NORTHWEST CROPS & SOILS PROGRAM

2022 Grain Corn
Variety x Seeding Rate

Dr. Heather Darby, UVM Extension Agronomist
Sophia Wilcox Warren
UVM Extension Crop and Soil Technicians
802-524-6501

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2022 GRAIN CORN VARIETY X SEEDING RATE TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

In the Northeast there is a strong demand from consumers to have access to a wide range of locally produced food products. This demand creates opportunities for specialty value-added markets and crops to emerge. One market that has been gaining popularity and expanding recently in the Northeast is the specialty corn market. Flint corn has very hard starch and can be ground and used in tortillas, tamales, corn meal, grits, and other products. Flint has a high proportion of hard starch in the kernel that produces a coarse meal. This is different than a soft-starch flour corn that, when ground, results in a fine flour. Dent corn is similar as it has a lower proportion of hard starch than flint corn, and thus forms a small dent on top of each kernel when mature (Figure 1). Flint and flour corn types, although recorded as being grown by Native Americans, have largely not been produced on a commercial scale in this region. However, new food entrepreneurs are looking to source local grain corn, producing potential value-added markets for local farmers. Therefore, it is important to evaluate both commercially available and locally saved flint, flour, and dent corn varieties to determine varieties that are well suited to our northern climate and production practices that produce economically viable yields and meet the quality expectations of this new market.

The University of Vermont Extension Northwest Crops and Soils Program conducted a grain corn variety x seeding rate trial in 2022 to evaluate commercially available flint and heirloom dent corn varieties planted at varying seeding rates for yield, quality, and suitability to our northern climate. It is important to remember that the data presented are from a replicated research trial from only one location in Vermont and represent only one season. Crop performance data from additional tests in different locations and over several years should be compared before making varietal selections or altering production practices.

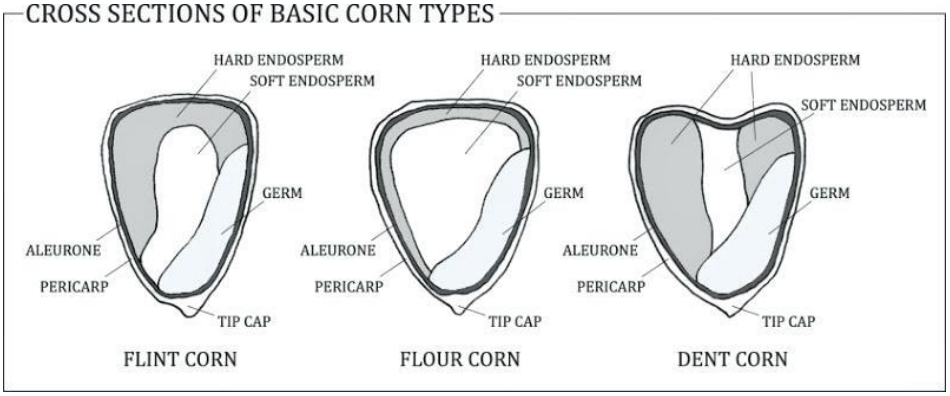

Figure 1. Difference in starch composition of grain corn types (Burton & Fincher, 2014).

MATERIALS AND METHODS

In 2022, two grain corn varieties, one flint and one heirloom dent, were each seeded at six different seeding rates at Borderview Research Farm in Alburgh, Vermont (Table 1). The trial design was a randomized complete block with split plots and four replications. Main plots were the varieties while sub-plots were seeding rates ranging from 20,000 to 30,000 seeds ac^{-1}. Plots were evaluated for populations, lodging, grain yield, grain moisture, and grain test weight. The soil type at the Alburgh location is a Benson rocky silt

loam, 0 to 5 percent slopes. The seedbed was prepared with a Pottinger TerraDisc. The previous crop was soybeans. Prior to planting, plots were fertilized with 7-18-36 at a rate 200 lbs ac^{-1} on 9-May. Plots were planted on 20-May with a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA). Plots were 20' long and consisted of four rows of corn 30" apart. Populations were counted in each plot after emergence and just prior to harvest. On 20-Jun, plots were top-dressed with 46-0-0 plus the inhibitor ContaiN MAX™ at a rate of 200 lbs ac^{-1}.

Table 1. Treatment and trial management information.

