode (Eggs per 100 cc)
C-SB	0.00	4.00a	2.3	0.00
C-SB-O/A	0.00	1.50ab	2.1	0.00
C-SB-O/A-A	0.00	1.00b	2.4	100.00
SB-W	N/A	2.75ab	2.4	0.00
LSD (0.05)	NS	2.73	NS	NS

Table 5. Soybean grain quality at Neely-Kinyon LTAR, 2003.

Treatment	Grain quality (%)				
	Carbohydrates	Fiber	Oil	Protein	Moisture
C-SB	21.70b	4.63	18.68a	37.00b	8.85
C-SB-O/A	22.03a	4.63	18.23b	37.13b	8.95
C-SB-O/A-A	21.84ab	4.63	17.93b	37.61a	9.05
SB-W	21.48c	4.60	18.00b	37.93a	9.00
LSD (0.05)	0.21	NS	0.37	0.40	NS