



2019 Heirloom Dry Bean Variety Trial



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Dry beans (*Phaseolus vulgaris*), a high-protein pulse crop, have been grown in the Northeast since the 1800's. As the local food movement continues to diversify and expand, consumers are asking stores to carry more locally-produced foods, and dry beans are no exception. Currently, the demand for heirloom dry beans has far exceeded the supply. In an effort to support and expand the local bean market throughout the northeast, the University of Vermont Extension Northwest Crops and Soils Program established a fifth year of trials in 2019 to evaluate heirloom dry bean varieties to see which ones thrive in our northern climate.

MATERIALS AND METHODS

The trial was established at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with four replications. The treatments were heirloom dry bean varieties. The heirloom dry bean varieties, seed source, relative maturity, and vining tendencies are listed in Table 1.

Table 1. Varietal information for the 10 heirloom dry bean varieties planted in Alburgh, VT, 2019.

Variety	Seed Source	Relative maturity	Vining
Black Calypso	Saved seed, Borderview Research Farm, VT	Early	No
Jacob's Cattle	Saved seed, Borderview Research Farm, VT	Early	No
Jacob's Cattle Gold	Saved seed, Borderview Research Farm, VT	Medium	No
Kenearly Yellow Eye	Saved seed, Borderview Research Farm, VT	Early	No
King of the Early	Saved seed, Borderview Research Farm, VT	Medium	No
Light Red Kidney	Saved seed, Borderview Research Farm, VT	Medium	No
Lina Sisco	Saved seed, Borderview Research Farm, VT	Early	No
Marifax	Saved seed, Borderview Research Farm, VT	Medium	No
Peregion	Saved seed, Borderview Research Farm, VT	Medium	Yes
Tiger's Eye	Saved seed, Borderview Research Farm, VT	Early	Yes

The seedbeds at the Alburgh location were prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The previous crop planted was winter wheat. The plot area was spring plowed, disked and spike tooth harrowed to prepare for planting. The plots were planted on 28-Jun with a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA), at a rate of seven seeds per foot. Prior to planting, the seed was treated with dry bean inoculant (*Rhizobium leguminosarum biovar phaseoli*). The plot size was 5' x 20', with 30-inch row spacing.

Table 2. General trial management information for the 2019 heirloom dry bean variety trials in Alburgh, VT.

Location	Borderview Research Farm, Alburgh, VT
Soil type	Covington silty clay loam, 0-3% slope
Previous crop	Winter wheat
Tillage operations	Spring plow, disk, & spike tooth harrow
Plot size (ft)	5 x 20
Row spacing (inches)	30
Replicates	4
Planting date	28-Jun
Seeding rate	7 seed ft ² (~122,000 seeds ac ⁻¹)
Harvest date	25-Oct

In Alburgh, the plots were hand weeded on 11-Jul and 18-Jul. The total number of plants per plot was recorded on 11-Jul. Plots were scouted on 10-Sep for overall pest damage and disease severity. Each plot was given a score from 0-4, with 0 indicating no leaf damage and 4 indicating that >75% of leaves had been damaged.

All plots were hand harvested on 25-Oct and then hung to dry in a well-ventilated space. Once dry the beans were threshed using a portable thresher with a rasp bar rotor. Beans were then weighed to calculate yields and a DICKEY-John MINI GAC Plus meter or an OHAUS MB23 moisture balance was used to determine bean moisture content and test weight. Data was analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications were treated as random effects and treatments were treated as fixed. 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 because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties 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 (e.g. yield). Least Significant Differences at the 10% level of probability are shown. Where the difference between two varieties within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. Bean varieties that were not significantly lower in performance than the highest variety in a particular column are indicated with an asterisk. In this example, variety A is significantly different from variety C but not from variety B. The difference between A and B is equal to 725 which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454 that is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety.

