2005

# Evaluation of Corn, Soybean, and Barley Varieties for Certified Organic Production, Crawfordsville—2004

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**Abstract**
Beginning in 1998, a long-term organic crop rotation experiment was initiated at the Southeast Research Farm (SERF) to examine the effects of organic practices on crop yields, soil quality, and grain quality. Because a soilbuilding crop rotation is required for certified organic crop production, organic fields at the SERF follow a rotation of corn-soybean-barley/red clover. In addition to the use of certified organic practices at this site, we have used organic seed in this experiment, as the National Organic Program (NOP) requires that organic farmers source organic seed. Results reported here represent the seventh year of production, which includes two cycles of the three-year crop rotation.

**Keywords**
Horticulture, Agronomy

**Disciplines**
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Horticulture

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## Introduction

Beginning in 1998, a long-term organic crop rotation experiment was initiated at the Southeast Research Farm (SERF) to examine the effects of organic practices on crop yields, soil quality, and grain quality. Because a soil-building crop rotation is required for certified organic crop production, organic fields at the SERF follow a rotation of corn-soybean-barley/red clover. In addition to the use of certified organic practices at this site, we have used organic seed in this experiment, as the National Organic Program (NOP) requires that organic farmers source organic seed. Results reported here represent the seventh year of production, which includes two cycles of the three-year crop rotation.

## Materials and Methods

Treatments in 2004 at the Southeast Research Farm consisted of three varieties of corn and soybeans and four varieties of barley. Plots were laid out in a completely randomized block design with four replications of each variety. Corn varieties included NC$^+$3448, NC$^+$58T36, and NC$^+$4771. Corn plots were planted on May 3, 2004, at a population of 32,000 plants/acre. Corn was planted at a depth of 2 in. in 30-in. rows in plots measuring 10 × 185 ft. Fertilization for the corn plots was provided through liquid hog manure that was broadcast and incorporated at a rate of 3,400 gal/acre on April 7, 2004. This application period corresponded with the certified organic requirement that raw manure be applied at least three months prior to harvest of agronomic crops. No insecticides, fungicides, or herbicides were applied in keeping with organic standards. Weeds in corn plots were managed through two rotary hoeings on May 10 and 15 (7 and 12 DAP–days after planting) and two-row cultivations on May 28 and June 8. Corn plots were harvested on October 21, 2004.

Soybean plots were planted to a cover crop of rye (1 bu/acre) the previous fall on October 22, following the harvest of 2003 corn plots. The rye was killed by chisel plowing and disking on April 30, 2004. Three organic soybean varieties were planted on May 27. These varieties included NC$^+$2FN93, NC$^+$2A83, and NC$^+$3F24. Soybeans were planted at a depth of 1 in. in 30-in. rows in plots measuring 20 × 185 ft. Planting density was 206,000 seeds/acre. Soybean weeds were managed through two rotary hoe operations on June 7 and 15 (11 and 19 DAP), and two-row cultivations on June 22 and July 14. Soybean plots were walked for weeds above the canopy on July 20 and were harvested on October 5, 2004.

Barley was planted at 2 bushels/acre on April 5 in plots measuring 20 × 40 ft. Barley varieties included Lacey, Conlon, AC Metcalfe, and Drummond. After barley was harvested on July 15, Red Mammoth red clover was planted as a cover crop in that field.

A core set of measurements was taken on three subsamples per plot for corn and soybean plots. Corn stands were counted on June 16 (44 DAP), and grass and broadleaf weeds were counted on June 16. A cornstalk sampling for stalk nitrate analysis was taken on October 5. Soybean stands were counted on June 16 (20 DAP), and weeds were counted on June 16 and July 7. Insect damage was quantified by observing corn borer damage in corn (July 2), and bean leaf beetles in soybeans (August 11 and September

16). Bean leaf beetles were sampled by sweeping 20 times across each plot with a 15-in.-diameter sweep net. Insects were placed in recloseable bags and transported in coolers to Iowa State University. Insects were frozen until counted in the laboratory. Soybean cyst nematode sampling was completed on October 5. Samples were collected from each corn and soybean plot for grain quality analysis conducted at the ISU Grain Quality Laboratory at Iowa State University. The percentage of stained soybeans was determined by counting the number of stained soybeans in a 200-gram sample that was randomly collected from the harvest of each plot.

## Results and Discussion

There were no significant differences among corn varieties in stand counts, weed counts, percent borer damage, and stalk nitrate levels in 2004 (Table 1). Soybean plant populations after two rotary hoeings were significantly larger in the 2FN93 and 2A83 plots (Table 2). There were no significant differences among varieties in soybean broadleaf and grass weeds on both sampling dates. Although there were no significant differences in soybean insect populations and staining, there was a trend toward larger bean leaf beetle populations on September 19 in the 3F24 plots as well as a higher percentage of staining (14% compared with an average of 10% in the other soybean plots) (Table 3). Organic corn yields ranged from 156 bushels/acre in the NC+4771 plots to 169 bushels/acre in the NC+3448 plots, but there were no significant differences among varieties (Table 4). Soybean yields were significantly higher in the 2FN93 plots (53 bu/acre) compared with the other soybean plots (averaging 48 bu/acre). Barley yields were significantly lower in the Conlon plots at 31 bushels/acre compared with an average of 46 bushels/acre in the other barley plots. There were no significant differences in corn protein levels, averaging 6.4% (Table 5). Significantly higher protein levels were found in the 2A83 soybeans (40.5%), with the lowest protein levels in the 3F24 soybeans (34.0%) (Table 6).

