

Evaluation of Organic Soybean Varieties and Organic Fertilizer for Organic Popcorn Southeast Research Farm, 2013

Kathleen Delate, professor
Andres Glasener, undergraduate research asst.
Departments of Horticulture and Agronomy
Myron Rees, farm superintendent

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 Southeast Research Farm for eleven 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 x 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, 2013. Weed management included rotary hoeing on June 24, and row cultivation on July 2, 8 and 16, 2013. Plant and weed stands were counted on July 9, 2013. Soybeans were harvested on October 14, 2013. Harvest samples were collected from each plot for grain quality analysis, which was conducted at the ISU Grain Quality

Laboratory, Ames, IA. 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 x 200 ft. were laid out in a randomized complete block design with four replications of each treatment: with 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, 2013. Stalk nitrate samples were taken on October 29 and analyzed at the Iowa State University Plant and Soils Lab, Agronomy Dept. (Ames, IA). Popcorn harvest occurred on November 4, 2013.

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 where the variety BR 29AR9 was planted 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 were also excellent in 2013, averaging 51 bu/acre (Table 3). Yields in the aphid-resistant variety, BR29AR9, however, were lower, at 45 bu/acre. This was most probably associated with the lower plant population. There was a low number of insect pests in 2013, and thus, soybean staining was also low, averaging less than 1% stained soybeans (Table 4). Soybean grain quality was good considering the poor weather (Table 4). Moisture levels were low, at 8.5% across all varieties (Table 4). Protein levels averaged 32.5% across all varieties, with no statistical differences among varieties. Carbohydrate levels averaged 24.2%, with 29AR9 having a higher level than the other varieties at 24.7% (Table 4). Oil content averaged 20.5% across all varieties (Table 4). Fiber content averaged 4.9% 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 the use of the Perfect Blend™ organic fertilizer were numerically higher than the control, at 3,298 lb/acre, compared to 2,996 lb/acre, although differences were only statistically greater at the 90% confidence level, not the typical 95% 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% 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 can be reduced. We will repeat this trial in 2014.

Acknowledgments

We would like to thank the Leopold Center for Sustainable Agriculture for their support of this project. Thanks also go to Chad Hesseltine, Evan Duyvejonck, Bob Turnbull, Allison Ditmer, and Meaghan Daley, for their help in production, data collection and analytical aspects of this project. We also thank Charles Hurburgh and Glen Rippke of the ISU Grain Quality Lab, Kerry Culp of the ISU Soil and Plant Analysis Lab, and Blue River Hybrids for their support.

Table 1. Soybean stand and weed population in the organic soybean variety trial experiment, Southeast Research Farm, 7/9/2013.

Variety	Soybean population (plants/acre)	Weed population (weeds/ft ²)
29AR9	92,750b ^y	2.17
30C3	114,630a	0.42
19AR1	111,130a	1.00
2A71	116,880a	1.00
LSD _{0.05}	14,070	NS
p value ($\alpha = 0.05$)	0.0060*	0.4969

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

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

Variety	SCN population (eggs per 100 cc soil)
29AR9	262.50
30C3	0.00
19AR1	0.00
2A71	0.00
LSD _{0.05}	NS ^y
p value ($\alpha = 0.05$)	0.3169

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

Table 3. Soybean yields in the organic soybean variety trial experiment, Southeast Research Farm, 10/14/2013.

Variety	Yield (bu/acre)
29AR9	45.26b ^y
30C3	52.99a
19AR1	52.94a
2A71	53.80a
LSD _{0.05}	2.60
p value ($\alpha = 0.05$)	0.001*

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

Table 4. Soybean staining in the organic soybean variety trial experiment, Southeast Research Farm, 2013.

Treatment	Stained soybeans (% stained)
29AR9	0.57
30C3	0.70
19AR1	0.55
2A71	0.63
LSD _{0.05}	NS
p value ($\alpha = 0.05$)	0.7963

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

Table 5. Soybean grain quality analysis in the organic soybean variety trial experiment, Southeast Research Farm, 2013.

Variety	Moisture (%)	Protein (%)	Oil (%)	Fiber (%)	Carbohydrates (%)
29AR9	8.55	32.38	19.98	4.95	24.73a
30C3	8.65	32.50	20.70	4.85	23.95b
19AR1	8.28	32.33	20.65	4.90	24.15b
2A71	8.40	32.68	20.53	4.88	23.93b
LSD _{0.05}	NS ^y	NS	NS	NS	0.56
p value ($\alpha = 0.05$)	0.3726	0.8336	0.2231	0.1933	0.0296*

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

Table 6. Corn stalk nitrate in the organic popcorn trial experiment, Southeast Research Farm, 2013.

Treatment	NO ₃ -N (mg/kg)
Organic fertilizer (100 lb N/acre)	41.25
Control	50.50
LSD _{0.05}	NS ^y
p value ($\alpha = 0.05$)	0.8731

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).

Table 7. Corn yield in the organic popcorn trial experiment, Southeast Research Farm, 11/4/2013.

Treatment	Yield (lb/acre)
Organic fertilizer (100 lb N/acre)	3,298
Control	2,996
LSD _{0.05}	NS ^y
p value ($\alpha = 0.05$)	0.088

^y Means followed by the same letter down the column are not significantly different at $P \leq 0.05$ (Fisher's Protected LSD test).