ORGANIC FARMING RESEARCH FOUNDATION

Organic farming research project report submitted to the Organic Farming Research Foundation:

Project Title:

Corn Variety Performance Trials for Ohio Organic Farms – 2001

FINAL PROJECT REPORT

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Objectives

Grain crops grown organically often are raised in conditions unlike that experienced in university and commercial variety performance trials. Objectives of this trial were to:

1) Evaluate the agronomic and grain quality performance of corn hybrids selected by certified organic grain producers
2) Determine if varieties suited to high input conditions are the same as those suited to low input conditions.
3) Assess the need for wide plots in evaluating grain quality.
4) Evaluate specialty corn grain quality performance in low input conditions.
5) Assess the effects of varying plant density on grain nutrient composition.

Background

Thirteen certified organic farms within Ohio participated in the project. Locations, seeding rates, planting dates and harvest dates are listed in Table 1. Average seeding rate was slightly below 25,000 seeds per acre across all farms. Cropping histories for the previous three years and tillage conducted in preparation for planting are indicated in Table 2. All the crop rotations except one included a legume in the year just prior to corn planting. Tillage was conducted in all fields in preparation for corn planting.

Twelve corn varieties were selected by the participating farmers at an organizational meeting in early February of 2001. Five of the hybrids were selected due to their yield performance in on-farm trials conducted the previous year. The varieties selected and their listed maturities were the following (hybrids evaluated the previous year are designated by an asterisk):

Agrigold A6447* – 109-day; Bird Hybrids B54V – 108-day; Campbell Seed 6380 – 107-day; Doebler 636XY* – 109-day; French's 440* – 108-day; Kidron Seeds 711 – 106-day; Masters Choice MC620 – 112-day; NC+Organics 3448 – 107-day; NC+Organics 4880* – 112-day; Pioneer 34K77* – 107-day; Seed Consultants 1091 – 109-day; Warner Seeds 297 – 109-day

Table 3 includes the soil types and soil test levels for each field measured approximately three weeks after corn planting. Soil tests below a critical level would be considered deficient for that nutrient to support optimum crop growth according to Ohio State University guidelines. For growing corn in Ohio the critical levels are: pH <6.3, LTI <68, P <15ppm, K <(75ppm plus 2.5 times the CEC), Ca <200ppm, Mg <50ppm and NO_3N <21ppm.

Besides organically produced feed and food grades of corn, there is also increasing demand for specialty corns. For corn growers, specialty corns offer value added opportunities to increase their margins of profit due to available premiums. Plant breeders using traditional breeding techniques have altered the starch, protein and oil content of corn to better meet the needs of the livestock feeder, the food industry, and industrial users of corn. Corn that meets specific user needs are called value-added or identity preserved (IP) grains. Varieties selected for the specialty corn part of this study (Table 4) have characteristics that have been bred naturally and not

enhanced through the use of biotechnology. Varieties that have the potential of drawing special market premiums based on the composition of the final grain product may add to the sustainability of farmers willing to grow them.

Methods

The study was conducted as a randomized complete block design beginning with the use of 13 farms as blocks or replicates. The varieties were randomized at each farm (one replication per location) in field length strips averaging nearly 1200 feet in length with widths varying from 10 to 60 feet (4 rows to 24 rows), but averaging 27 feet. Farmers were instructed to use planting rates they normally use.

Producers were asked to record the date for each variety when half the plants had achieved their first unfolded leaf after emerging. Soil samples at the farm sites were taken approximately three to four weeks after planting, corresponding to what would be the time of sampling for sidedress nitrogen recommendations in conventional fields. Early season stand counts were based on the number of emerged plants per 0.001 acre sampled twice at three different locations per plot. Height data were the averages of 3 samples per variety per farm taken at three different locations per plot.

To determine grain quality and to examine xenia effect, plots of the hybrids equal to or wider than 40 feet per variety were used at three of the participating farms. Xenia effect is the influence of pollen drift from neighboring hybrids. Samples for grain quality were taken within a week of harvest at all sites from the center two rows of each variety strip plot.

To assess an additional factor of seeding rate effect on grain nutrient composition, two plant populations were created on the farms using the wide plots. Rates examined were the organic farmers' rates and one-third less. This was done by thinning 4-row sections that were 50 feet in length near the centers of each variety plot.

Specialty corn evaluations were established at three of the participating farms. The specialty corns and a conventional check were planted in blocks nearly 1200 feet in length with widths 40 to 60 feet. However, due to heavy weed pressure and late planting, samples were obtained from only two of the farms (Nos. 4 and 8). Grain samples of the specialty corns were collected from the center two rows to avoid the xenia effect of pollen drift from neighboring hybrids.

The twelve hybrids selected by participating producers, the six specialty corns and conventional check were also established using conventional inputs at four OSU-OARDC research farms in Ohio near Wooster, Hoytville, South Charleston and Columbus. The twelve test hybrids were planted in plots of four 30 inch rows and 25 feet long replicated three times. Specialty corns were planted in replicated blocks 60 to 200 feet in width and at least 100 feet in length. Grain for quality determination was collected on the two center rows of each block to avoid the xenia effect.

