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Evaluation of Corn, Soybean and Barley Varieties for Certified Organic Production, Crawfordsville–2003

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Abstract
Beginning in 1998, a long-term 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. Results reported here represent the sixth year of production, which includes two cycles of the 3- year crop rotation.

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Introduction

Beginning in 1998, a long-term 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. Results reported here represent the sixth year of production, which includes two cycles of the 3-year crop rotation.

Materials and Methods

Treatments in 2003 at the Southeast Research farm consisted of three varieties of corn and soybeans and four varieties of barley. Plots measuring 5 × 185 ft were laid out in a completely randomized block design with four replications of each variety. Corn varieties included NC$^+$112E, NC$^+$3448, and NC$^+$4771. Corn plots were planted on May 19, 2003, at a population of 32,000 plants/acre. Corn was planted at a depth of 2 inches in 30-in. rows. Fertilization for the corn plots was provided through liquid hog manure that was broadcast and incorporated at a rate of 3,000 gal/acre on April 2, 2003. 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 24 and 29 (5 and 10 DAP–days after planting) and a row cultivation on June 12. Corn plots were harvested on October 7.

Soybean plots were planted to a cover crop of rye (1 bu/acre) the previous fall on October 26, following the harvest of 2002 corn plots. The rye was killed by chisel plowing and disking on May 18, 2003. Three organic soybean varieties were planted on June 12. These varieties included Vinton 81, IA3001, and NC$^+$3F43. Soybeans were planted to a depth of 1 in. in 30-in. rows in plots measuring 12.5 × 180 ft. Planting density was 206,000 seeds/acre. Soybean weeds were managed through two rotary-hoe operations on June 16 and 20 (4 and 8 DAP), and two row cultivations on June 28 and July 13. Soybean plots were walked for weeds above the canopy on July 30 and August 9. Soybean plots were harvested on October 7.

Barley was planted at 2 bushels/acre on March 27. Barley varieties included ‘Lacey,’ ‘Robust,’ ‘Excel,’ and ‘Foster.’ After barley was harvested on July 16, ‘AC Greenfix’ chickling vetch (*Lathyrus sativus*) was planted as a cover crop instead of the red clover.

A core set of measurements was taken on three sub-samples/plot for corn and soybean plots. Corn stands were counted on June 10 (22 DAP), and grass and broadleaf weeds were counted on June 10 and July 8. Corn stalk sampling for stalk nitrate analysis occurred on September 19. Soybean stands were counted on June 27 (13 DAP), and weeds were counted on June 27. Insect damage was quantified by observing corn borer damage in corn (July 8) and bean leaf beetles in soybeans (July 8 and 30; September 11). Bean leaf beetles were sampled by sweeping 20 times across each plot with a 15 in.-diameter sweep net. Insects were placed in Zip-lock bags and transported in coolers to Iowa

State University. Insects were frozen until enumeration in the laboratory. Soybean cyst nematode sampling was completed on September 24. 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 significant differences among corn varieties in stand counts at 22 days after planting (Table 1). NC$^+$4771 had a significantly lower plant population (22,167 plants/acre) than the other varieties, after three tillage operations (Table 1). Grass and broadleaf weed populations in the corn varieties on June 10 were not significantly different but, on July 8, broadleaf weeds were significantly less in the NC$^+$112E plots (Table1). The soybean plant population on June 10 (14 DAP) was significantly higher in NC$^+$3F43 and was lowest in IA3011 (Table 2). Grass weed pressure was greater than broadleaf weed populations, with a significantly lower number of broadleaf weeds in IA3011 plots (Table 2). Organic corn yields ranged from 116 bushels/acre for NC$^+$112E to 142 for NC$^+$3448 and NC$^+$4771 (Table 3). Soybean yields were lowest in Vinton 81 (28.5 bu/acre) and highest in NC$^+$3F43 (41.4 bu/acre). The NC$^+$3F43 soybean yield was one of the highest organic tofu soybean yields recorded in the dry summer of 2003. Barley yields were not significantly different among varieties, averaging 72.5 bushels/acre (Table 3). Bean leaf beetle populations were less than 2002 populations, with no significant differences among treatments on any sampling date (Table 4). Seed staining was also reduced in 2003, although there was a greater number of stained soybeans in NC$^+$3F43 (Table 4). Corn borer damage was numerically greater in the NC$^+$112E plants, but because of the high variability among plants, statistical differences among varieties were not observed (Table 4). No soybean cyst nematodes were recovered from any plot. Corn protein was significantly greater in the NC$^+$4771 variety, averaging 8.6% (Table 5). Soybean protein levels were highest in IA3011 (39%) compared with Vinton 81 (38%) and NC$^+$3F43 (36%) (Table 6).

