On-Farm Organic Corn Hybrid Trial, 2008

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Introduction

With demand for organic corn increasing, variety selection is a key step in successful organic corn production. In 2007, research on growing pure stands or mixing organic corn hybrids was initiated in a joint project with Ohio State University and the University of Wisconsin with the overall goal of identifying organic corn varieties best suited for organic grain production in three distinct production regions of the Corn Belt. Activities focused on two objectives: 1) evaluate the agronomic performance and grain quality of organic certified varieties in pure stands, and 2) investigate potential benefits of mixing corn varieties to enhance grain yield and quality. Results of recent studies in South Dakota and Minnesota indicate that farmers can improve grain yield and protein content of corn without additional inputs by mixing varieties of different parentage and similar flowering date in the same field. Studies with various cereals have shown that varietal blends can enhance yield stability and help minimize yield losses from various foliar diseases.

Materials and Methods

Three treatments, replicated three times in a completely randomized design, consisted of two single varieties of organic hybrid corn seed (Blue River 56M30 and BR 48B30) and one mixture of the two varieties. At the Frantzen Farm (New Hampton, IA), seed was planted on May 15, 2008, at 32,000 seeds/acre into a certified organic field, that had received an application of mixed cattle and swine manure at 5 tons/acre on May 9–10, 2008. Corn was planted at 2.2 in. depth. Weeds were managed with one rotary hoeing on June 1 and two row cultivations on June 20 and July 1. At the Lubke Farm (Ridgeway, IA), seed was planted on May 26, 2008, at 32,500 seeds/acre into a certified organic field that had received an application of cattle manure at 4 tons/acre in August 2007. The previous crop was a mixture of barley/peas/oats. Weeds were managed by double dragging (harrow) the field on June 2, two row cultivations on June 20 and July 10, and a propane flame weeding on July 4.

Corn plant population data were taken on June 11 and 25 at the Frantzen Farm and on June 16 and 25 at the Lubke Farm. Weed populations (grasses and broadleaves) and weed ratings were taken on July 9 at the Frantzen Farm and on July 24 at the Lubke Farm, by estimating the percent of cover provided by the corn plants versus the weeds. Corn borer evidence and presence data were taken on 12 corn plants from each treatment on July 24 at each farm.

Ear and plant height data were taken on November 3 on both farms. Corn stalk samples were taken on October 13 at the Frantzen Farm and brought to the Iowa State University Soils & Plant Analysis Laboratory for stalk nitrate (SN) analysis. Due to rain events during the same period, SN testing could not be completed at the Lubke Farm in 2008. Ears were collected from the field at harvest and data pertaining to ear length, ear diameter, ear weight, grain weight, tip damage, and rot ratings (0 = no damage; 3 = >20% of ear damaged) were taken the following week. Plots were harvested with a combine on November 3, 2008. Grain quality was determined by the ISU Grain Quality Analysis Lab, Ames, Iowa.

Results and Discussion

On the Frantzen Farm in 2008, there were no significant differences in plant populations among varieties at the first sampling date, but by June 25, 48B30 populations were greater than 56M30 stands, with the variety mixture equal to both varieties, averaging 27,667 plants/acre (Table 1). Although yields were not statistically different among treatments, averaging 169 bu/acre, the mixture had a numerical increase of 6.5 bu/acre over the average of 48B30 and 56M30 yields (Table 1). Plant height, averaging 283 cm, was equivalent in all treatments (Table 1). The height of the corn ear, at 117 cm, was also similar between varieties (Table 1). In the June 11 weed counts, broadleaves averaged 11 weeds/sq. meter while grass weeds averaged 14 weeds/sq. meter, with no difference among varieties (Table 2). Weed counts on June 25 were lower, at 6 grass weeds/sq. meter and 3 broadleaf weeds/sq. meter, showed a similar trend of no differences among treatments. On July 9, weed coverage averaged 7% across all treatments, with no statistical differences detected (Table 2). Corn borer damage averaged 15% of stalks showing evidence of larval feeding, with no differences among varieties (Table 2).

Ear length averaged 22 cm, with ear width 16 cm, and no significant differences among the three treatments (Table 1). Average ear weight was 219 g/ear, with no significant differences among the three treatments (Table 1). Some ear tip damage (from insects/disease/mold), averaging 2 cm in length, was visible at harvest (Table 1). Ear rot ratings averaging <1 across all treatments (Table 1). Moisture at harvest averaged 20%, but 48B30 was significantly lower at 18% (Table 3). Protein levels in harvested grain were lower in 2008 at 6.3%, with no differences among treatments, suggesting leaching of nitrogen supplies during flooded periods (Table 3). Oil content averaged 3.5%, with the mixture higher at 3.85%, and starch averaged 62%, with no significant differences among the three treatments (Table 3).

On the Lubke Farm in 2008, there were no significant differences in plant populations among varieties at the first and second sampling date, averaging 32,926 plants/acre and 31,000, respectively (Table 4). Yields were not statistically different among treatments, averaging 157 bu/acre (Table 4). Plant height, averaging 264 cm, was equivalent in all treatments (Table 4). The height of the corn ear, at 107 cm, was also similar between varieties (Table 4). In 2008, weed management suffered from flooded conditions in the organic corn trial. In the June 11 weed counts, broadleaves averaged 148 weeds/sq. meter while grass weeds averaged 724 weeds/sq. meter, with no difference among varieties (Table 5). Weed counts on June 25 were much lower, at 41grass weeds/sq. meter and 120 broadleaf weeds/sq. meter, with higher broadleaves in 48B30, at 173 weeds/sq. meter. On July 24, weed coverage averaged 9% across all treatments, with no statistical differences detected (Table 25. Corn borer damage averaged 18% of stalks showing evidence of larval feeding, with no differences among varieties (Table 5).