Variety	Yield
A	3161
B	3886*
C	4615*
LSD	889

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 3). Overall, the season began cooler and wetter than normal but became hot and dry in the middle of the summer. July brought above normal temperatures and little rainfall. The longest period without rainfall in July lasted 12 days. However, these warm conditions did provide optimal Growing Degree Days (GDDs) through the season with a total of 2211 GDDs accumulated from June to October, 197 above normal.

Table 3. Weather data for Alburgh, VT, 2019.

Alburgh, VT	June	July	August	September	October
Average temperature (°F)	64.3	73.5	68.3	60.0	50.4
Departure from normal	-1.46	2.87	-0.51	-0.62	2.22
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Precipitation (inches)	3.06	2.34	3.5	3.87	6.32
Departure from normal	-0.63	-1.81	-0.41	0.23	2.72
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Growing Degree Days (50-86°F)	446	716	568	335	146
Departure from normal	-29	76	-13	17	146

Historical averages are for 30 years of data provided by the NOAA (1981-2010) for Burlington, VT.

Heirloom Dry Bean Scouting

While all plots were impacted by disease and/or insect damage, there was a significant difference in overall severity between varieties (Table 4, Figure 1). The average rating for severity was 1.93. Black calypso and Marifax had the lowest severity with a score of 1.00. Four other varieties, Peregrion, Lina Sisco, Kenealy Yellow Eye, and Jacob's Cattle Gold were statistically similar to the top performing varieties.

Table 4. 2019 Heirloom dry bean overall disease/pest severity in Alburgh, VT.

Variety	Severity
	0-4†
Black Calypso	1.00
Jacob's Cattle	2.25
Jacob's Cattle Gold	1.75*
Kenealy Yellow Eye	1.75*
King of the Early	3.25
Light Red Kidney	2.50
Lina Sisco	1.75*
Marifax	1.00
Peregrion	1.50*
Tigers Eye	2.50
<i>LSD (p=0.10)</i>	0.96
<i>Trial Mean</i>	1.93

†0 to 4 rating; where a rating of 0 = no damage and a rating of 4 means >75% of leaves damaged
 Values shown with an asterisk * are statistically similar to the top performer in **bold**.