Ears sampled for quality analysis were shelled by hand and grain oil, protein and starch content were determined by near infrared transmittance (NIRT) analysis. Metabolizable energy for swine (M.E.) and lysine were estimated by calculation using NIRT oil and protein values.
End of season corn stalk nitrate samples of the twelve test hybrids and soil nitrate nitrogen samples were taken to examine nitrogen use in the field. Stalk samples were taken between 1 and 3 weeks after black layer development using 8-inch stalk segments cut from between 6 and 14 inches above the soil. Stalk samples were tested at Spectrum Analytic, Inc., Washington Court House, Ohio.

The entire plot area was harvested with the exception of field no. 1 where the east three rows of six row strips were harvested and the center 4 rows of 6 row strips on field no. 7 was harvested. Farm no. 8 harvested ears of corn by hand using two 80 row-feet samples per hybrid. All mechanical yield determinations were made by weighing individual strip plots with portable scales or commercial grain elevator scales. Grain moisture was determined by use of a Farmex moisture grain tester or commercial grain equipment. All other stand and harvest data were taken from the center two rows of each variety strip plot at harvest or within two weeks of harvest. Population counts were assessed from counting the number of plants per 0.001 acre twice. Lodging and barren scores were taken from 100 plants per variety at each location.

Results

According to the soil tests, 11 of the 13 farms were nitrogen deficient, 8 were potassium deficient, one was phosphorus deficient, and two were too acidic for optimum production. Most of these fields, had they been conventional fields, would have had nitrogen fertilizer applied to achieve optimum corn yields (Iowa State University recommendations would suggest additional N for nitrate levels below 21 ppm.).

Early Height and Emergence Data Analysis:

Due to the difficulty of ordering non-treated seed for most of the varieties after selection at the farmer-planning meeting, all seeds received commercial seed treatment. This action was allowed by the organic certifying offices of the participating producers to facilitate the research project. The seed provider of Bird Hybrids B54V additionally treated with T-22.

For the 13 farms that planted the 12 test varieties, the average planting rate was 24,736 seeds per acre. There was no significant difference in emergence rates among the varieties at the 5% level of significance (F = 1.8, CV = 12.7%). Average emergence rate over all varieties was 91.1% of seeds planted.

Ten of the participating farms recorded emergence dates. There was no significant difference in days that it took for approximately half the seeds from each variety to unfold the first leaf after planting (F = 1.3, CV = 6.7%). There was an average of 9.8 days after planting for this stage to occur.

Early season moisture affected planting and early plant vigor. Climate information is provided in Tables 5 and 6. Excess rainfall from mid-May until the first week of June across the state caused

a defined difference in early growing conditions in fields planted before and after this period. Thus, it became necessary to analyze and report early growth in two separate farm groups. Another factor influencing management of the fields was difficulty in timely application of mechanical weed control. This difficulty led to the abandonment of field no.11 from continued participation in the variety performance trial.

Significant differences were found among the hybrids in early growth plant height before and after the excessive rain. For the seven fields (Table 7) with timely dates of planting (5/3/01 to 5/21/01), the average plant height 24-25 days after planting was 3.8 inches. For the six fields (Table 8) planted late (5/31/01 to 6/20/01), the average plant height 24-25 days after planting was 12.1 inches. Four hybrids together had the greatest height in both planting date groups and were not significantly different from each other: Bird Hybrids B54V, French's 440, NC+ Organics 3448 and Seed Consultants 1091.

Harvest Results and Data Analysis:
Harvest yields, grain moisture and test weight for 11 of the twelve farms that continued to grow the selected hybrids are given in Table 9. Extensive wildlife damage and weather conditions prevented adequate and timely mechanical harvest of farm no. 9. Three hybrids as a group yielded significantly higher than other varieties: Bird Hybrids B54V, French's 440 and Seed Consultants 1091. Masters Choice MC620 had the highest grain moisture with French's 440, Seed Consultants 1091 and the two NC+ Organics entries as a group possessing the lowest grain harvest moisture status. Test weights were highest among Agrigold A6447, NC+ Organics 3448 and Pioneer 34K77.

Stand characteristics for the selected hybrids are reported in Table 10. There were no significant differences among the entries for harvest population and proportion of seeded population remaining at harvest. As a group the smallest amount of lodging was found with Kidron Seeds 711, NC+ Organics 3448, Seed Consultants 1091 and Warner Seeds 297. There was only slight differentiation among the hybrids with respect to barren plant scores with an overall average of 12.2%.

Having several varieties being similarly tested during the previous year as well as located at some of the same farms provided an opportunity to record a two-year summary. These results are reported in Table 11. Averaging across two years and seven locations, there were no significant differences in yields among these five hybrids. French's 440 and Pioneer 34K77 as a group were significantly lower in grain harvest moisture than the other three varieties tested over two years.

