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Comparison of Organic and Conventional Crops at the Long-Term Agroecological Research Site

Kathleen Delate
Iowa State University, kdelate@iastate.edu

Andrea McKern
Iowa State University

Cynthia A. Cambardella
USDA National Soil Tilth Lab, cindy.cambardella@ars.usda.gov

Robert Burcham
Iowa State University

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Abstract
The Long-Term Agroecological Research (LTAR)site at the Neely-Kinyon Farm 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). Arapahoe winter wheat was planted October 25, 2006, at 85 lb/acre and Cardinal red clover wasfrost-seeded into the wheat plots on March 15, 2007, at a rate of 12 lb/acre. On April 16, 2007, Kame oats were underseeded with Bluebird alfalfa at a rate of 110 lb/acre and 18 lb/acre, respectively. Following harvest of the organic corn plots in 2006, winter rye was no-till drilled at a rate of 70 lb/acre on November 8, 2006.

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

Materials and Methods

The Long-Term Agroecological Research (LTAR) site at the Neely-Kinyon Farm 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). Arapahoe winter wheat was planted October 25, 2006, at 85 lb/acre and Cardinal red clover was frost-seeded into the wheat plots on March 15, 2007, at a rate of 12 lb/acre. On April 16, 2007, Kame oats were underseeded with Bluebird alfalfa at a rate of 110 lb/acre and 18 lb/acre, respectively. Following harvest of the organic corn plots in 2006, winter rye was no-till drilled at a rate of 70 lb/acre on November 8, 2006.

Hoop-barn swine compost was applied to organic corn plots at a rate of 12 tons/acre and 4 tons/acre to oat plots on April 4. Manure was applied to organic soybean-wheat plots at 12 tons/acre on May 21, before the soybeans were replanted, to supply 300 lb/acre of phosphorus, while the conventional corn-soybean plots received 200 lb/acre of 11-52-0 on May 21, providing 104 lb/acre of phosphorus. To incorporate the fertility inputs, the conventional soybean plots and the soybeans in the organic soybean-wheat rotation were disked on May 21. Corn and soybean variety selection and planting methods in 2007 were as follows: Blue River 61R34 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, 2007. Blue River 34A7 soybeans were planted at a depth of 2 in. in organic and conventional plots at a rate of 200,000 seeds/acre on May 22, 2007. Due to insufficient stands, soybeans in the organic soybean-wheat rotation were replanted to Blue River 34A7 soybeans on June 6, 2007, at the same initial rate. All soybean plots were cultivated June 5.

Conventional corn plots were fertilized May 17, 2007, with 32% nitrogen at 145 lb N/acre along with 2.25 oz/acre of Balance Pro™ herbicide. Conventional corn was also sprayed June 25 with 0.66 oz/acre of Accent, 1 pt/acre of Buctril, 4 oz/acre of NIS, and 1.5 lb/acre of AMS. Conventional soybeans received an application of 1.44 oz/acre of Pursuit on June 21. Due to the high number of aphids present in late July and early August, Nufos (Lorisban) at 2 pt/acre was applied to the conventional soybean plots, while Neemix 4.5 was applied to the organic soybean plots at 1 pt/acre August 2–10.

Soil in corn plots was sampled June 14, 2007, and analyzed for late-spring nitrate content by the Iowa State University Soil and Plant Analysis Laboratory, Ames, Iowa. Fall samples were taken October 26 for soil quality analysis.

All organic soybean plots were rotary hoed on June 1 and 19; soybeans in the organic corn-soybean-oats/alfalfa and organic corn-soybean-oats/alfalfa-alfalfa were also rotary hoed June 8, while the organic soybean-wheat rotation was rotary hoed June 14. Soybeans in the corn-soybean-oats/alfalfa and organic corn-soybean-oats/alfalfa-alfalfa were cultivated June 12,

while the organic soybean-wheat rotation was cultivated June 20. All organic soybean plots were cultivated on June 26 and July 26. The organic soybean-wheat rotation was buffalo cultivated July 11. Organic soybean and corn plots were "walked" on June 28 and July 12. Organic corn plots were rotary hoed on May 31. Organic corn plots were cultivated June 5 and June 21. Corn stands were counted June 5 and soybeans on June 11 in the conventional rotation and the organic corn-soybean-oats/alfalfa and organic corn-soybean-oats/alfalfa-alfalfa rotations, and June 21 in the organic soybean-wheat rotation.

