Comparison of Organic and Conventional Crops at the Neely-Kinyon Long-term Agroecological Research (LTAR) Site-2000

Kathleen Delate, assistant professor, Depts. of Horticulture & Agronomy
Cynthia Cambardella, soil scientist, USDA National Soil Tilth Lab
Bob Burcham, farm supervisor, Neely-Kinyon Research and Demonstration Farm
Heather Friedrich, graduate student, Dept. of Horticulture

Introduction

Sales of organic products are expected to reach $8 billion in the U.S. in the year 2001, showing a continued 20% annual growth rate. In Iowa alone, organic acreage for all crops has increased from 13,000 in 1995 to 150,000 in 1999. 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 third year of the N-K LTAR, organic certification was obtained through the State of Iowa Organic program. We continued our examination of the agronomic and economic performance of conventional and organic systems, using required practices for certified organic production.

Materials and Methods

Planting scheme. Treatments, replicated four times, in the LTAR planting include conventional Corn-Soybean (C-SB), organic Corn-Soybean-Oats/Alfalfa (C-SB-O/A), organic Corn-Soybean-Oats/Alfalfa-Alfalfa (C-SB-O/A-A) and soybean-rye (SB-R) where the rye was plowed in the spring prior to planting soybeans. All crops in all rotations are grown each year. A hay crop (alfalfa, fescue and oats), seeded in 1998 in the 30-ft border strips around each plot and around the perimeter of the experiment, was periodically mowed and maintained as the required buffer between conventional and organic production, per certification standards.

Fertilization and weed control scheme. The fertilization goal in this study was to apply equal rates of nutrients in each treatment. Compost was applied to organic corn plots at a rate of 12 tons/acre on April 4, 2000. Oat plots were fertilized with compost at 4 tons/acre, on March 29, 2000. Conventional corn plots were fertilized April 24 with 28% urea at 125 lbs/acre N. Weed control followed local conventional or organic practices as closely as possible.

Pest management, soil health, and sampling. Weed counts, corn borer populations, soybean cyst nematode infestations, and stalk nitrate levels, were all performed on a timely basis. Soil samples were taken both before spring tillage and after fall harvest to measure nutrients and soil health. Oats were harvested on July14. Corn and soybeans were combined October 9, 2000.

Results and Discussion

Plant performance. There were no significant differences between organic and conventional yields in corn or soybeans. Organic corn averaged 144 bu/acre and conventional corn averaged 141 bu/acre. Organic soybeans averaged 37 bu/acre and conventional soybeans averaged 40 bu/acre. Oats yielded 62 bu/acre. Organic alfalfa hay yielded an average of 3.52 tons/acre over four harvest dates, with the greatest harvest on May 22.

Weed populations were significantly greater in organic corn and soybean plots compared with conventional plots. Early grass and broadleaf weed populations were greater in the organic corn and soybean plots. Additional rye in the soybean system led to significantly less weed pressure in that rotation. Conventional corn plots had statistically higher plant populations than organic plots. On June 30, an average of 28,000 plants/acre were counted in conventional plots, compared with 24,500 plants/acre in the organic plots. Stand counts were not significantly different in organic and conventional soybean plots. The mean soybean stand was 113,500 plants/acre on June 30.

Grain analysis. Organic soybeans had significantly higher levels of protein in 2000, and significantly lower levels of oil and carbohydrates compared with conventional soybeans. No significant differences were detected between conventional and organic corn samples for carbohydrates, protein, oil, and starch content.

Soil Health. Soil quality improved over time in the oat and alfalfa plots sampled from 1998 to 2000. Increases in total carbon, particulate organic matter carbon, aggregate stability and potentially mineralizable nitrogen increased from 1998 to 2000. There were greater increases in soil quality in the organic system compared with the conventional system in 1998 and 1999.

Over time, we expect to see greater differences in the systems, in terms of insect, weed and nematode populations, as rotational effects occur. It is also anticipated that soil quality will continue to improve over time in the organic systems in conventional systems. Because stable yields are correlated with enhanced soil fertility and lower pest loads, the sequence of crops is critical in increasing or immobilizing soil nutrients, and disrupting or attracting pests. We will continue to examine these factors in our long-term horticultural and agronomic organic farming systems research. where longer crop rotations, and additions of organic matter from compost and cover crops, occur.

Conclusions

Long-term research on organic cropping systems is still in its infancy. Crop rotations influence crop production by improving soil physical properties, decreasing erosion, increasing organic matter quantity and quality, and increasing the activities of beneficial soil microbes and invertebrates. The hypothesis directing our long-term research is that longer crop rotations in organic systems provide better plant protection, enhanced soil health, more stable yields, and more economic benefits, than shorter rotations