

Comparison of Organic and Conventional Crops at the Neely-Kinyon Long-term Agroecological Research (LTAR) Site, 2005

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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 randomized 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 in 2005 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 in conventional plots, on May 16, 2005. Schillinger 240F.Y soybeans were planted at a depth of 2 in. in organic and conventional plots at a rate of 205,000 seeds/acre on May 25, 2005. 'Wesley' winter wheat was planted on October 15, 2004, at 90 lb/acre and 'Arlington' red clover was frost-seeded into the wheat plots on March 9, 2005, at a rate of 17.5 lb/acre. All plots were harrowed on March 25. On April 4, 2005, 'Jim' oats were underseeded with NC+ 'Robin' alfalfa at a rate of 3.0 bushels/acre and 18 lb/acre, respectively. Due to bad crop stands, oats were destroyed by field cultivation on April 15 and replanted on April 25 with 'Reeves' oats at 4 bu/acre and 'Vernal' alfalfa at 22 lbs/acre. Following harvest of the organic corn plots in 2004, winter rye was no-till drilled at a rate of 1 bushel/acre on November 24, 2004. Hoop-house swine compost was applied to organic corn plots at a rate of 12 tons/acre and 4 tons/acre to oat

plots on March 16. Conventional corn plots were fertilized on May 20, 2005, with 32% urea at 160 lbs N/acre (47 gal/ac) along with 1.75 oz/acre of Balance Pro™ herbicide. Soil in corn plots was sampled on June 20, 2005, and analyzed for late-spring nitrate content by the Iowa State University Soil and Plant Analysis Laboratory, Ames, Iowa, and fall samples taken for soil quality. Conventional soybeans received an application of 1.44 oz/acre of Pursuit™ on June 2. Organic soybean plots were cultivated on June 15 and July 1, and rotary hoed on June 15 and June 22. Soybean plots were hand hoed on July 11. Organic corn plots were harrowed on May 19 and May 24 and rotary hoed on June 2. Organic corn plots were cultivated on June 7 and June 21. All corn plots were hand hoed on June 29. Corn stands were counted on June 7 and soybean stands on June 15. Weed counts were enumerated in corn plots on June 7 and July 6 and in soybean plots on June 15 and June 27 using square meter quadrats at three randomly selected areas within a plot. Corn borer populations were monitored on July 6. Soybean plots were sampled for bean leaf beetles on June 15, July 13, and August 30. Corn stalk nitrate samples were collected on September 29, and soybean cyst nematode sampling was completed on September 27. Samples were collected from each corn and soybean plot for grain quality analysis, which was conducted at the ISU Grain Quality Laboratory, Ames, IA.

Alfalfa was baled on June 27, July 25, September 2, and September 19. Wheat plots were harvested and baled on July 8, and oat plots were harvested and baled on July 25. Soybean plots were harvested on October 10. Corn plots were harvested on October 17. Corn stalk nitrate analysis was conducted at the Iowa

State University Soil and Plant Analysis Laboratory, Ames, IA.

Results and Discussion

There were no significant differences in corn stands among the three rotations on June 7. Weed populations were low in all corn plots throughout the season, and no significant differences were observed among rotations for grasses and broadleaves on the first sampling date, June 7. On the second sampling date, July 6, the C-S-O/A plots had higher broadleaf weed numbers, while the C-S-O/A-A had higher grass weed numbers (Table 1). Late-spring nitrate levels in the C-S-O/A-A and C-S-O/A averaged 29.5 and 24.4 ppm NO₃-N respectively, compared with 28.3 ppm in the conventional plots with no significant differences among rotations, signifying adequate N in plots (Table 1). There was a trend towards greater corn stalk nitrate levels at the end of the season in the C-S-O/A-A rotation compared to the other two rotations, although the difference was not significant (Table 1).

