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# Comparison of Organic and Conventional Crops at the Neely-Kinyon Long-term Agroecological Research (LTAR) Site, 2004

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**Abstract**
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 (CS-O/A-A), and Soybean-Wheat (S-W).

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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 2004 were as follows: Pioneer 34D71 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 30,200 seeds/acre in conventional plots on May 17, 2004. Schillinger 240F.Y soybeans were planted at a depth of 2 in. in organic and conventional plots at a rate of 190,000 seeds/acre on June 4, 2004. Wesley winter wheat was planted on October 13, 2003, at 100 lb/acre and red clover was frost-seeded into the wheat plots on March 12, 2004, at a rate of 14 lb/acre. All plots were harrowed on March 25. On March 25, 2004, Jay oats were underseeded with Pioneer 54H91 leafhopper-tolerant alfalfa at a depth of 0.5 in. at a rate of 3.0 bushels/acre and 16 lb/acre, respectively. Following harvest of the organic corn plots in 2003, winter rye was no-till drilled at a rate of 1 bushel/acre on October 15, 2003. 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 24. Conventional corn plots were fertilized on May 19 with 32% urea at 160 lb/acre N. Soil in corn plots was sampled on July 7, 2004, and analyzed for late-spring nitrate content by the USDA-ARS National Soil Tilth Laboratory, Ames, IA. Conventional corn plots received applications of 0.67 oz/acre of Accent® and 1 pt/acre of Buctril® on June 14, 2004. Conventional soybeans received applications of 1.44 oz/acre of Pursuit®, 7 oz/acre of Select®, and 2 lb/acre of AMS®. Conventional soybean plots were cultivated on June 4, 23, and July 20. Organic soybean plots were cultivated on June 4, 23, and July 12, and rotary-hoed on June 16, 28, and July 6. Conventional corn plots were cultivated on June 28, and organic corn plots were cultivated on June 8, 17, and 28. Corn stands were counted on June 15 and soybean stands on June 22. Weed counts were taken in corn plots on June 15 and July 23 and in soybean plots on June 22 and July 6 using square meter quadrants 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 September 7. Cornstalk nitrate samples were collected on October 4, and soybean cyst nematode sampling was completed on October 11. Samples (200 g) 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 mowed and baled on June 7 and July 12, 2004. Wheat plots were harvested on July 15, and oat plots were harvested July 27. Soybean plots were harvested on October 11, while corn plots were harvested on November 9. Cornstalk nitrate analysis was conducted at the USDA National Soil Tilth Laboratory, Ames, IA.

## Results and Discussion

There were no significant differences in corn stands among the three rotations on June 15, but there was a trend towards higher plant

populations in the conventional C-S rotation after two rotary hoeings in the organic corn plots (Table 1). Weed populations after tillage operations were lower in 2004 compared with other years, with equal numbers of grasses and fewer broadleaves in the organic C-S-O/A corn plots compared with the conventional plots (Table 1). On July 23, broadleaf weed populations were equal among treatments, but there was a trend toward fewer total weeds in the organic corn plots. However, grass weeds were greater in the organic C-S-O/A-A corn plots. Late-spring nitrate levels in the organic corn plots averaged 5.3 ppm $NO_3$-N compared with 4.72 ppm in the conventional plots with no differences among rotations (Table 1). Cornstalk nitrate levels at the end of the season were significantly greater in the C-S-O/A-A rotation compared with the other two rotations (Table 1).

Soybean plant stands were equivalent in conventional and organic plots on June 22, with a trend towards higher plant populations in the organic S-W and conventional C-S rotations (Table 2). Grass weeds were significantly greater in the organic S-W plots on June 22 and July 6 (Table 2). Broadleaf weeds were similar in conventional and organic plots on June 22, but on July 6, there were greater numbers of broadleaf weeds in the conventional C-S rotation (Table 2).

Organic corn yields averaged 194.3 bushels/acre and organic soybean yields averaged 42.6 bushels/acre (Table 3). The organic C-S-O/A-A corn plot yields at 202 bushels/acre were significantly greater than the organic C-S-O/A corn yields, but equal to the conventional C-S yields. The organic C-S-O/A and C-S-O/A-A soybean yields were significantly greater at 45.4 and 43.7 bushels/acre, respectively, than the conventional C-S yield of 39.3 bushels/acre. There were no significant yield differences between oat rotations, averaging 112.8 bushels/acre and 1.42 tons/acre of oat straw. Wheat yielded 56.7 bushels/acre and 1.10 tons/acre straw (Table 3).

