Evaluation of Organic Barley Varieties and Organic No-Till Soybean Demonstration

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Introduction

According to the USDA National Organic Program, certified organic farmers must source organic seed (seed from organically raised crops). The organic seed industry currently is 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 17 years with excellent results.

Materials and Methods

Barley. All certified organic acres received an application of three tons/acre of ag lime March 10, 2017, to maintain a proper pH in the study site. There were four varieties selected for the 2017 organic barley variety trial. These included the following Albert Lea Seed House (Albert Lea, MN) barley varieties: Conlon, Pinnacle, Quest, and Robust.

Plots measuring 20 ft x 380 ft were arranged in a randomized complete block design with four replications of each variety. Barley was planted at 96.5 lb/acre at a depth of 1 in. April 21. Red clover was planted as an underseeding to improve soil health at 12 lb/acre. Barley emergence was recorded May 1. Three varieties (Pinnacle, Quest, and Robust) were sampled for nutrient analysis July 14 by cutting forage at the soil line in three randomly selected square ft areas within each plot and drying before sending to the Plant and Soils Lab (Agronomy Dept., Ames, IA). Barley was harvested July 26. Barley grain (200-g sample from random harvest samples) was analyzed for nutrient content by Medallion Labs (Minneapolis, MN).

No-till soybean. Rolled rye prior to organic soybean demonstration plot was drilled at three bushels/acre October 18, 2016, in an organic site previously in organic soybeans in 2016. Rye was sampled for biomass amounts before crimping June 7 by cutting at the soil line in three randomly selected square ft areas of the demonstration plot. Rye was rolled immediately prior to soybean planting June 8 and again June 10 before soybean emergence with a Dawn ZRX™ (Sycamore, IL) cover crop roller. Aphid-resistant soybeans (IA3051RA12: ISU, Ames, IA) were planted at a 1.5-in. depth at 200,000 seeds/acre. There was no cultivation for weed management, as the rye mulch layer was meant to suppress weed populations. Plant and weed populations were counted June 22 in 10 randomly selected areas (17.4 ft of row) across the demonstration plot. Following weed counts, one area of the demonstration plot was walked for weeds above the canopy, to determine yield differences with the non-weeded area. Pest and beneficial insects were collected August 11 by sweeping 20 times with a 15-in. sweep net across three randomly selected soybean rows in each area. The soybean plot was harvested October 27 with a combine equipped with a scale.

Results and Discussion

Barley. Despite the challenging weather in 2017, organic barley emergence and performance was very good in southeast Iowa.

Barley forage averaged 42 percent carbon and 1.2 percent protein (Table 1). Barley yields averaged 32 bushels/acre across all varieties (Table 2). The Quest variety yield was numerically higher, at 42 bushels/acre, but not significantly more than Robust (34 bu/ac) or Pinnacle (31 bu/ac). Pinnacle was equivalent with Conlon, which was the lowest yielding variety at 21 bushels/acre. These results mirrored previous organic barley production results at this site in 2014, when Conlon was significantly lower yielding at 36 bushels/acre, than the other three varieties, which averaged 48 bushels/acre. Grain quality was good considering the poor weather, with protein levels averaging 10.5 percent compared with 9.5 percent in 2014 (Table 3). Total fat content averaged 1.2 percent across all varieties. Specific fatty acids differed only in palmitic acid, where Conlon, Robust, and Quest had the highest levels, at 22.7 percent, with Pinnacle the lowest, at 22.1 percent (Table 3). Oleic acid averaged 14 percent across all varieties, with Quest numerically lower at 13.5 percent compared with 14.1 percent in the other three varieties. Linoleic acid, an essential fatty acid, averaged 56 percent across all varieties.

Soybean following rolled rye. Rye biomass averaged 9.8 tons/acre (Table 4), which led to an excellent mulch for crushing. Soybean plant populations in the rolled rye averaged 86,200 plants/acre (Table 5) compared with the 90,167 plants/acre in 2016. Plant populations ranged from 36,000 to 140,000 plants/acre, demonstrating uneven emergence through the rye mulch. Because of the large gaps between the crop row and the mulch layer, weed populations flourished, and emerged in the gaps. Broadleaf weeds averaged 12 weeds/m^2 (Table 5) and grass weeds were over one hundred/m^2. These results contrast with the excellent weed management in tilled organic soybeans in 2016, when weeds averaged three grass and broadleaf weed/m^2 with two rotary hoeings and two row cultivations after planting. Pest insects, such as bean leaf beetles, stinkbugs, and thrips, were in low numbers, and generally more numerous in the non-weeded section of the plot (Table 7). Only grasshoppers were significantly greater in the non-weeded compared with the weeded area. There were no aphids collected from these aphid-resistant soybeans. Beneficial insects, including spiders, nabids, and green lacewings, generally were more numerous in the weedy section, but there were no statistical differences in beneficial insects between weeded and non-weeded areas.