Soybean plant stands were significantly lower in the organic S-W rotation on June 15, but no significant difference was observed in the other three rotations (Table 2). Grass weeds were significantly greater in the organic S-W plots on June 15 and June 27 (Table 2). Broadleaf weed counts were similar in conventional and organic plots on June 15, but numbers were significantly greater in the organic S-W plots on June 27 (Table 2).

Organic corn yields averaged 194.27 bushels/acre and organic soybean yields averaged 52.25 bushels/acre (Table 3). The organic C-S-O/A-A and C-S-O/A corn plot yields at 195.99 bu/acre and 192.54 bu/acre, respectively, were significantly greater than the conventional C-S yields at 173.74 bu/acre. The organic C-S-O/A soybean yield was significantly greater at 56.15bu/acre than the conventional C-S yield of 51.67 bu/acre. No

soybean yield difference was observed between the C-S-O/A-A rotation (55.48 bu/acre) and the organic C-S-O/A and conventional C-S rotations. The organic S-W rotation exhibited the lowest yield. There were no significant yield differences between oat rotations, averaging 106.61 bushels/acre and 1.52 tons/acre of oat straw. Wheat yielded 56.71 bushels/acre and 1.68 tons/acre straw (Table 3).

Pest populations remained fairly low in 2005, with no corn borers observed in any plots on July 6. Bean leaf beetle numbers were not high or significantly different until the final sampling date of August 30. On that sampling date the S-W rotation had significantly lower bean leaf beetle populations, while the C-S-O/A-A exhibited the highest numbers. Pest populations in general were not significantly different on any of the sampling dates. Beneficial insects were generally higher in the organic rotations although results were not significantly different (Tables 5-7). Soybean seed staining was also less in 2004, with only 0.93% of all soybeans stained over all treatments and no significant differences among rotations. Soybean cyst nematodes were also below economic threshold levels, with no significant differences among treatments (Table 4). Soybean grain oil content was equivalent among rotations, but protein levels were higher in the C-S and S-W rotations. Carbohydrate levels were greater in the rotations with alfalfa (Table 8). No significant difference was observed in corn grain oil content, but the C-S rotation exhibited a higher carbohydrate level. Higher protein levels in corn (8.41%) were found in the two organic rotations (Table 8).

In the LTAR experiment, surface soil samples (0-15 cm) were collected after harvest from 1998 through 2005, and evaluated for soil organic C (SOC) and total N (TN), microbial biomass C (MBC), particulate organic matter C (POMC), potentially mineralizable N (PMINN), stable macroaggregates, NO₃-N, Bray P, EC,

pH, and bulk density. After 7 years of organic management, SOC and TN, among other changes, were significantly greater in the organic systems than in the conventional system.

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Table 1. Corn stands and weed populations in corn plots at Neely-Kinyon LTAR, 2005.

Treatment	Corn stands plants/acre	Corn stalk Nitrate ppm NO ₃ -N	Late-spring Nitrate ppm NO ₃ -N	Corn weeds/m ² June 7, 2005		Corn weeds/m ² July 6, 2005	
				Grasses	Broadleaves	Grasses	Broadleaves
Conv. C-S	26,833	20.00	28.25	0.25	1.92	0.25a	0.83a
Org. C-S-O/A	25,000	307.50	24.38	0.92	2.67	0.42a	3.42b
Org. C-S-O/A-A	25,083	576.00	29.50	0.42	0.92	2.58b	1.75a
LSD (0.05)	NS	NS	NS	NS	NS	1.18	1.45

Table 2. Soybean stands and weed populations in soybean plots at Neely-Kinyon LTAR, 2005.

Treatment	Soybean stands plants/acre	Soybean weeds/m ² June 15, 2005		Soybean weeds/m ² June 27, 2005	
		Grasses	Broadleaves	Grasses	Broadleaves
Conv. C-S	110,167a	0.17a	3.08	0.25a	1.58a
Org. C-S-O/A	109,250a	1.00a	7.25	0.00a	2.67a
Org. C-S-O/A-A	110,917a	2.92a	6.83	1.17a	1.42a
Org. S-W	92,917b	101.00b	12.92	20.42b	5.42b
LSD (0.05)	10,970	40.52	NS	4.45	1.98

Table 3. Organic and conventional grain crop yields at Neely-Kinyon LTAR, 2005.

