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Evaluation of Corn, Soybean and Barley Varieties for Certified Organic Production—Crawfordsville Trial, 2002

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Abstract
Beginning in 1998, a long-term crop rotation experiment was initiated to examine the effects of organic practices on crop yield, soil quality, and grain quality. A minimum three-year crop rotation is required for certified organic crop production (National Organic Program, 2002). Organic fields at the Southeast Research Farm follow a rotation of corn-soybean-barley/red clover. Results reported here represent the fifth year of production—the second year of the row crop (corn or soybean) following a full 3-year rotation.

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Introduction

Beginning in 1998, a long-term crop rotation experiment was initiated to examine the effects of organic practices on crop yield, soil quality, and grain quality. A minimum three-year crop rotation is required for certified organic crop production (National Organic Program, 2002). Organic fields at the Southeast Research Farm follow a rotation of corn-soybean-barley/red clover. Results reported here represent the fifth year of production—the second year of the row crop (corn or soybean) following a full 3-year rotation.

Materials and Methods

Treatments in 2002 at the Southeast Research Farm consisted of three varieties of corn and soybeans, and four varieties of barley with four replications of each variety. Corn varieties included NC+112E, NC+3448, and NC+4771. Corn plots were planted on May 6, 2002, at a population of 32,000 plants/acre. Corn was planted in 30-in rows to a depth of 2 inches in plots measuring 5 × 185 ft.

Soybean plots were planted to a cover crop of rye (1 bushel/acre) the previous fall on October 26, following the harvest of 2001 corn plots. The rye was killed by chisel plowing then disking, on May 5, 2002. Three clear-hilum soybean varieties were planted on May 22. These varieties included Schillinger 240F.Y, Schillinger 290F.HP, and Pioneer 9305. Soybeans were planted in 30 in. rows to a depth of 1 in. in plots measuring 12.5 × 180 ft. Planting density was 188,500 seeds/acre.

Barley and red clover plots were interseeded on March 20, 2002. Barley was planted at 2 bushels/acre and red clover at 12 lb/acre. Barley varieties included ‘Drummond,’ ‘Excel,’ ‘Lacey,’ and ‘Foster’ with ‘Star Fire’ red clover as an underseeding.

Fertilization for the corn plots was provided through liquid hog manure that was broadcast at a rate of 3,000 gal/acre on March 27, 2002. This application period corresponded with the requirement that raw manure be applied at least three months prior to harvest for agronomic crops. No insecticides, fungicides or herbicides were applied in keeping with organic standards. Weeds in corn plots were managed through three rotary-hoeings on May 10, 15, and 22 (4, 9, and 16 days after planting (DAP), respectively). Corn plots were also cultivated on May 29, June 7, and 17. Soybean weeds were managed through two rotary-hoe operations on May 30 and June 7 (8 and 16 DAP, respectively), and two row cultivations on June 17 and July 1.

A core set of measurements was taken on three sub-samples per plot for corn and soybean plots. Corn stands were counted on June 4 (28 DAP) and grass and broadleaf weeds were counted on June 4 and July 12 (66 DAP). Soybean stands were counted on June 18 (27 DAP), and weeds were counted on June 18 and July 12 (51 DAP). Insect damage was quantified by observing corn borer damage in corn (July 12) and counting bean leaf beetles in soybeans (July 12, September 9). Stalk nitrate content and soybean cyst nematode samples were both taken on September 23. Soybean plots were harvested on October 11, whereas corn was harvested on October 15, 2002, with a combine equipped with a scale to measure quantify yields. All measurements were subjected to analysis of variance and Fisher's PLSD test.

Results and Discussion

There were significant differences among varieties in stand counts at 28 days after planting (Table 1). NC+112E had the highest stand (25,416 plants/acre) after four tillage operations. Grass and broadleaf weed populations on June 4 and July 12 were not significantly different among the varieties. There was little damage due to corn borers by July 12, and no larvae were found. Corn yields were not significantly different among varieties, averaging 140.6 bushels/acre (Table 1).

Stalk nitrate content was not significantly different among varieties, although all samples from NC+4771 were below the detectable limit (Table 2). There were significant differences in

moisture, starch and density in corn grain quality, but not in protein levels, which averaged 7.7%. NC+112E had significantly higher moisture and density and a lower starch content (59.5%) compared with other varieties (Table 2).

