Evaluation of Organic Corn Varieties

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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 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 23 years, with excellent results.

There were four corn varieties selected for the 2021 organic variety trial. These included the following varieties: Viking 0.46-02 and 0.51-04 (Albert Lea Seed), BR54C27 and BR64K93 (Blue River Hybrids). Plots measuring 20 x 480 ft. were laid out in a randomized complete block design with four replications of each variety. Turkey manure (5 tons/acre; 3-2-1.5 N-P-K) was spread on the field October 31, 2020, and plowed under with the 2020 barley residue and red clover cover crop April 5, 2021. The field was field-cultivated April 26 and May 6 to prepare for planting. Corn was planted at a 2-in. depth at 38,000 seeds/acre May 6. Weed management included rotary hoeing May 1, pre-corn emergence. Unfortunately, due to 6.38 in. of rain in May, post-emergence weed management was not adequately achieved, and the crop was terminated by field cultivation May 27 and June 2. Corn was replanted June 3 at 38,000 seeds/acre. The replanted trial was rotary hoed June 10 and 14, and row cultivated June 17. Corn was harvested by combine November 4, 2021.

Plant populations were determined in three randomly selected areas in each replication of each variety July 14, 2021. Grass and broadleaf weed populations also were counted in square-foot quadrats in three randomly selected areas in each replication of each variety July 14. Soil samples and stalk nitrate samples were taken October 10, 2021 and analyzed at Midwest Labs in Omaha, Nebraska.

Results and Discussion

Average seasonal precipitation and temperatures in 2019, 2020, and 2021, as well as the 30-year monthly and seasonal averages at the Southeast Research Farm, are presented in Table 1. The highest total precipitation by month, from 2019-2021, occurred in May 2019 at 9.59 in. In 2020, the total seasonal precipitation, at 29.77 total in., was the lowest of the three years. Total precipitation for 2019 and 2021 were similar at 39.11 in. and 35.49 in., respectively. The 30-year average seasonal precipitation was 34.29 in., showing 2020 to be 4.52 in. below normal, but 2021 to be similar to the 30-year average, with May rainfall 1.06 in. above the average. The average temperatures in 2019, 2020, and 2021 showed 2020 to be 1.54°F and 2021 to be 0.84°F warmer than 2019, with July 2019 having the highest recorded average temperature for all three years, at 79.29°F.

There were similar temperatures in the months of June and July in 2019, 2020, and 2021, and the overall seasonal average in 2021, at 53.69°F, was similar to the 30-year average temperature of 53.50°F (Table 1).

Despite the mixed weather pattern in 2021, leading to a re-planting June 3, organic corn performance was excellent in southeast Iowa. Plant stands averaged 32,563 plants per acre among all hybrid corn varieties, with no difference between varieties (Table 2). Weed management was excellent in the 2021 replanted trial. Weed populations were equivalent across varieties. Broadleaf weeds averaged 3.75 weeds/ft^2 across all varieties, while grass weeds averaged < 1 weeds/ft^2 (Table 2).

Organic hybrid corn yields were excellent considering the weather issues and late planting in 2021. There were greater yields in the organic Viking 0.46-02, at 150.79 bushels per acre, compared with an average of 141.16 bushels per acre for all other varieties (Table 3). The Viking 0.51-04 yielded 146.60 bushels/acre, which was numerically greater than the other two Blue River varieties, which yielded an average of 138.45 bushels/acre (Table 3).

Soil analysis from the organic variety trial at the Crawfordsville site showed excellent soil quality, due to being in an organic rotation for 23 years. Soil samples were taken at a 6-in. depth in three random locations per plot October 13. Organic matter averaged 4.07% across the site. Soil pH averaged 7.06 with an average cation exchange capacity of 23.46 meq/100g, which shows a strong ability to store and release nutrients. Phosphorus averaged 182.19 ppm across the site. Soluble salts averaged 0.22 mmhos/cm, showing excellent resistance to salt injury, which may occur in conventional rotations with excessive fertilization. Surface nitrogen averaged 4.75 ppm, which reflected the low N status in the corn stalks (Table 4).

Table 1. Precipitation and temperature averages: 2019, 2020, 2021.