The drilled soybeans in rolled rye with hand weeding yielded 21 bushels/acre, and the non-weeded plots averaged 17.5 bushels/acre. Organic soybean yields were much lower than 2016 results from tilled organic plots. Previous organic no-till soybean yields ranged from 30 to 45 bushels/acre with the roller/crimper. Even with lower yields, the 21 bushels/acre yield would have brought premium organic soybean prices of $388.50/acre, compared with $385.60 if conventional prices were received for a 40-bushels/acre yield. Several possibilities are associated with the reduced emergence and weed gaps between the crop row and the rye mulch layer: 1) the planter and roller/crimper need to be one unit, as opposed to a separate rolling and planting operation, as conducted in 2017; and 2) the ZRX roller was designed for conventional systems (with herbicides) and additional adjustments and attachments (closing wheels, row cleaners) must be tested in organic systems to facilitate a narrowing of the planting row and pulling the crushed rye mulch over the row after planting.

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Table 1. Barley forage nutrient analysis in the barley variety trial, 7/14/17.

Variety	Total C (%)	Total N (%)
Pinnacle	42.0	1.29
Quest	42.4	1.12
Robust	41.8	1.18
Average	42.07	1.20

Table 2. Barley yield in the barley variety trial, 7/26/17.

Variety	Yield (bu/ac)
Conlon	21.0b[x]
Pinnacle	31.2ab
Quest	42.1a
Robust	33.8a
LSD	12.61
p-value	0.025

[x]Means followed by the same letter in the column are not significantly different at $P \leq 0.05$ or not significant (NS) (Fisher's Protected LSD Test).

Table 3. Barley grain analysis in the barley variety trial.

Variety	Protein (%)	Total fat (%)	Saturated fat (%)	Mono-unsaturated fat (%)	18:2 linoleic (%)	16:0 palmitic (%)	18:1 oleic (%)
Conlon	10.80	2.05	0.50	0.29	55.80	22.91a	14.16
Pinnacle	10.14	2.04	0.49	0.30	55.70	22.13b	14.16
Quest	10.35	2.01	0.49	0.28	55.55	22.48ab	13.52
Robust	10.70	1.88	0.47	0.27	55.29	22.76a	14.05
LSD	NS[x]	NS	NS	NS	NS	0.5144	NS
p-value	0.226	0.694	0.841	0.601	0.132	0.048	0.069

[x]Means followed by the same letter in the column are not significantly different at $P \leq 0.05$ or not significant (NS) (Fisher's Protected LSD Test).

Table 4. Rye biomass before rolling in the organic no-till soybean demonstration, 6/7/17.

	Rye biomass (tons/ac)	Total C (%)	Total N (%)
	12.63	44.0	0.626
	7.20	43.6	0.556
	9.70	44.2	0.683
Avg	9.84	43.93	0.622

Table 5. Soybean stand and weed populations in the organic no-till soybean demonstration, 8/22/17.

Sample	Plants/acre	Broadleaf weeds/m^2	Grass weeds/m^2
1	86,000	2	300
2	90,000	40	90
3	94,000	8	122
4	74,000	8	68
5	140,000	12	208
6	92,000	6	178
7	120,000	0	136
8	82,000	14	148
9	36,000	20	184
10	48,000	8	230
Average	86,200	11.8	166.4

Table 6. Pest and beneficial insect populations in the organic no-till soybean demonstration, 8/11/17 (number/20 sweeps).

Area	Aphids	BLB[x]	Thrips	Corn rootworms	Cater-pillars	White-flies	Grass-hoppers	Leaf-hoppers	Flea beetles
Unweeded	0	0.60	11.80	1.20	0.00	2.60	2.60	1.20	3.80
Weeded	0	0.60	3.40	1.20	0.20	0.60	0.20	0.20	2.60
LSD[y]	--	NS	NS	NS	NS	NS	1.9293	NS	NS
p-value	--	1.00	0.122	1.00	0.347	0.187	0.021	0.226	0.738

Area	Tarnished plant bugs	Moths	Stinkbugs	Mites	Colaspis beetle
Unweeded	0.20	0.20	0.40	1.20	0.20
Weeded	0.00	0.00	0.60	3.40	0.20
LSD[y]	NS	NS	NS	NS	NS
p-value	0.3466	0.3466	0.7328	0.4098	1.00

Area	Honey bees	Minute pirate bugs	Spiders	Nabids	Green lacewings	Parasitoid wasps	Ants	Other flies
Unweeded	0.20	0.00	0.60	0.60	0.20	0.20	0.20	4.00
Weeded	0.20	0.40	0.00	0.00	0.00	0.00	0.20	8.40
LSD[y]	NS	NS	NS	NS	NS	NS	NS	NS
p-value	1.00	0.1411	0.1720	0.3466	0.3466	0.3466	1.00	0.3345

[x]BLB = beanleaf beetles.

[y]NS = not significant. Least significant difference (LSD).