Nitrate-nitrogen levels for the fields used and harvest time stalk nitrate levels are given in Table 12. Soil nitrate levels decreased through the season on all farms where nitrogen levels were sampled at harvest. Stalk nitrate levels were low or less than 700ppm at 9 of the 12 farms sampled. Stalk nitrate was in excess (above 2000ppm) at the other three farms.

Table 13 provides a listing of Pearson's linear correlation coefficients between the corn yield averages and soil test results reported above in Tables 3. Spring NO_3-N was highly correlated with yields ($r^2 = 0.84$) that ranged from 15 bu/A to 145 bu/A for the 11 farms from which harvest

data was collected. Other soil parameters were not significantly correlated with average yields across locations.

Results of the grain quality analysis for the twelve selected corn hybrids are shown in Tables 14 ("wide" plots) and 15 ("narrow" plots). Pearson's linear correlation coefficient (r^2) and Spearman's coefficient of rank correlation (r_s^2) for protein, starch and lysine indicate that plot width influences composition values and suggest that wide plots are a more reliable indicator of grain quality traits strongly influenced by the xenia effect. In this trial, it appears protein, starch and lysine levels were most affected.

Paired t tests were performed to determine if reducing plant population influenced the various grain quality attributes measured. Results indicate that a 1/3 reduction in plant stand significantly increased protein and lysine content and significantly decreased starch content of grain, but had little effect on grain oil content or M.E. (Table 16).

Table 17 provides the agronomic input background for the conventional inputs used on the Ohio State University test plots conducted collaboratively with the same hybrids used on-farm. The agronomic performance at the OSU sites and correlations with on-farm data are listed in Table 18.

When Pearson's linear correlation coefficient (r^2) is equal to 1.0, any change in one variable is accompanied by a proportional change in the other. According to Table 18, the amount of differences among hybrids when grown on the OSU sites were close to the differences found over all the organic farms for yield, harvest moisture and test weight.

Spearman's coefficient of rank correlation (r_s^2) measures correspondence between ranks. It provides an indication of the competence of a rating system against a standard of ranks. According to Table 18, the rankings among the hybrids for harvest moisture and test weight were close to that found for the organic farms. However, the ranking of yields on the OSU sites was not significantly correlated with the order of yields realized on the organic farms.

Table 19 indicates the grain oil, protein, starch, lysine and M.E. content of the specialty corns grown using conventional and organic inputs. Highly significant Pearson's linear correlation coefficient (r^2) and Spearman's coefficient of rank correlation (r_s^2) indicate that differences among hybrids for the various grain quality attributes on the OSU sites were similar to those found at the organic farms.

Oil levels for the HOC TC Blend were higher than the other specialty corns and nearly 3 percentage points higher than the conventional check. The oil content of Mycogen 2660 was about 1.5 percentage points less than 34B25, but higher than 34K77, 33Y18, 34F83, and 34B23. Grain protein levels for 33Y18 and SR470 were 1 to 2 percentage points lower than the other specialty corns and check. Mycogen 2660 and Pioneer 34B25 had the lowest starch levels but the highest M.E. and lysine levels.

Summary

Originally it was planned to have 13 certified organic farms participate in the trial; however, only 11 farms were able to successfully bring the test varieties completely to harvest. Excessive rain hindered mechanical weed control and delayed planting for nearly half the participants. In general, the varieties were grown under typical organic farm conditions with moderate weed pressure and marginally low soil fertility.

Organic producers have a difficult time attaining seed that is not commercially treated. For this trial, all of the varieties were treated to avoid comparing a mixture of untreated and treated hybrids. (Permission was attained from the International Office of the Organic Crop Improvement Association so that the certification status of participating producers would not be jeopardized by the use of chemically treated seed.)

Organic grain producers regard early plant vigor as an important characteristic of varieties for their weed management programs. Normally planting is done later than conventional farms to mechanically control early occurring weeds. Once the corn emerges, fast growth is desirable to compensate for late planting and to provide a canopy over weeds that emerge after planting. The varieties tested in 2001 were all similar in timing of emergence and rate of emergence from planted rates.

In terms of achieving early plant height, Bird Hybrids B54V, French's 440, NC+ 3448 and Seed Consultants 1091 as a group were the tallest hybrids 24-25 days after planting whether planted before or after the excessive rain experienced in the last half of May.

Seed Consultants 1091, Bird Hybrids B54V, and French's 440 were not significantly different from each other as the highest yielding group. These three were also not significantly different in test weight or in oil, protein and starch levels. French's 440 was significantly better in terms of harvest moisture compared to Bird Hybrids B54V but not the Seed Consultants 1091 hybrid. The Seed Consultants 1091 lodged significantly less than the French's hybrid.

There was no significant difference in two-year yield averages for the five hybrids tested in both years of the trial. Among these hybrids French's 440 and Pioneer 34K77 as a group had the most favorable harvest moisture.