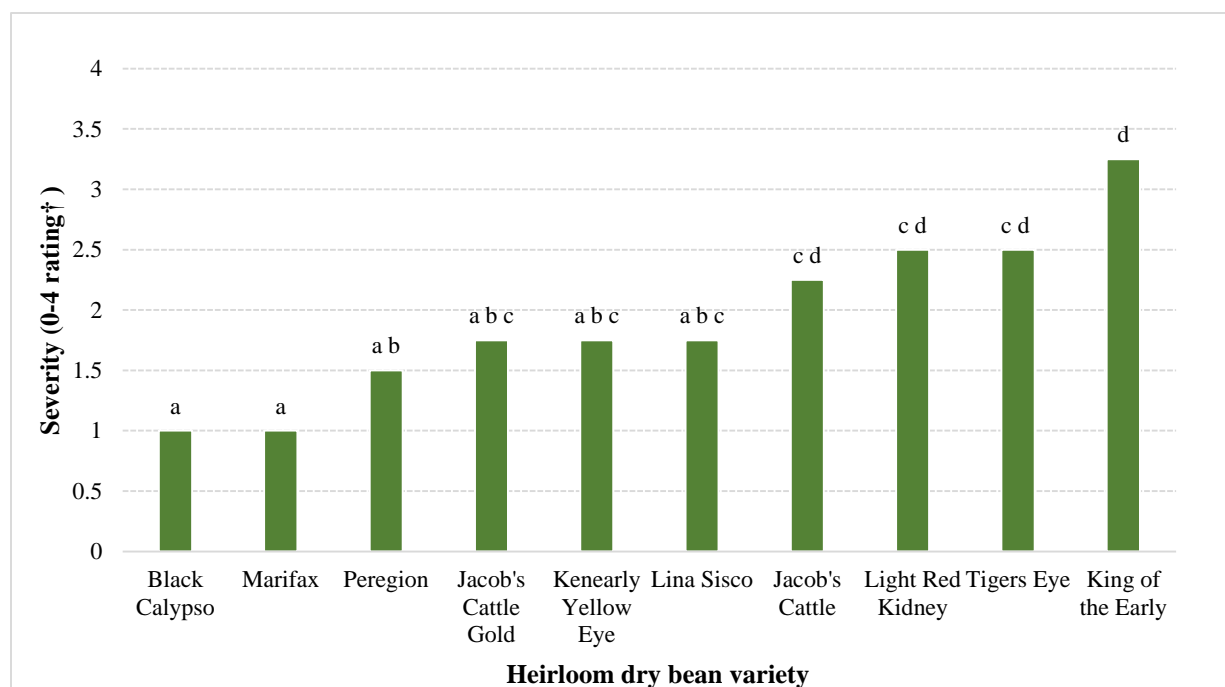


Figure 1. Overall severity of insect damage and disease by variety, Alburgh, VT, 2019.

Varieties with the same letter are statistically similar ($p=0.10$). †0 to 4 rating where 0=no damage and 4 means >75% of leaves damaged.

Heirloom Dry Bean Harvest

There were significant differences in the plant population, yield, and harvest moisture (Table 5). The plant population at harvest ranged from 39,313 plants ac^{-1} to 95,505 plants ac^{-1} . King of the Early had the highest population (95,505 plants ac^{-1}) and Light Red Kidney was statistically similar with a population of 89,516 plants ac^{-1} . The highest yielding variety was Peregrion (2813 lbs ac^{-1}) and the lowest yielding was Tiger's Eye with 1136 lbs ac^{-1} . The variety with the lowest harvest moisture was Lina Sisco (9.9%) and the highest moisture at harvest was Light Red Kidney (13.4%). All of the harvest moistures were below the recommend level of 14% for proper storage. The variety with the highest test weight was Marifax (59.8 lbs bu^{-1}) and the lowest was Jacob's Cattle at 49.0 lbs bu^{-1} . There was no significant difference in test weights and none of the varieties had test weights that met or exceeded the industry standard of 60 lbs bu^{-1} .

Table 5. 2019 Heirloom dry bean harvest measurements, Alburgh, VT.

Variety	Harvest population	Dry matter yield	Harvest moisture	Test weight
	plants ac^{-1}	lbs ac^{-1}	%	lbs bu^{-1}
Black Calypso	39313	1612	11.0*	58.5
Jacob's Cattle	64904	2268	10.8*	49.0
Jacob's Cattle Gold	74597	2516*	10.7*	58.6
Kenearly Yellow Eye	84724	2421*	10.2*	51.2

King of the Early	95505	1768	12.8	58.0
Light Red Kidney	89516*	2036	13.4	55.7
Lina Sisco	66974	1634	9.9	50.4
Marifax	45738	2036	10.0*	59.8
Peregrin	79606	2813	11.2*	59.0
Tigers Eye	56846	1136	13.1	52.6
<i>LSD (p=0.10)</i>	8657	538	1.30	NS
<i>Trial Mean</i>	69772	2024	11.3	55.3

Values shown with an asterisk * are statistically similar to the top performer in **bold**.

NS - not significant at p=0.10.

DISCUSSION

In 2019, dry beans were planted about a month later than in previous years, when beans were planted in late May to early June. While the weather was cooler and wetter than average in June, we saw warmer and drier weather throughout July and August, which may have resulted in better growing conditions for dry beans and a decrease in weed pressure, allowing for better emergence and development of the beans. The increased precipitation and warmer weather in September and October likely created the ideal conditions for fungal pathogens or disease, as some varieties were more severely impacted by disease toward the end of the growing season. Overall, the increased number of growing degree days likely impacted dry bean yields, which were higher than in previous years, although test weights were low for all varieties in the trial. The later planting date allowed for better plant emergence and less pest/disease pressure early on in the season, and overall resulted in high yields even with increased severity of disease/insect damage later in the season. It is important to remember that the results only represent one year of data.

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