Ear length averaged 21 cm, with ear width 16 cm, and no significant differences among the three treatments (Table 4). Average ear weight was 198 g/ear, with no significant differences among the three treatments (Table 4). Some ear tip damage (from insects/disease/mold), averaging 2 cm in length, was visible at harvest (Table 4). Ear rot ratings averaging <1 across all treatments (Table 4). Moisture at harvest averaged 24% with no differences among varieties (Table 6). Protein levels averaged 6.2%, with no differences among treatments, also suggesting leaching of nitrogen supplies during flooded periods

(Table 6). Oil content averaged 3.6%, with the mixture higher at 3.85%, and starch averaged 62%, with no significant differences among the three treatments (Table 6).

Overall, organic corn yields were excellent, considering the challenging environment, but protein content suffered as a result of poor conditions. The organic corn seed performed very well across all locations, but the variety mixture did not appear to impart any significant benefits in terms of yield or grain quality.

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Table 1. Corn crop performance in Frantzen OSU trial, 2008.

Treatment	Yield (bu/acre)	Population 11 June (plants/acre)	Population 25 June (plants/acre)	Stalk nitrate (ppm)	Corn height at harvest (cm)	Height of plant where corn ear originated (cm)	Corn ear length (cm)	Corn ear width (cm)	Weight of corn ear (g)	Damage on corn ear (cm)	Rot rating (0 to 3)
Variety A (56M30)	169.2	28556	25667b	20	285.2	121.0	22.22	16.56	225.17	1.33	0.33
Variety A + B	173.1	31778	27667ab	20	280.7	114.9	21.72	16.72	223.70	1.72	0.78
Variety B (48B30)	163.9	28167	29222a	20	282.8	115.2	22.00	15.83	207.17	1.89	0.56
Significance $_{0.05}$	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means within a column are not significant (NS), or significant at $p \leq 0.05$ (Tukey-Kramer HSD test).

Table 2. Weed populations in Frantzen OSU trial, 2008.

	11 June		9 July		25 June		
Treatment	Grass (plants/m^2)	Broadleaves (plants/m^2)	Weed cover (%)	Corn cover (%)	Grass (plants/m^2)	Broadleaves (plants/m^2)	Corn borer (% showing CB evidence)
Variety A	31.4	12.89	8.00	90.89	9.00	0.78	0
Variety A + B	9.22	18.33	6.44	93.56	3.22	1.78	33.0
Variety B	1.00	1.50	5.67	94.33	5.67	5.78	11.0
LSD $_{0.05}$	NS [z]	NS	NS	NS	NS	NS	NS

[z] Means within a column are not significant (NS), or significant at $p \leq 0.05$ (Fisher's protected LSD test).

Table 3. Grain quality in Frantzen OSU trial, 2008.

Treatment	Density	Starch	Oil	Protein	Moisture
Variety A	1.25	61.80	3.30b	6.07	21.12a
Variety A + B	1.25	61.97	3.85a	6.47	20.67a
Variety B	1.26	62.30	3.43b	6.43	17.87b
LSD $_{0.05}$	NS [z]	NS	0.27	NS	2.14

[z] Means within a column are not significant (NS), or significant at $p \leq 0.05$ (Fisher's protected LSD test).

Table 4. Corn crop performance in Lubke OSU trial, 2008.

Treatment	Yield (bu/acre)	Population 11 June (plants/acre)	Population 25 June (plants/acre)	Corn height at harvest (cm)	Height of plant where corn ear originated (cm)	Corn ear length (cm)	Corn ear diameter (cm)	Weight of corn ear (g)	Damage on corn ear (cm)	Rot rating (0 to 3)
Variety A	159.7	34,444	31,333	263.3	106.7	21.2	16.2	200.0	2.28	1.22
Variety A + B	159.3	29,778	29,000	265.1	108.0	21.4	16.0	203.0	2.44	0.67
Variety B	153.3	34,556	32,667	263.4	105.4	20.7	15.9	190.1	1.94	0.67
Significance $_{0.05}$	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means within a column are not significant (NS), or significant at $p \leq 0.05$ (Tukey-Kramer HSD test).

Table 5. Weed populations in Lubke OSU trial, 2008.

	11 June		24 July		25 June		
Treatment	Grass (plants/m^2)	Broadleaves (plants/m^2)	Weed cover (%)	Corn cover (%)	Grass (plants/m^2)	Broadleaves (plants/m^2)	Corn borer (% showing CB evidence)
Variety A	702.3	141.1	7.1	92.9	30.9	96.4b	33.0
Variety A + B	773.6	139.0	9.7	90.3	41.6	92.8b	11.0
Variety B	694.6	165.2	8.6	91.4	50.1	172.8a	11.0
LSD $_{0.05}$	NS	NS	NS	NS	NS	67.9	NS

[z] Means within a column are not significant (NS), or significant at $p \leq 0.05$ (Fisher's protected LSD test).

Table 6. Grain quality in Lubke OSU, 2008.

Treatment	Density	Starch	Oil	Protein	Moisture
Variety A	1.24	61.5	3.70	6.27	23.7
Variety A + B	1.25	62.0	3.53	6.20	22.0
Variety B	1.23	61.2	3.70	6.23	25.0
LSD $_{0.05}$	NS	NS	NS	NS	NS