Nitrogen was the single most significant soil nutrient associated with yield. Nearly all the variation in yield averages across participating farms could be attributed to variation in nitrogen levels. Its effect on yield was probably so strong as to surpass any detectable effect of various levels of the other soil nutrients tested. On nine of the farms stalk nitrate levels were in the low category. According to Spectrum Analytic lab recommendations, there is a high probability that greater availability of N in low category locations would have resulted in higher yields.

Two of the farms tested in the excess category for stalk nitrate despite having less than critical soil test levels for nitrate nitrogen. A possible explanation for this is that in some areas of the state near drought like conditions existed in the last two months of corn development. Under

drought related stress nitrate accumulates in corn stalks and is not distributed to the developing ear.

Correlation between performance of the selected hybrids on participating farms with performance at Ohio State University test sites was significant for proportional differences in yield, harvest moisture and test weight. However, overall rankings for yield were significantly different. Yield rank correlations between on-farm results and OSU sites were highly correlated in the first year of testing but not for the trial in 2001. Thus, it appears Ohio's organic producers can refer to OSU trials for relative differences in agronomic performance of hybrids. However, caution should be taken in attempting one-on-one comparisons between any two hybrids.

The use of plots wider than 40 feet per variety is necessary to evaluate grain quality characteristics, especially protein, starch and lysine. Thus, comparisons of varieties for grain components should be based on trials using wide plots that avoid the xenia effect. If Ohio organic producers desire extra premiums from growing specialty corns, they should be able to obtain desired grain characteristics despite soil nutrient conditions that tend to be lower than conventional production.

Enhanced protein and lysine with accompanying reductions in grain starch levels were found with reduced plant population. This was llikely due to reduced plant competition for marginally available resources, particularly soil nitrogen.

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Corn Variety Performance Trials for Ohio Organic Farms – 2001

Tables

Table 1. Certified organic farms participating in statewide performance trials, seeding rate, planting dates and harvest dates for the corn test plots.[1]

Farm No.	Region of State	County	Nearest Town	Farm	Seeding Rate (seeds/A)	Planting Date	Harvest Date
1	Northwest	Defiance	Mark Center	Joe Hammond	24167	5/10/01	11/16/01
2	North-Central	Sandusky	Clyde	Jeff Dean	24000	5/21/01	11/09/01
3	North-Central	Seneca	Alvada	Don Reinhart	23500	5/03/01	11/05/01
4	North-Central	Medina	Litchfield	Gary Mennell	24000	5/21/01	11/13/01
5	Northeast	Wayne	West Salem	Dean McIlvaine	24600	5/11/01	11/22/01
6	Northeast	Wayne	Wooster	Art Riggenbach	25600	5/16/00	12/12/01
7	Northeast	Columbiana	Beloit	Ron Miller	27700	5/31/01	11/24/01
8	Central	Delaware	Delaware	Stratford Center	24000	6/11/01	12/03/01
9	Central	Morrow	Ashley	Elias Poston	20060	6/18/01	No data
10	Central	Knox	Centerburg	Stuart Veatch	27646	5/06/01	11/20/01
11	Central	Knox	Mt. Vernon	Rex Spray	24000	5/09/01	No data
12	West	Darke	Union City	Dan Young	26197	6/20/01	11/15/01
13	West-Central	Madison	West Jefferson	Dwight Law	27700	6/14/01	11/21/01

[1]Row width equaled 30 inches at all farms except farm no. 2 which used 22–inch rows.

Table 2. Crop rotations and tillage preparation of variety test plot areas.

Farm No.	Rotations (Previous Crops 2000/1999/1998)	Tillage Before Planting
1	Alfalfa/alfalfa/spelt	Moldboard, roterra 2x
2	Clover/spelt/soybean	Fall chisel, field cultivator 2x
3	Soybean/corn/soybean	Disk, harrow
4	Alfalfa-clover-grass hay two yr/soybean	Plowed after current year first cutting
5	Spelt+clover/soybean/spelt+clover	Disk, field cultivator 2x
6	Alfalfa hay/wheat/corn	Chisel plow with sweeps, disk
7	Alfalfa-timothy-clover hay two yr/spelt	Moldboard, field cultivator
8	Alfalfa-grass hay two yr/oats	Chisel plow, disk, field cultivator 2x
9	Fallow/spring barley+sweet clover/soybean	Disk, cultivator, harrow
10	Alfalfa+wheat cover/wheat/soybean	Disk 2x, cultivator 2x, Danish tine 3x
11	Clover/wheat/soybean	Disk, cultivator
12	Soybean/corn/clover	Disk, field cultivator
13	Soybean+winter cover rye/Soybean/Corn	Plow, disk, tooth harrow

Table 3. Soil types and soil test levels for test plots on participating farms.[1]