Soybean plant population on July 18 (27 DAP) was greatest in Schillinger 290F.HP (Table 3). Weed populations within soybean plots were not significantly different among the varieties on June 18 and July 12. All soybean varieties yielded well, despite the lack of rain throughout the season. Pioneer 9305 yielded significantly more (42 bushels/acre) than Schillinger 240F.Y (37 bushels/acre) and 290F.HP (38 bushels/acre) (Table 3).

Bean leaf beetle populations were not significantly different on July 12, averaging 17 beetles per 20 sweeps (Table 4). On September 9, the average population of the second generation was 37 beetles per 20 sweeps. Soybean staining, which is associated with bean leaf beetles, was significantly less in Schillinger 290F.HP (5.7% stained) than other varieties (averaging 13% stained). The normal cut-off in the soyfood industry is 10% stained soybeans. Soybean cyst nematode eggs remained below the economic threshold, and there were no significant differences among the treatments.

Significant differences in soybean grain quality were found in the percentages for moisture, protein, oil, and carbohydrates (Table 5). Schillinger 290GF.HP had the highest level of protein (44.2%) and the lowest levels of oil and carbohydrates. Pioneer 9305 had the highest percentage of oil (18.8%), and Schillinger 240F.Y had the highest moisture (12.3%), although this moisture level did not impact storage.

Barley yields among the varieties were not significantly different. Yields ranged from 63.7–70.8 bushels/acre (Table 6). Despite the lack of rain and the abundance of grass weed populations in 2002, organic crop yields were greater than 2001, with continued excellent grain quality.

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Table 1. Corn yield, plant stands, weed population and corn borer damage, 2002.

Treatment	Yield		June 6		July 12		Corn borers
	(bu/ac)	Plants/ac	Grasses/m^2	Broadleaves/m^2	Grasses/m^2	Broadleaves/m^2	(%)
NC+112E	133.2	25416 b	15.08	0.67	25.80	1.79	0.0
NC+3448	141.6	21833 a	14.33	0.64	25.33	3.33	3.0
NC+4771	146.9	19333 a	16.25	1.17	21.87	1.33	1.5
LSD (0.05)	NS	3178	NS	NS	NS	NS	NS

Table 2. Corn stalk nitrate and grain quality, 2002.

Treatment	Stalk nitrate (ppm NO_3-N)	Moisture (%)	Protein (%)	Oil (%)	Starch (%)	Density (%)
NC+112E	901	19.00 b	8.00	3.75	59.46 a	1.28 b
NC+3448	707	16.50 a	7.75	3.75	60.3 ab	1.26 a
NC+4771	BDL[z]	16.75 a	7.25	4.00	60.67 b	1.26 a
LSD (0.05)	NS	1.03	NS	NS	0.86	0.01

[z]Below detectable limit

Table 3. Soybean yield, plant stands, and weeds, 2002.

	Yield		June 18		July	
Treatment	(bu/ac)	Plants/ac	Grasses/m^2	Broadleaves/m^2	Grasses/m^2	Broadleaves/m^2
Schill. 240F.Y	37.09 a	95167 a	2.00	0.00	1.33	0.58
Schil. 290F.HP	38.21 a	116333 b	4.92	1.00	2.75	0.33
P9305	41.51 b	108083 b	2.00	0.42	1.00	0.75
LSD (0.05)	1.50	11067	NS	NS	NS	NS

Table 4. Bean leaf beetle populations, soybean staining, and soybean cyst nematode populations, 2002.

Treatment	July 12	Sept 9	Stained	SCN
	Beetles/20 sweeps	Beetles/20 sweeps	(%)	(eggs/100cc)
Schill. 240F.Y	15.67	28.00	14.30 b	0
Schill. 290F.HP	20.25	41.25	5.67 a	75
P9305	13.75	42.75	12.41 b	63
LSD (0.05)	NS	NS	3.73	NS

Table 5. Soybean grain quality, 2002.

Treatment	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrate (%)
Shill. 240F.TY	12.25 b	38.45 a	17.75 b	4.28	21.53 b
Shill. 290F.HP	11.80 a	44.18 b	16.10 a	4.20	17.53 a
P9305	11.51 a	38.1 a	18.73 c	4.39	20.79 b
LSD (0.05)	0.41	2.17	0.96	NS	1.28

Table 6. Barley yields, 2002.

Treatment	Yield
Drummond	63.7
Excel	70.8
Foster	66.6
Lacey	69.5
LSD (0.05)	NS