

# Evaluation of Organic Barley Varieties and Organic Popcorn Varieties and Fertilization Southeast Research Farm, 2014

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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 Southeast Research Farm for thirteen years with excellent results. In addition, a new organic fertilizer (Biotic Organic™ 4-4-4, Perfect Blend, Bellevue, WA) was tested in 2014 for organic popcorn production.

### Barley

There were four barley varieties selected for the 2014 organic variety trial. These included the following varieties: Lacey, Robust, Conlon and Rasmusson (Albert Lea Seedhouse, Albert Lea, MN).

Plots measuring 20 x 380 ft. were laid out in a randomized complete block design with four replications of each variety. Barley was underseeded with red clover at rates of 72 lb/acre and 8 lb/acre, respectively, on April 9, 2014. Plant stands and height were determined on May 29, 2014, along with barley and clover biomass by cutting barley at the soil line in three randomly selected square foot areas within each plot. Barley was harvested on July 16. Barley grain samples (200 g) were

randomly collected from each plot for grain quality analysis, which was conducted at Medallion Labs (Minneapolis, MN).

### Popcorn

The second year of the organic popcorn trial followed a conventional soybean field, so plots will not be certified organic until 2016. Plots measuring 10 x 100 ft. were laid out in a randomized complete block design of two varieties (AP2204 and N15262) and two organic fertilizer treatments: with fertilizer and a control (no fertilizer). There were four replications of each treatment. On June 12, 2014, 60 lb/plot of Perfect Blend™ organic 4-4-4 fertilizer was applied to supply 100 lb N/acre. Popcorn seeds were planted at 32,000 plants/acre on June 13. Plots were rotary hoed on June 16 and 26; and row cultivated on July 14. Plant and weed stands were counted on July 11, 2014. Popcorn harvest occurred on November 10, 2014. Percent fill and corn ear length were determined from 3 randomly selected ears from each plot after harvest.

## Results and Discussion

### Barley

Despite the challenging weather, organic barley performance was excellent in southeast Iowa. Plant stands averaged 2,346,795 plants/acre, with the highest plant populations in the Robust and Conlon varieties (Table 1). Average height was similar across all varieties, at 20 inches (Table 1). Barley biomass on May 29 averaged 1,732 lb/acre, with no differences between varieties (Table 2). Clover biomass was equivalent in all plots, averaging 16 lb/acre. Barley yields were excellent considering the wet weather, and averaged 45 bu/acre across all varieties (Table 3). Robust,

Lacey and Rasmussen varieties were equivalent at 48 bu/acre, while Conlon was significantly lower yielding than the other three varieties, averaging 36 bu/acre. Grain quality was also good considering the poor weather, with protein levels averaging 9.5% across all varieties (Table 4). Robust and Conlon varieties had the highest protein levels, at 9.7%, while Rasmussen and Lacey varieties were lower, at 9.3%.

### Popcorn

Popcorn plant populations were similar between varieties and between fertilizer treatments, averaging 29,750 plants/acre (Table 5). Grass and broadleaf weeds were also similar between treatments, averaging <1 weed/m<sup>2</sup> for both grass and broadleaf weeds (Table 5). The excellent weed management was due to the rotary hoeing within 3 days of planting and timely cultivation after rotary hoeing. Organic popcorn yields with the use of the Perfect Blend™ organic fertilizer were numerically higher than the control, at 1,511 lb/acre compared to 1,242 lb/acre in the control (Table 6), but differences were not statistically significant, similar to first-year results. Yields were significantly lower than 2013 yields of 3,298 and 2,996 lb/acre, in the fertilized and control plots, respectively. This was due to poor weather, and an abundance of corn rootworm beetles migrating from GMO corn to the non-GMO popcorn and consuming popcorn silks. The organic popcorn needs to be grown away from GMO corn or pest management of beetles must occur to ensure silking. The N15262 variety yields were significantly greater than the AP2204 yields (Table 6). Ear length and percent fill were also different between varieties and fertilizer treatment (Table 7). The N15262 variety had significantly longer ears, at 6.58 inches, compared to 5.38 inches for the AP2204 variety. Popcorn ear fill at 74% in N15262 was also higher than the 31% average fill in AP2204 ears. The fertilizer application was

associated with longer ears, averaging 6.4 inches, compared to 5.6 inches in the control (Table 7), but the fertilizer did not affect the ear fill, which averaged 52% across both treatments. We will repeat this trial in 2015.