Farm No.	Soil Type	Ph	LTI[2]	P ppm	K ppm	Ca ppm	Mg ppm	Base[3] Ratio	CEC meq/ 100g	O.M. (%)	NO_3-N ppm
1	Wabasha silty clay loam	7.7	70	14	118	4850	1017	2.9	33.0	3.9	10.3
2	Kibbie fine sandy loam	7.1	70	27	83	1730	228	4.6	10.8	2.2	15.3
3	Blount & Pandora silt loams	6.4	68	44	131	2300	508	2.7	18.5	3.5	3.3
4	Mahoning silt loam & Jimtown loam	6.6	70	16	98	1910	362	3.2	12.8	3.3	7.3
5	Cardington & Bennington silt loams	6.7	70	24	80	1520	226	4.0	9.7	2.5	6.0
6	Mechanicsburg silt loam	6.9	70	60	203	1560	240	3.9	10.3	3.5	38.8
7	Bogart & Chili loams	6.3	69	20	104	890	109	4.9	6.8	3.2	22.8
8	Morley silt loam	6.8	70	18	89	1640	257	3.8	10.5	3.1	13.1
9	Centerburg, Amanda & Sleeth silt loams	6.6	69	23	127	1530	273	3.4	11.5	2.8	4.7
10	Chili & Homewood silt loams	6.3	70	28	138	790	180	2.6	5.8	2.8	17.8
11	Luray silty clay loam	5.8	64	19	100	2710	480	3.4	25.0	5.2	12.0
12	Savona silt loam & Patton & Brookston silty clay loams	6.6	69	34	115	2990	1548	1.2	29.3	4.0	12.4
13	Kokomo silty clay loam & Crosby silt loam	6.4	67	19	121	3380	1134	1.9	30.3	5.1	7.2

[1]Soil tests conducted by Ohio State University OARDC STAR laboratory, Wooster, Ohio.
[2]LTI = Lime test index which is the buffer pH x 10
[3]Base Ratio= Ratio of calcium base saturation to magnesium base saturation

Table 4. Specialty corn hybrids grown on two certified organic farms and OSU research farms, 2001.

Brand/Hybrid	Specialty Trait
Channel SR470	High lysine
Mycogen 2660	Supercede (nutritionally enhanced)
Pioneer 34F83	Waxy
Pioneer 33Y18	High extractable starch
Pioneer 34K77	Yellow food grade
Pioneer 34B25	Top Cross high oil corn
Pioneer 34B23	Conventional check

Table 5. Precipitation for 2001 corn evaluations[1].

Month	Hoytville (northwest)	Wooster (northeast)	S. Charleston (west-central)	Columbus (central)
	(inches)			
April	4.1 (3.3)	3.4 (3.3)	3.8 (4.0)	4.0 (3.7)
May	5.1 (3.4)	4.0 (3.9)	6.8 (4.6)	7.5 (4.4)
June	2.4 (3.6)	1.5 (3.9)	2.4 (4.2)	3.4 (4.5)
July	3.0 (3.8)	1.1 (4.1)	7.2 (4.1)	3.7 (4.7)
Aug	2.7 (3.0)	5.1 (3.6)	5.1 (3.6)	1.6 (3.7)
Sept	3.4 (2.7)	1.4 (3.1)	1.7 (3.0)	1.6 (2.9)
Total	20.7 (19.8)	16.5 (21.9)	27.0 (23.4)	21.8 (23.9)

[1]long term averages in parentheses

Table 6. Air temperatures for 2001 corn evaluations[1].

Month	Hoytville (northwest)	Wooster (northeast)	S. Charleston (west-central)	Columbus (central)
	(degrees F)			
April	52.3 (48.9)	53.1 (48.1)	55.1 (51.0)	56.5 (51.1)
May	61.5 (59.8)	59.9 (58.1)	62.4 (61.3)	63.3 (61.4)
June	68.8 (69.5)	68.3 (67.6)	69.1 (70.3)	70.9 (70.4)
July	72.2 (72.8)	71.5 (71.5)	72.0 (73.8)	74.0 (63.5)
Aug	71.8 (70.6)	72.0 (69.9)	72.2 (72.0)	75.0 (72.6)
Sept	61.4 (64.0)	60.9 (63.4)	62.1 (65.2)	61.8 (66.1)
Average	20.7 (19.8)	64.3 (63.2)	65.5 (65.6)	66.9 (64.2)

[1]long term averages in parentheses

Table 7. Average corn height 24-25 days after planting for 7 farms with planting date prior to 5/22/01.

Hybrid	Height (in)
NC3448	4.07 a
Seed Consultants 1091	4.01 ab
Pioneer 34K77	3.95 abc
Bird Hybrids B54V	3.92 abc
Agrigold A6447	3.89 abc
Frenchs 440	3.86 abcd
NC+ Organics 4880	3.75 abcd
Warner Seeds 297	3.71 bcd
Campbell Seed 6380	3.67 cd
Doeblers 636XY	3.55 de
Kidron Seeds 711	3.55 de
Masters Choice MC620	3.35 e

Hybrid means followed by the same letter are not significantly different at 5% level of significance. LSD = 0.32 inches (F = 14.7 significant at P=.01, CV=24.0%)

Table 8. Average corn height 24-25 days after planting for 6 farms with planting date after 5/30/01.