Weed counts were enumerated in corn plots on June 5 and 20, and in soybean plots June 11 in the conventional rotation and the organic corn-soybean-oats/alfalfa and organic corn-soybean-oats/alfalfa-alfalfa rotations, and June 21 in the organic soybean-wheat rotation, and in all soybean plots June 27, 2007, using square meter quadrats at three randomly selected areas within a plot. Corn borer populations were monitored on July 5. Soybean plots were sampled for bean leaf beetles June 11, July 13, and August 6. Corn stalk nitrate samples were collected September 21, and soybean cyst nematode sampling was completed September 26. 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 6, July 9, August 14, and September 17. Wheat plots were harvested and baled July 16, and oat plots were harvested July 17 and baled July 25. Soybean plots were harvested October 26. Corn plots were harvested October 29. Corn stalk nitrate analysis was conducted at the Iowa State University Soil and Plant Analysis Laboratory, Ames, IA.

Results and Discussion

In the corn plots, there were no differences between conventional C-S and organic stands in 2007 (Table 1). Weed populations were low in all corn plots throughout the season, and no differences were observed between rotations for grasses and broadleaves on the first and second sampling dates (Table 2). Late-spring nitrate levels in the C-S-O/A-A and C-S-O/A averaged 15.4 ppm NO_3-N, which is less than the recommended 25 ppm, compared with greater levels at 53.6 ppm in the conventional plots (Table 1). Corn stalk nitrate levels at the end of the season were greater in the conventional C-S rotation compared to the organic rotations, although the organic rotations had sufficient N (over 2,000 ppm) (Table 1). Thus, some luxury N was present in corn from all rotations by the end of the season, despite early low late spring nitrate levels in the organic corn plots.

Soybean plant stands were greater in the conventional C-S and organic S-W rotations in 2007, but the S-W rotation had been replanted (Table 1). Grass weeds were similar among rotations on June 11, but on June 27, grasses were higher in the conventional C-S and organic S-W plots (Table 2). Broadleaf weed counts were similar in conventional and organic plots on the first sampling date, but numbers were greater in the organic S-W plots on June 27 (Table 2).

While the 2007 season was extremely dry mid-season, with low rainfall in June and early July, a 10-year high yield was obtained in the organic C-S-O/A-A rotation, where yields averaged 209 bushels/acre (Table 1). Conventional C-S corn yields averaged 188 bushels/acre and soybean yields averaged 61 bushels/acre (Table 1). The organic C-S-O/A-A corn yield at 191 bushels/acre was equivalent to the conventional C-S corn yield. The organic C-S-O/A soybean yield at 65 bushels/acre and the conventional soybean yield of 61 bushels/acre were greater than the other rotations, but the other organic soybean yields were also excellent, averaging 56 bushels/acre. There were no yield differences between oat rotations, averaging 106

bushels/acre of grain and 0.96 tons/acre of oat straw. Wheat yielded 47 bushels/acre and 0.84 tons/acre straw. Alfalfa yielded 3.32 tons/acre (Table 1).

Pest populations were similar to 2005 levels, with less than 1% of corn ears exhibiting corn borer damage on July 5. Bean leaf beetle numbers were also lower than in 2006, with populations reaching 8 beetles/20 sweeps at the peak period (Table 3). The organic S-W plots had the greatest number of beetles at the peak period. Beneficial insects were generally higher in the organic rotations although results were not different (Table 3). Soybean cyst nematodes were low, with no differences among treatments (Table 3).

Soybean protein levels, averaging 34%; carbohydrate levels, averaging 25%; and oil levels, averaging 19%, were equivalent among all rotations in 2007 (Table 4). Corn starch levels were greater in the organic C-S-O/A-A and C-S-O/A rotations, while protein levels were greatest in the conventional C-S and organic C-S-O/A-A rotations, averaging 8.4%. No difference was observed in corn grain oil content. Wheat protein averaged 14% in 2007—2% greater than 2006 levels.

The 2007 season represented the tenth cropping season of the LTAR. The strong competitiveness of the organic crops in the LTAR (with yields equal or greater than conventional counterparts) could not have occurred without the excellent management skills of Bob Burcham, the N-K Farm staff, and the Organic Ag program staff.

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