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Table 1. Barley plant population and height in the organic barley variety trial experiment, Southeast Research Farm, 5/29/2014.

Variety	Population (plants/acre)	Average height (in.)
Robust	2,090,880b <sup>y</sup>	21.26
Rasmusson	1,981,980b	20.97
Conlon	2,983,860a	18.60
Lacey	2,330,460b	19.78
LSD <sub>0.05</sub>	378,014	NS
p value ( $\alpha = 0.05$ )	0.0187*	0.0820

<sup>y</sup> 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. Barley and red clover biomass in the organic barley variety trial experiment, Southeast Research Farm, 5/29/2014.

Variety	Barley		Clover	
	Fresh weight (lbs./acre)	Dry weight (lb/acre)	Fresh weight (lb/acre)	Dry weight (lb/acre)
Robust	13,214	1,743	56.18	10.56
Rasmusson	13,447	1,817	111.64	25.45
Conlon	11,725	1,517	26.65	13.45
Lacey	13,372	1,851	74.91	13.21
LSD <sub>0.05</sub>	NS <sup>y</sup>	NS	NS	NS
p value ( $\alpha = 0.05$ )	0.7244	0.7301	0.3443	0.5919

<sup>y</sup> 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. Barley yields in the organic barley variety trial experiment, Southeast Research Farm, 7/16/2014.

Variety	Yield (bu/acre)
Robust	47.54a <sup>y</sup>
Rasmusson	48.04a
Conlon	35.93b
Lacey	48.47a
LSD <sub>0.05</sub>	6.11
p value ( $\alpha = 0.05$ )	0.0028*

<sup>y</sup> 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. Barley protein analysis in the organic barley variety trial experiment, Southeast Research Farm, 2014.

Variety	Protein (%)
Robust	9.68a <sup>y</sup>
Rasmusson	9.30b
Conlon	9.73a
Lacey	9.21b
LSD <sub>0.05</sub>	0.26
p value ( $\alpha = 0.05$ )	0.0016*

<sup>y</sup> 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. Popcorn stand and weed populations in the organic popcorn experiment, Southeast Research Farm, 7/11/2014.

Variety	Corn population (plants/acre)	Grass weeds (weeds/m <sup>2</sup> )	Broadleaf weeds (weeds/m <sup>2</sup> )
AP2204	30,042	0.08	1.08
N15262	29,458	0.42	0.88
LSD <sub>0.05</sub>	NS <sup>y</sup>	NS	NS
p value ( $\alpha = 0.05$ )	0.3503	0.1433	0.5252

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

Treatment	Corn population (plants/acre)	Grass weeds (weeds/m <sup>2</sup> )	Broadleaf weeds (weeds/m <sup>2</sup> )
Compost	30,250	0.25	1.25
No compost	29,250	0.25	0.71
LSD <sub>0.05</sub>	NS <sup>y</sup>	NS	NS
p value ( $\alpha = 0.05$ )	0.1060	1.0000	0.0942

<sup>y</sup> 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. Popcorn yield in the organic popcorn variety and fertilization experiment, Southeast Research Farm, 11/10/2014.

Variety	Yield (lb/acre)
AP2204	913b <sup>y</sup>
N15262	1,841a
LSD <sub>0.05</sub>	320
p value ( $\alpha = 0.05$ )	0.0055*

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

Treatment	Yield (lb/acre)
Compost	1,511
No compost	1,242
LSD <sub>0.05</sub>	NS <sup>y</sup>
p value ( $\alpha = 0.05$ )	0.4788

<sup>y</sup> 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. Popcorn ear length and fill in the organic popcorn variety and fertilization experiment, Southeast Research Farm, 2014.

Variety	Corn ear length (in.)	Corn ear fill (%)
AP2204	5.38b <sup>y</sup>	30.63b <sup>y</sup>
N15262	6.58a	73.75a
LSD <sub>0.05</sub>	0.85	41.07
p value ( $\alpha = 0.05$ )	0.0001*	0.0001*

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

Treatment	Corn ear length (in.)	Corn ear fill (%)
Compost	6.37a <sup>y</sup>	53.75
No compost	5.59b	50.63
LSD <sub>0.05</sub>	0.33	NS <sup>y</sup>
p value ( $\alpha = 0.05$ )	0.0009*	0.6289

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