Hybrid	Height (in)
Bird Hybrids B54V	13.8 a
NC+ Organics 3448	13.1 ab
Frenchs 440	12.9 abc
Seed Consultants 1091	12.9 abc
Warner Seeds 297	12.4 bcd
Doeblers 636XY	12.2 bcde
Campbell Seed 6380	12.1 bcde
Agrigold A6447	12.0 cde
Pioneer 34K77	11.8 def
Kidron Seeds 711	11.1 ef
NC+ Organics 4880	10.8 fg
Masters Choice MC620	10.0 g

Hybrid means followed by the same letter are not significantly different at 5% level of significance. LSD = 1.11 inches (F = 65.2 significant at P=.01, CV=23.8%)

Table 9. Corn grain characteristics at harvest – 11 certified organic farms.

Variety	Yield[1]	Harvest Moisture	Test Weight[2]
	(bu/A)	(%)	(lb/bu)
Seed Consultants 1091	99.4 a	19.81 abc	53.8 b
Bird Hybrids B54V	90.2 ab	20.27 bcd	53.0 bcd
French's 440	88.4 abc	18.42 a	53.9 b
Kidron Seeds 711	86.4 bc	20.71 bcd	53.4 bc
Pioneer 34K77	84.9 bc	20.25 bcd	56.1 a
Agrigold A6447	83.9 bcd	20.22 bcd	54.7 ab
Campbell Seed 6380	83.2 bcd	20.84 cd	53.2 bc
NC+Organics 4880	81.9 bcd	20.20 abcd	53.9 b
NC+Organics 3448	81.7 bcd	19.00 ab	55.7 a
Doebler 636XY	78.8 bcd	21.62 d	52.0 cd
Warner Seeds 297	77.5 cd	21.79 d	52.0 cd
Masters Choice MC620	72.4 d	23.92 e	51.5 d
LSD(0.05)	12.05	1.80	1.72
F	2.5	4.9	5.4
CV%	17.0	10.3	3.2

[1]Yields adjusted to 15.0% grain moisture.
[2]Data missing from 3 farms.
Means followed by the same letter in the same column are not significantly different.

Table 10. Stand characteristics at harvest – 11 certified organic farms.

Variety	Harvest Population	Stand	Lodging[1]	Barren[2]
	(plants/A)	(% planted)	(%)	(%)
Seed Consultants 1091	21,409	85.3	1.59 a	10.7 abc
Bird Hybrids B54V	22,818	83.9	4.59 bcd	13.0 bcd
French's 440	22,136	86.1	6.55 d	8.2 ab
Kidron Seeds 711	22,500	85.3	2.59 ab	17.9 d
Pioneer 34K77	21,955	85.5	4.91 bcd	7.3 a
Agrigold A6447	21,682	87.8	4.41 bcd	11.7 abc
Campbell Seed 6380	21,227	86.8	4.18 bcd	11.7 abc
NC+Organics 4880	21,591	87.6	5.45 cd	13.3 bcd
NC+Organics 3448	21,136	89.2	2.41 ab	11.4 abc
Doebler 636XY	20,727	82.6	4.23 bcd	13.5 bcd
Warner Seeds 297	21,864	87.6	3.09 abc	12.9 abcd
Masters Choice MC620	22,727	84.8	5.36 cd	14.7 cd
LSD(0.05)	NS	NS	2.52	5.7
F	1.3	<1	2.6	1.9
CV%	8.5	8.7	72.4	55.0

[1]Plants broken below ear.
[2]Plants with no ear or very small ear (nubbin).
Means followed by the same letter in the same column are not significantly different.

Table 11. Two-year performance of five hybrids at 7-farm locations[1].

Variety	Yield	Harvest Moisture
	(bu/A)	(%)
French's 440	106.9	19.5 a
Agrigold A6447	103.9	21.4 b
Pioneer 34K77	101.1	20.1 ab
Doebler 636XY	96.9	21.2 b
NC+Organics 4880	96.1	21.2 b
LSD (0.05)	NS	1.3
F	1.1	3.3
CV (%)	16.1	14.5

[1]Farms nos. 1,2,4,6,8,10 and 12

Table 12. Soil nitrogen change through 2001 season and corn stalk sample NO_3-N.

Farm No.	Spring NO_3-N	Harvest NO_3-N	Net NO_3-N Decrease	Stalk NO_3-N
	(ppm)	(ppm)	(ppm)	(ppm)
1	10.3	4.4	5.9	160
2	15.3	4.2	11.1	116
3	3.3	2.8	0.5	10
4	7.3	na	na	72
5	6.0	3.6	2.4	29
6	38.8	14.2	24.6	6950
7	22.8	6.3	16.5	483
8	13.1	9.8	3.3	117
9	4.7	2.6	2.1	93
10	17.8	4.4	13.4	3060
12	12.4	5.4	7.0	2520
13	7.2	4.1	3.1	10

Table 13. Soil test level association with yield.