	Monthly precipitation, inches				Average air temperature (°F)			
MONTH	2019	2020	2021	30-YEAR AVERAGE	2019	2020	2021	30-YEAR AVERAGE
January	1.51	1.73	2.00	3.37	19.02	27.34	23.48	21.95
February	2.69	0.25	1.13	1.54	20.13	29.36	13.96	25.76
March	2.01	4.00	2.72	2.33	34.55	43.85	43.06	38.43
April	4.55	1.68	3.27	3.58	51.10	49.98	50.17	50.50
May	9.59	4.99	6.38	5.32	59.34	59.34	59.32	61.60
June	3.38	5.27	5.07	5.19	71.15	72.80	73.17	71.40
July	1.04	2.86	5.06	4.19	79.29	77.15	74.16	74.70
August	4.71	0.47	2.32	4.11	73.21	73.45	74.35	72.62
September	7.49	6.20	1.91	3.55	71.30	62.68	67.72	65.15
October	2.14	2.32	5.63	3.12	49.44	47.95	57.55	52.86
Total seasonal precipitation and seasonal average air temperature	39.11	29.77	35.49	34.29	52.85	54.39	53.69	53.50

Table 2. Organic corn stand and weed populations, July 14.

Variety	Population (plants/acre)	Grass weeds (plants/ft^2)	Broadleaf weeds (plants/ft^2)
Blue River 54C27	34,000	3.50	0.25
Blue River 64K93	32,250	3.00	1.00
Viking O.46-02	32,750	4.50	0.25
Viking O.51-04	31,250	4.00	0.75
p value (a=0.05)	0.2322	0.5330	0.5084

Table 3. Organic corn yields.

Variety	Average yield (bu./ac.)
Blue River 54C27	142.16
Blue River 64K93	134.73
Viking O.46-02	150.79
Viking O.51-04	146.60
p value (a=0.05)	0.8592

Table 4. Soil analysis, organic corn variety trial.

Variety	Organic matter %	P1 weak Bray (ppm)	P2 strong Bray (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	Na (ppm)	Soil pH	Cation exchange capacity (meq/100g)	K % saturation	Mg % saturation
Viking O.51-04GS	3.98	29.00	551.25	171.50	713.00	3258.75	15.25	7.08	22.75	1.98	26.08
Blue River 54C27	4.13	29.75	54.25	160.50	733.00	3386.00	14.50	7.05	23.53	1.78	25.95
Viking O.46-02P	4.13	31.00	62.50	165.00	748.50	3481.75	14.50	7.08	24.13	1.75	25.85
Blue River 64K93	4.05	30.50	60.75	153.50	715.50	3403.25	14.25	7.03	23.43	1.68	25.48
p value (a=0.05)	0.8916	0.8163	0.1831	0.7204	0.8464	0.6114	0.9114	0.8267	0.7180	0.4589	0.7701

Variety	Ca % saturation	H % saturation	Na % saturation	Surface N (ppm)	S (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	B (ppm)	Soluble salts (mmhos/cm)
Viking O.51-04GS	71.68	0	0.28	4.50	7.00	3.68	4.00	67.50	2.43	0.48	0.20
Blue River 54C27	72.00	0	0.28	4.75	6.50	3.73	3.75	57.25	2.33	0.45	0.20
Viking O.46-02P	72.15	0	0.25	4.50	6.50	3.80	3.75	54.50	2.40	0.48	0.23
Blue River 64K93	72.58	0	0.28	5.25	5.50	4.18	4.75	59.50	2.63	0.48	0.25
p value (a=0.05)	0.4326	N/A	0.8732	0.9152	0.0915	0.4287	0.3186	0.4970	0.3303	0.8732	0.2476

Corn stalk nitrate levels showed no significant differences between varieties in 2021, but did show the Viking 0.46-02 variety to be numerically higher, at 132 ppm, compared with an average of 53.2 ppm for all other varieties (Table 5). The Blue River 54C27 stalks averaged 86.25 ppm, which was numerically greater than the Viking 0.51-04 and Blue River 64K93 varieties, which averaged only 37 ppm (Table 5).

These results show great promise for organic hybrid seed, which is gaining in popularity for organic production in Iowa. New organic corn hybrids currently are under development in a USDA-OREI organic corn breeding project at ISU, and will be tested at the Southeast Research Farm in the future.

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Table 5. Corn stalk nitrate concentrations, organic corn variety trial, October 13.

Variety	Nitrate (ppm)
Viking 51-04GS	41.25
Blue River 54C27	86.25
Viking 0.46-02	132.00
Blue River 64K93	32.75
p value (a=0.05)	0.3076