Pest populations remained low in 2004, with no corn borers observed in any plots on July 6. Bean leaf beetles did not reach economic threshold levels in 2004, averaging 2.33 beetles/20 sweeps in the organic soybean plots and 0.75 in the conventional soybean plots on September 7 (Table 4), with significantly higher beetle populations in the organic S-W plots. There was an average of 1.25 beneficial insects/20 sweeps in the organic soybean plots and 0.75 in the conventional soybean plots, with a significantly higher population of beneficial insects in the organic C-S-O/A compared with the other soybean plots (Table 4). Soybean seed staining was also less in 2004, with only 2.11% 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. Soybean grain protein and oil content were equivalent among rotations, with high protein levels (39–40%); however, greater fiber and carbohydrates were found in the rotations with alfalfa (Table 5). Higher protein levels (8%) were found in the corn from the organic C-S-O/A-A rotation (Table 5).

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**Table 1. Corn stands and weed populations in corn plots at Neely-Kinyon LTAR, 2004.**

| Treatment | Corn stands (plants/acre) | Cornstalk nitrate (ppm $NO_3$-N) | Late-spring nitrate (ppm $NO_3$-N) | Corn weeds/$m^2$ June 15, 2004 | | Corn weeds/$m^2$ July 23, 2004 | |
|---|---|---|---|---|---|---|---|
| | | | | Grasses | Broadleaves | Grasses | Broadleaves |
| Conv. C-S | 27,000 | 336.50b | 4.72 | 0.67ab | 9.42b | 1.92a | 27.17 |
| Org. C-S-O/A | 25,000 | 952.00b | 3.97 | 0.00a | 2.58a | 1.25a | 19.58 |
| Org. C-S-O/A-A | 25,917 | 4107.50a | 6.57 | 1.50b | 2.83a | 4.75b | 13.50 |
| LSD (0.05) | NS | 1529.20 | NS | 1.12 | 3.48 | 2.57 | NS |

**Table 2. Soybean stands and weed populations in soybean plots at Neely-Kinyon LTAR, 2004.**

| Treatment | Soybean stands (plants/acre) | Soybean weeds/$m^2$ June 22, 2004 | | Soybean weeds/$m^2$ July 6, 2004 | |
|---|---|---|---|---|---|
| | | Grasses | Broadleaves | Grasses | Broadleaves |
| Conv. C-S | 139,583 | 0.17a | 7.42 | 0.17a | 5.17b |
| Org. C-S-O/A | 130,167 | 1.25a | 6.92 | 0.00a | 0.22a |
| Org. C-S-O/A-A | 132,000 | 0.42a | 5.00 | 0.00a | 0.75a |
| Org. S-W | 142,750 | 4.17b | 5.33 | 0.75b | 0.50a |
| LSD (0.05) | NS | 1.92 | NS | 0.48 | 2.15 |

**Table 3. Organic and conventional grain crop yields at Neely-Kinyon LTAR, 2004.**

| 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 | 200.41a | 39.36c | N/A | N/A | N/A | N/A |
| Org. C-S-O/A | 180.09b | 45.35a | 113.06 | 1.38 | N/A | N/A |
| Org. C-S-O/A-A | 202.34a | 43.72ab | 112.43 | 1.45 | N/A | N/A |
| Org. S-W | N/A | 42.04bc | N/A | N/A | 56.7 | 1.10 |
| LSD (0.05) | 9.50 | 3.19 | NS | NS | N/A | N/A |

**Table 4. Insect populations and stained soybeans at Neely-Kinyon LTAR, 2004.**

| Treatment | Corn borer damage | Beneficial insect (population/ 20 sweeps) | Bean leaf beetle (population/ 20 sweeps) | Stained soybean (%) | Soybean cyst nematode (eggs/100 cc) |
|---|---|---|---|---|---|
| Conv. C-S | 0.00 | 0.75cb | 0.75a | 1.65 | 0.00 |
| Org. C-S-O/A | 0.00 | 2.25a | 1.25a | 3.03 | 0.00 |
| Org. C-S-O/A-A | 0.00 | 1.25b | 1.25a | 2.60 | 0.00 |
| Org. S-W | N/A | 0.25c | 4.50b | 1.17 | 50.00 |
| LSD (0.05) | NS | 0.99 | 2.32 | NS | NS |

**Table 5. Soybean and corn grain quality at Neely-Kinyon LTAR, 2004.**

| Treatment | Grain quality (%) | | | | | |
|---|---|---|---|---|---|---|
| | Carbohydrates | | Oil | | Protein | |
| | Soybean | Corn | Soybean | Corn | Soybean | Corn |
| Conv. C-S | 21.39b | 60.76 | 16.03 | 3.51 | 40.07 | 7.43b |
| Org. C-S-O/A | 21.77a | 60.68 | 15.75 | 3.55 | 39.91 | 7.53b |
| Org. C-S-O/A-A | 21.79a | 60.45 | 15.92 | 3.54 | 39.71 | 7.98a |
| Org. S-W | 21.37b | N/A | 15.69 | N/A | 40.42 | N/A |
| LSD (0.05) | 0.36 | NS | NS | NS | NS | 0.18 |

Values with the same letter do not differ.