	N	ph	LTI	P	K	Ca	Mg	O.M.	CEC	Ca/Mg Base Ratio
r^2	**0.84**	0.13	0.34	0.21	0.30	-0.15	-0.10	0.05	-0.17	0.28
P-value	**0.001**	0.69	0.28	0.52	0.34	0.64	0.76	0.88	0.59	0.38

Table 14. Grain quality of test hybrids at farms using 3 widest plots (60', 45', 40')[1]

Hybrid	Oil	Protein	Starch	ME	Lysine
	(dw %)	(dw %)	(dw %)	(dw Kcal/lb)	(dw %)
Seed Consultants 1091	3.53 abc	7.55 abc	73.93 abcd	1755 abc	0.278 abc
Bird Hybrids B54V	3.38 bc	7.20 c	73.77 abcd	1750 bc	0.272 c
French's 440	3.66 ab	7.95 abc	73.15 cd	1759 ab	0.284 abc
Kidron Seeds 711	3.87 a	7.42 bc	74.08 abc	1766 a	0.280 abc
Pioneer 34K77	3.64 ab	8.62 a	73.32 bcd	1759 ab	0.293 a
Agrigold A6447	3.56 abc	8.32 ab	72.88 d	1756 abc	0.288 ab
Campbell Seed 6380	3.36 bc	7.92 abc	73.95 abcd	1750 bc	0.281 abc
NC+Organics 4880	3.86 a	7.40 bc	74.27 ab	1766 a	0.280 abc
NC+Organics 3448	3.17 c	7.58 abc	73.74 abcd	1744 c	0.275 bc
Doebler 636XY	3.72 ab	7.82 abc	73.18 bcd	1762 ab	0.283 abc
Warner Seeds 297	3.74 ab	7.86 abc	73.32 bcd	1761 ab	0.284 abc
Masters Choice MC620	3.30 bc	8.62 a	74.75 a	1747 bc	0.289 ab
LSD(0.05)	0.45	1.07	1.09	14.7	0.0155
F	2.1*	1.6	2.1*	2.1*	1.3
Probability	0.07	0.16	0.06	0.06	0.30
CV(%)	7.5	8.0	<1	<1	3.2

[1]Means in the same column followed by same letter are not significantly different from each other. Oil, protein and starch by NIR; M.E. and lysine by calculation. M.E. is non-ruminant metabolizable energy content.

Table 15. Grain quality test hybrids at 3 narrowest plots (10', 15', 15')[1] and correlation with grain quality in widest plots (Table 14).

	Oil	Protein	Starch	ME	Lysine
	(dw %)	(dw %)	(dw%)	(dw Kcal/lb)	(dw%)
Seed Consultants 1091	3.94 abc	8.67 abcd	72.73 bc	1768 ab	0.297 ab
Bird Hybrids B54V	3.73 cde	8.88 abcd	73.00 bc	1762 bcd	0.297 ab
Frenchs 440	3.90 abc	9.11 abc	72.35 c	1767 ab	0.302 ab
Kidron Seeds 711	3.95 abc	8.42 bcd	73.41 ab	1769 ab	0.294 abc
Pioneer 34K77	4.14 a	9.00 abc	72.35 c	1775 a	0.303 ab
Agrigold A6447	3.86 bc	8.45 bcd	72.93 bc	1766 ab	0.293 abc
Campbell Seed 6380	3.78 cd	8.85 abcd	73.01 bc	1763 bc	0.298 ab
NC+ Organics 4880	4.09 ab	9.43 ab	72.53 bc	1773 a	0.308 a
NC+ Organics 3448	3.49 e	7.80 d	74.22 a	1754 d	0.281 c
Doeblers 636XY	3.88 abc	8.85 abcd	72.79 bc	1766 ab	0.299 ab
Warner Seeds 297	3.96 abc	8.23 cd	72.94 bc	1769 ab	0.291 bc
Masters Choice MC620	3.53 de	9.72 a	73.12 bc	1755 cd	0.306 abc
LSD(0.05)	0.28	1.1	0.89	8.8	0.0154
F	4.2	1.9	2.8	4.5	1.9
Probability	0.002	0.09	0.02	0.001	0.09
CV(%)	4.3	7.5	<1	<1	3.1
Wide plot r^2	**0.85**	0.32	0.26	**0.85**	0.42
p-value	0.001	0.307	0.410	0.0004	0.177
Wide plot r_s^2	**0.80**	0.24	0.42	**0.81**	0.36
P-value	0.002	0.457	0.177	0.002	0.237

[1]Means in the same column followed by same letter are not significantly different from each other. Oil, protein and starch by NIR; M.E. and lysine by calculation. M.E. is non-ruminant metabolizable energy content.

Table 16. Select grain quality attributes of corn grown in normal and reduced plant populations.