## Acknowledgments

We would like to thank the Leopold Center for Sustainable Agriculture for their support of this research. Thanks also go to Matt Rohrig, David Rosmann, Miriam Perozo Mur, Kristin Brown, Greg Shepherd, Vanessa Salvador-Ferrer, Jenny Petersen, and Mark Rosmann for their help on production, data collection, and analytical aspects of this project. We also thank Charles Hurburgh and the ISU Grain Quality Lab for grain analysis, and NC$^{+}$Organics, Lincoln, Nebraska, for providing seeds for this study.

**Table 1. Corn plant stands, weed and insect populations, and corn stalk nitrate, SERF, 2004.**

| Treatment | Corn stands (plants/acre) | Corn weeds/$m^2$ Grasses | Corn weeds/$m^2$ Broadleaves | Corn borer damage (%) | Corn stalk nitrate (ppm $NO_3$-N) |
|---|---|---|---|---|---|
| NC+3448 | 24,417 | 39.67 | 13.25 | 0.00 | 413.00 |
| NC+58T36 | 23,500 | 32.50 | 8.42 | 0.00 | 118.50 |
| NC+4771 | 24,000 | 30.17 | 9.67 | 0.00 | 74.00 |
| $LSD_{(0.05)}$ | NS | NS | NS | NS | NS |

**Table 2. Soybean stands and weed populations, SERF, 2004.**

| Treatment | Soybean stands (plants/acre) | Soybean weeds/$m^2$ June 16, 2004 Grasses | Soybean weeds/$m^2$ June 16, 2004 Broadleaves | Soybean weeds/$m^2$ July 2, 2004 Grasses | Soybean weeds/$m^2$ July 2, 2004 Broadleaves |
|---|---|---|---|---|---|
| 2FN93 | 161,080a | 1.17 | 3.25 | 0.25 | 0.25 |
| 2A83 | 155,250a | 0.42 | 0.42 | 1.17 | 0.17 |
| 3F24 | 126,083b | 0.17 | 1.33 | 3.42 | 0.17 |
| $LSD_{(0.05)}$ | 11,153 | NS | NS | NS | NS |

**Table 3. Insects in soybeans, SERF, 2004.**

| | August 11, 2004 | | | September 19, 2004 | | | |
|---|---|---|---|---|---|---|---|
| Treatment | Bean leaf beetles | Aphids | Beneficials | Bean leaf beetles | Aphids | Beneficials | Stained soybeans (%) |
| 2FN93 | 1.0 | 0.0 | 1.0 | 12.0 | 0.75 | 2.25 | 8.97 |
| 2A83 | 0.0 | 0.3 | 2.3 | 12.0 | 1.25 | 1.50 | 11.72 |
| 3F24 | 0.5 | 0.0 | 1.5 | 19.0 | 1.00 | 1.00 | 14.01 |
| $LSD_{(0.05)}$ | NS | NS | NS | NS | NS | NS | NS |

**Table 4. Corn, soybean and barley yields, SERF, 2004.**

| Corn yield | | Soybean yield | | Barley yield | |
|---|---|---|---|---|---|
| Treatment | Bu/ac | Treatment | Bu/ac | Treatment | Bu/ac |
| NC+3448 | 169.13 | 2FN93 | 53.44a | Lacey | 49.19a |
| NC+58T36 | 158.87 | 2A83 | 48.28b | Conlon | 31.17b |
| NC+4771 | 156.37 | 3F24 | 47.80b | AC Metcalfe | 41.20a |
| | | | | Drummond | 48.28a |
| $LSD_{(0.05)}$ | NS | $LSD_{(0.05)}$ | 2.71 | $LSD_{(0.05)}$ | 8.18 |

**Table 5. Corn grain quality, SERF, 2004.**

| Treatment | Moisture (%) | Protein (%) | Oil (%) | Starch (%) | Density (%) |
|---|---|---|---|---|---|
| NC+3448 | 16.96b | 6.35 | 3.70 | 61.99 | 1.27a |
| NC+58T36 | 16.89b | 6.31 | 3.61 | 62.00 | 1.24b |
| NC+4771 | 18.04a | 6.59 | 3.74 | 61.74 | 1.28a |
| $LSD_{(0.05)}$ | 0.53 | NS | NS | NS | 0.01 |

**Table 6. Soybean grain quality, SERF, 2004.**

| Treatment | Moisture (%) | Protein (%) | Oil (%) | Fiber (%) | Carbohydrate (%) |
|---|---|---|---|---|---|
| 2FN93 | 11.53a | 37.70b | 17.66a | 4.80a | 21.84a |
| 2A83 | 11.01a | 40.51a | 16.54b | 4.71a | 20.24a |
| 3F24 | 19.20b | 33.96c | 16.58b | 4.41b | 27.05b |
| $LSD_{(0.05)}$ | 3.15 | 1.34 | 0.61 | 0.21 | 2.09 |