

Evaluation of Organic Soybean Varieties and Organic Fertilizer for Organic Popcorn

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Materials and Methods

According to the USDA National Organic Program, certified organic farmers must source organic seed (seed from organically raised crops). The organic seed industry is currently growing in Iowa and the Midwest, and with this growth, organic growers are looking for University-based recommendations on organic varieties to use in Iowa. The Organic Agriculture Program at Iowa State University has been using organic seed at the ISU Southeast Research Farm for 11 years with excellent results. In addition, a new organic fertilizer (Biotic Organic™ 4-4-4, Perfect Blend, Bellevue, WA) was tested in 2013 for organic popcorn production.

Soybean. There were four soybean varieties selected for the 2013 organic variety trial. These included the following Blue River (Kelley, IA) varieties: 29AR9, 30C3, 19AR1, and 2A71.

Plots measuring 20 ft × 380 ft were laid out in a randomized complete block design with four replications of each variety. Soybeans were planted at 168,000 seeds/acre at a depth of 1.5 in. on June 12. Weed management included rotary hoeing on June 24 and row cultivation on July 2, 8, and 16. Plant and weed stands were counted on July 9. Soybeans were harvested on October 14. Harvest samples were collected from each plot for grain quality analysis, which was conducted at the ISU

Grain Quality Laboratory, Ames, Iowa. In addition, a 200-g soybean sample was analyzed from each plot for the percentage of soybeans that were stained from insects and/or diseases.

Popcorn. The first year of the organic popcorn trial followed a conventional soybean field, so plots will not be certified organic until 2015. Plots measuring 10 ft × 200 ft were laid out in a randomized complete block design with four replications of each treatment—organic fertilizer and a control (no fertilizer). On June 18, 2013, 125 lb/plot of Perfect Blend™ organic 4-4-4 fertilizer was applied to supply 100 lb N/acre. Popcorn seeds were planted at 35,600 plants/acre on June 19. Plots were rotary hoed on June 24, and row cultivated on July 2, 8, and 16. Plant and weed stands were counted on July 9. Stalk nitrate samples were taken on October 29 and analyzed at the Iowa State University Plant and Soils Lab, Agronomy Department (Ames, IA). Popcorn harvest occurred on November 4.

Results and Discussion

Excessive rains in spring followed by drought in July and August impacted growth and yield of crops throughout Iowa in 2013.

Soybean. Despite the challenging weather, organic soybean emergence and performance was excellent in southeast Iowa. Plant stands averaged 108,848 plants/acre, but plots with the variety BR 29AR9 experienced a lower population, averaging 92,750 plants/acre (Table 1). On July 9, there was no difference among varieties in weed populations, averaging < 2 weeds/ft² (Table 1). Soybean cyst nematodes (SCN) were extremely low in 2013, averaging only 66 eggs/100 cc of soil among all varieties (Table 2). Organic

soybean yields also were excellent in 2013, averaging 51 bushels/acre (Table 3). Yields in the aphid-resistant variety, BR29AR9, however, were lower, at 45 bushels/acre. This was probably associated with the lower plant population. There was a low number of insect pests in 2013, therefore soybean staining also was low, averaging less than 1 percent stained soybeans (Table 4). Soybean grain quality was good considering the poor weather (Table 5). Moisture levels were low, at 8.5 percent across all varieties (Table 4). Protein levels averaged 32.5 percent across all varieties, with no statistical differences among varieties. Carbohydrate levels averaged 24.2 percent, with 29AR9 having a higher level than the other varieties at 24.7 percent (Table 5). Oil content averaged 20.5 percent across all varieties (Table 5). Fiber content averaged 4.9 percent across all varieties.

Popcorn. Corn stalk nitrate averaged 46 ppm nitrate-N, with no differences between treatments (Table 6). Stalk nitrate levels could have been low due to the late sampling and mineralization of soil nitrogen, but there was no difference in stalk nitrate levels with the organic fertilizer. Organic popcorn yields with Perfect Blend™ organic fertilizer were numerically higher than the control, at 3,298 lb/acre, compared with 2,996 lb/acre, although differences were only statistically greater at the 90 percent confidence level, not the typical 95 percent level (Table 7).

These results show great promise for organic popcorn, as this was the first time organic popcorn was grown in trials at ISU, and yields were 89 percent of the highest conventional popcorn yields, which were based on 150 lb N/acre from synthetic N sources and synthetic herbicides. By using an N source based on natural sources (manure-based), groundwater pollution potentially may be reduced. We will repeat this trial in 2014.

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Table 1. Soybean stand and weed population in the organic soybean variety trial, 7/9/2013.¹

Variety	Soybean population (plants/acre)	Weed population (weeds/ft²)
29AR9	92,750 b	2.17
30C3	114,630 a	0.42
19AR1	111,130 a	1.00
2A71	116,880 a	1.00
LSD _{0.05}	14,070	NS
P value ($\alpha=0.05$)	0.006*	0.50

¹Means within a column followed by the same letter do not differ ($P \leq 0.05$).

Table 2. Soybean cyst nematode populations in the organic soybean trial, 10/13/2013.

Variety	SCN population (eggs per 100 cc soil)
29AR9	262.5
30C3	0.00
19AR1	0.00
2A71	0.00
LSD _{0.05}	NS
P value ($\alpha=0.05$)	0.32

Table 3. Soybean yields in the organic soybean variety trial, 10/14/2013.¹

Variety	Yield (bu/acre)
29AR9	45.3 b
30C3	53.0 a
19AR1	52.9 a
2A71	53.8 a
LSD _{0.05}	2.6
P value ($\alpha=0.05$)	0.001*

¹Means within a column followed by the same letter do not differ ($P \leq 0.05$).

Table 4. Soybean staining in the organic soybean variety trial.

Treatment	Stained soybeans (% stained)
29AR9	0.6
30C3	0.7
19AR1	0.6
2A71	0.6
LSD _{0.05}	NS
P value ($\alpha=0.05$)	0.80

Table 5. Soybean grain quality analysis in the organic soybean variety trial.¹

Variety	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
29AR9	8.6	32.4	20.0	5.0	24.7 a
30C3	8.7	32.5	20.7	4.9	24.0 b
19AR1	8.3	32.3	20.7	4.9	24.2 b
2A71	8.4	32.7	20.5	4.88	23.9 b
LSD _{0.05}	NS	NS	NS	NS	0.6
P value ($\alpha=0.05$)	0.37	0.83	0.22	0.19	0.03*

¹Means within a column followed by the same letter do not differ ($P \leq 0.05$).

Table 6. Corn stalk nitrate values in the organic popcorn trial.

Treatment	NO₃-N (mg/kg)
Organic fertilizer (100 lb N/acre)	41.3
Control	50.5
LSD _{0.05}	NS
P value ($\alpha=0.05$)	0.87

Table 7. Corn yield in the organic popcorn trial, 11/4/2013.

Treatment	Yield (lb/acre)
Organic fertilizer (100 lb N/acre)	3,298
Control	2,996
LSD _{0.05}	NS
P value ($\alpha=0.05$)	0.09