Location	**Borderview Research Farm- Alburgh, VT**
Soil type	Benson rocky silt loam, 0 to 5 percent slopes
Previous crop	Soybean
Row width (in)	30
Plot size (ft)	10 x 20
Varieties	Cascade Ruby-Gold (flint type) Wapsie Valley (dent type)
Seeding rates (seeds ac^{-1})	20,000 22,000 24,000 26,000 28,000 30,000
Planting date	20-May
Tillage operations	Pottinger TerraDisc
Fertilizer (lbs ac^{-1})	7-18-36 (200); 9-May
Top dress fertilizer (lbs. ac^{-1})	46-0-0 (200) plus ContaiN MAX™; 20-Jun
Harvest dates	30-Sep (Cascade Ruby-Gold) 26-Oct (Wapsie Valley)

On 30-Sep and 26-Oct, the Cascade Ruby Gold and Wapsie Valley plots were harvested respectively. Corn populations and the number of barren plants (plants that did not form an ear) were counted. Plots were also visually assessed for lodging severity on a scale from 0 (no lodging) to 5 (completely lodged). Corn was picked by hand and fed through an Almaco SPC50 plot combine. The corn from each plot was weighed and the moisture and test weight measured using a Dickey John Mini-GAC Plus moisture and test weight meter.

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and hybrids were treated as fixed. Hybrid mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$). Variations in yield and quality can occur due to variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the

difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two hybrids. Hybrids that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yield of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

Hybrid	Yield
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

RESULTS

Weather data was recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 2). Temperatures were below normal in all months except for October at 1.24° F above normal. The overall growing season for grain corn was cool, at 3.67° F below normal. This season also experienced more rainfall than normal at 3.73 inches more than the 30-yr average. These conditions brought fewer Growing Degree Days (GDDs) with a total of 2290 being accumulated through the growing season, 93 below the 30-year normal.

Table 2. Weather data for Alburgh, VT, 2022.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	65.3	71.9	70.5	60.7	51.5
Departure from normal	-2.18	-0.54	-0.20	-1.99	1.24
Precipitation (inches)	8.19	3.00	4.94	4.40	2.56
Departure from normal	3.93	-1.06	1.40	0.73	-1.27
Growing Degree Days (50-86°F)	459	674	630	343	184
Departure from normal	-64	-20	-11	-44	46

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1991-2020) from Burlington, VT.

Impact of Variety

Cascade Ruby-Gold was extremely affected by a high presence of weeds. All plots of Cascade Ruby-Gold experienced lodging and barren plants. Due to these conditions, yield data was not collected. The rest of this report will discuss the impact of seeding rate on one heirloom variety, Wapsie Valley.

Impact of Seeding Rate

Seeding rate did not significantly impact harvest moisture, test weight, yield, lodging, or the proportion of barren plants (Table 3). The highest yield was obtained at a seeding rate of 22,000 plants ac^{-1} but did not significantly differ from all other seeding rates. The average yield for all treatments in the trial was 97.4 bu ac^{-1}. Lodging and barren plants were measured prior to harvest, but there were no plots with lodging or barren ears and are not listed in the table.

Table 3. Harvest characteristics of six seeding rates of Wapsie Valley grain corn, Alburgh, VT, 2022.

Seeding rate	Harvest moisture	Test weight	Yield at 13% moisture	
plants ac^{-1}	%	lb bu^{-1}	lb ac^{-1}	bu ac^{-1}
20,000	22.7	55.2	4694	83.8
22,000	22.6	53.4	6101	109
24,000	22.9	53.1	5146	91.9
26,000	23.2	54.2	5505	98.3
28,000	22.9	54.7	5407	96.6
30,000	22.5	53.9	5886	105
LSD (p=0.10)	NS†	NS	NS	NS
Trial mean	22.8	54.1	5456	97.4

†NS, within a column there was no significant differences between the treatments.

DISCUSSION

These two specialty grain corn varieties were selected for this trial due to their differences in growth characteristics and kernel starch types. Cascade Ruby-Gold is a short stature flint corn, while Wapsie Valley is a very tall dent corn. The flint corn had a greater potential to produce tillers and the dent corn had lower potential to producer tillers. We hypothesized that these characteristics may impact their response to plant population. Unfortunately, we were unable to collect yield data on the flint corn variety.

While corn planted at a seeding rate of 22,000 plants ac^{-1} had the highest yield of 6101 lbs ac^{-1} and 109 bu ac^{-1}, there was no significant difference compared to the other seeding rates.

Identifying optimum plant populations for flint and heirloom dent corn is critical to help farmers maximize yields of these high value corn types. As these data only represent two varieties planted at one location over one season, additional information should be consulted before making management decisions.

REFERENCES

Burton, Rachel A., and Fincher, Geoffrey B. 2014. Evolution and Development of Cell Walls in Cereal Grains. Frontiers in Plant Science 5:456.

ACKNOWLEDGEMENTS

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