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-S	173.74b	51.67b	N/A	N/A	N/A	N/A
Org. C-S-O/A	192.54a	56.15a	106.75	1.50	N/A	N/A
Org. C-S-O/A-A	195.99a	55.48ab	106.47	1.53	N/A	N/A
Org. S-W	N/A	45.12c	N/A	N/A	56.71	1.68
LSD (0.05)	10.01	4.19	NS	NS	N/A	N/A

Table 4. Insect and nematode populations and stained soybeans at Neely-Kinyon LTAR, 2005.

Treatment	Corn borer damage	Stained soybean (%)	Soybean cyst nematode (Eggs/ 100 cc)
Conv. C-S	0.00	0.78	62.50
Org. C-S-O/A	0.00	0.52	87.50

Org. C-S-O/A-A	0.00	0.85	50.00
Org. S-W	N/A	1.58	50.00
LSD (0.05)	NS	NS	NS

Table 5. Insect populations in soybeans at Neely-Kinyon LTAR, June 15, 2005.

Treatment	Beneficial insect population/ 20 sweeps	Pest population/ 20 sweeps	Bean leaf beetle population/ 20 sweeps
Conv. C-S	0.00	0.08	0.08
Org. C-S-O/A	0.17	0.08	0.08
Org. C-S-O/A-A	0.33	0.00	0.00
Org. S-W	0.42	0.00	0.00
LSD (0.05)	NS	NS	NS

Table 6. Insect populations in soybeans at Neely-Kinyon LTAR, July 13, 2005.

Treatment	Beneficial insect population/ 20 sweeps	Pest population/ 20 sweeps	Bean leaf beetle population/ 20 sweeps
Conv. C-S	2.33	5.67	3.33
Org. C-S-O/A	2.75	6.75	4.00
Org. C-S-O/A-A	4.25	5.75	3.25
Org. S-W	3.75	8.50	3.75
LSD (0.05)	NS	NS	NS

Table 7. Insect populations in soybeans at Neely-Kinyon LTAR, August 30, 2005.

Treatment	Beneficial insect population/ 20 sweeps	Pest population/ 20 sweeps	Bean leaf beetle population/ 20 sweeps
Conv. C-S	4.75	44.50	39.75ab
Org. C-S-O/A	4.75	51.75	43.00ab
Org. C-S-O/A-A	3.75	70.00	62.50b
Org. S-W	10.00	29.50	18.00a
LSD (0.05)	NS	NS	26.03

Table 8. Soybean and corn grain quality at Neely-Kinyon LTAR, 2005.

Treatment	Grain quality (%)							
	Carbohydrates		Oil		Protein		Moisture	
	Soybean	Corn	Soybean	Corn	Soybean	Corn	Soybean	Corn
Conv. C-S	21.63c	60.90a	18.38	3.35	37.45a	7.93b	13.35c	14.00a
Org. C-S-O/A	22.10ab	60.58b	18.58	3.45	36.70ab	8.33ab	12.43ab	14.50a
Org. C-S-O/A-A	22.33a	60.48b	18.58	3.38	36.45b	8.48a	12.48b	15.60b
Org. S-W	21.90bc	N/A	18.18	N/A	37.35a	N/A	12.23a	N/A
LSD (0.05)	0.35	0.26	NS	NS	0.76	0.43	0.21	0.58

Table 9. Wheat quality at Neely-Kinyon LTAR, 2005.

Treatment	Grain quality (%)		Kettle Test WT (lb/bu)
	Protein	Moisture	

Org. S-W

11.95

13.68

55.93