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Table 1. Corn plant stands and weed populations, SERF, 2003.

Treatment	Corn stands plants/acre	Corn weeds/m² June 10, 2003		Corn weeds/m² July 8, 2003	
		Grasses	Broadleaves	Grasses	Broadleaves
NC+112E	26,250a	0.17	7.5	0.42	3.9b
NC+3448	27,833a	0.08	7.3	0.42	7.3a
NC+4771	22,167b	0.4	8.0	1.2	6.8a
LSD (0.05)	2,486	NS	NS	NS	2.8

Table 2. Soybean stands and weed populations, SERF, 2003.

Treatment	Soybean stands plants/acre	Soybean weeds/ m² June 27, 2003	
		Grasses	Broadleaves
Vinton 81	119,000b	84.5	1.7ab
IA3011	99,000a	92.0	0.5a
NC+3F43	131,667c	65.9	2.4b
LSD (0.05)	12,092	NS	1.34

Table 3. Corn, soybean and barley yields, and corn stalk nitrate levels, SERF, 2003.

Corn yield			Soybean yield		Barley yield	
Treatment	Yield bu/ac	Corn stalk nitrate (ppm NO_3-N)	Treatment	Yield bu/ac	Treatment	Yield bu/ac
NC+112E	115.76b	6,887.50	Vinton 81	28.52c	Lacey	72.7
NC+3448	142.26a	8,332.00	IA3011	32.16b	Robust	70.3
NC+4771	142.18a	5,925.00	NC+3F43	41.41a	Excel	69.7
					Foster	77.4
LSD (0.05)	24.38	NS	LSD (0.05)	2.14	LSD (0.05)	NS

Table 4. Insect and nematode populations, SERF, 2003.

	Insects in soybeans					Insects in corn	
Treatment	Cyst nematodes (eggs/100cc)	Beetles/20 sweeps 8-Jul-03	Beetles/20 sweeps 30-Jul-03	Beetles/20 sweeps 11-Sept-03	Stained soybeans (%)	Treatment	Corn borer damage (%)
Vinton 81	0	0.08	5.50	6.75	1.29b	NC+112E	0.10
IA3011	0	0.00	5.00	4.00	2.04b	NC+3448	0.20
NC+3F43	0	0.00	5.75	4.25	10.48a	NC+4771	0.15
LSD (0.05)	NS	NS	NS	NS	4.74	LSD (0.05)	NS

Table 5. Corn grain quality, SERF, 2003.

Treatment	Moisture (%)	Protein (%)	Oil (%)	Starch (%)	Density (%)
NC+112E	18.16b	8.10b	3.30c	61.05a	1.27
NC+3448	19.48ab	7.89b	3.55b	60.95a	1.26
NC+4771	22.06a	8.64a	3.86a	59.85b	1.27
LSD (0.05)	3.59	0.42	0.22	0.34	NS

Table 6. Soybean grain quality, SERF, 2003.

Treatment	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrate (%)
Vinton 81	9.23	37.90b	18.28b	4.60b	21.23b
IA3011	9.41	38.95a	17.99b	4.50c	20.56c
NC+3F43	18.18	35.69c	18.73a	4.84a	22.75a
LSD (0.05)	NS	0.61	0.39	0.04	0.56