Select Grain Quality Attribute	Normal (N) Mean	Reduced (R) Mean	Difference (N-R)
oil, dw%	3.94	4.06	-0.12
protein, dw%	8.38	9.17	-0.79 *
starch, dw%	72.38	71.92	0.46 *
lysine, dw%	0.2931	0.3043	-0.0112 *
metabolizable energy, dw kcal/lb	1766.4	1758.3	8.1

*differences significant at 0.05

Table 17. Test plot locations, cultural practices and soil types for the varieties at Ohio State University Corn Performance Trials.

Location	Planting Date	Fert Rate/A	Tillage	Seeding Rate/A	Harvest Date	Previous Crop	Soil Type
OARDC Wooster Campus Wooster Wayne County Northeast Ohio	5/6/01	220#N 40# P 40# K	Conventional	30000	11/7/01	Soybean	Canfield Silt Loam
Marsh Foundation Farm Van Wert Northwest Ohio Van Wert County	5/3/01	300#N 60# P 60# K	Conventional	30000	10/31/01	Soybean	Hoytville Silty Clay
OARDC Northwest Branch Near Hoytville Wood County Northwest Ohio	5/4/01	340#N 40# P 40# K	Stale Seedbed	30000	11/1/01	Soybean	Hoytville Silty Clay
Unger Farm Bucyrus Crawford County Northeast Ohio	5/7/01	200#N 80# P 100#K	Conventional	30000	10/24/01	Wheat	Blount Silt Loam & Pewamo Silty Clay Loam

Table 18. Performance of the 12 varieties at four Ohio State University testing sites and correlations with performance at 11 certified organic farms.

Variety	OSU Yield[1] (bu/A)	Harvest Population (plants/A)	Harvest Moisture (%)	Lodged (%)	Test Weight	Emergence (%)
Seed Consultants 1091	164.8	26444	20.9	5.1	55.3	90.6
Bird B54V	142.3	22717	20.7	6.1	56.0	91.2
Frenchs 440	148.8	27350	19.6	6.7	55.7	92.3
Kidron Seeds 711	140.2	28275	22.1	6.0	55.3	84.8
Pioneer 34K77[2]	152.1	26444	20.7	6.1	57.8	91.2
Agrigold A6447	144.4	24042	21.4	5.8	56.6	86.1
Campbell Seed 6380	150.6	28642	21.4	13.2	55.3	90.2
NC+4880	139.7	29183	22.2	4.9	55.4	92.7
NC+3448	153.1	28742	19.7	15.3	56.2	92.6
Doebler 636XY	144.8	24383	21.6	4.8	54.7	85.0
Warner Seeds 297	150.0	28033	21.7	5.9	54.9	90.4
Masters Choice MC620	114.1	29675	23.9	23.3	55.0	89.6
Average	134.2	27119	21.3	8.6	55.7	89.7
r^2	**0.67**[3]	-0.04	**0.89**	0.09	**0.85**	0.21
p-value	0.02	0.90	0.00	0.77	0.00	0.51
r_s^2	0.25	-0.11	**0.66**	0.13	**0.86**	-0.09
p-value	0.42	0.73	0.02	0.68	0.00	0.78

[1]Yields adjusted to 15.0% grain moisture.
[2] Average of 3 sites since extensive wildlife damage at one site
[3]Bold indicates significant correlation between performance on OSU test sites and performance on farms.

Table 19. Specialty corn grain quality levels (two farms) and OSU results (farm/OSU) and correlations between farms and OSU sites.[1]

HYBRID	Oil	Protein	Starch	ME	Lysine
	(dw %)	(dw %)	(dw %)	(dw Kcal/lb)	(dw %)
Channel SR470	3.80/4.2	7.03/7.2	73.05/72.8	1763/1823	0.274/0.281
Mycogen 2660	4.63/5.4	8.82/9.7	71.38/70.1	1789/1861	0.306/0.326
Pioneer 33Y18	3.11/3.4	7.62/8.3	74.30/74.0	1741/1799	0.275/0.287
Pioneer 34F83	3.36/4.6	8.41/9.5	72.75/72.0	1750/1834	0.291/0.314
Pioneer 34K77	3.60/4.1	8.97/8.9	73.15/72.5	1758/1821	0.297/0.301
Pioneer 34B23	3.01/3.4	8.68/8.9	73.30/73.3	1738/1798	0.284/0.294
Pioneer 34B25	6.15/6.9	9.10/9.3	68.75/68.6	1827/1889	0.326/0.332
LSD (0.05)	1.03/0.2	1.18/0.6	1.08/0.6	24.1	0.011/0.016
r^2	**0.97**	**0.86**	**0.97**	**0.95**	**0.93**
p-value	0.0004	0.01	0.0002	0.0009	0.003
r_s^2	**0.88**	0.58	**0.96**	**0.89**	**0.96**
p-value	0.02	0.16	0.002	0.01	0.002

[1]Oil, protein, and starch by NIR; M.E. and lysine by calculation. M.E. is non-ruminant metabolizable energy content.