

2016

# Heirloom Dry Bean Variety Trial

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## 2016 Heirloom Dry Bean Variety Trial



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## 2016 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 and 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, as part of a USDA NE-SARE Partnership Grant (PG16-049), established a second year of trials in 2016 to evaluate heirloom dry bean varieties to see which ones thrive in our northern climate.

### MATERIALS AND METHODS

The trials were established at Borderview Research Farm in Alburgh, VT and at our partner farm, Morningstar Farms in Glover, VT. Morningstar Farms is certified organic through Vermont Organic Farms, LLC (Richmond, VT). The experimental design at both locations was a randomized complete block with four replications. The treatments were heirloom dry bean varieties. The heirloom dry bean varieties, seed sources, relative maturity, and vining tendencies for both sites are listed in Table 1. The varieties with an asterick (\*) were trialed in Glover.

**Table 1. Varieties, seed sources, relative maturity, and vining of the 18 heirloom dry bean varieties planted in Alburgh and 12 in Glover, VT, 2016.**

Variety	Seed Source	Relative maturity	Vining
Black Calypso*	Saved seed, Borderview Research Farm, VT	Early	No
Hutterite Soup*	University of Minnesota, MN	Medium	Yes
Jacob's Cattle Gold*	University of Minnesota, MN	Medium	No
Jacob's Cattle	Saved seed, Borderview Research Farm, VT	Early	No
Kenearly Yellow Eye*	University of Minnesota, MN	Early	No
King of the Early	Saved seed, Borderview Research Farm, VT	Medium	No
Lowe's Champion*	Rusted Rooster Farm, ME	Medium	No
Lina Sisco*	University of Minnesota, MN	Early	No
Light Red Kidney	Saved seed, Borderview Research Farm, VT	Medium	No
Marifax*	Rusted Rooster Farm, ME	Medium	No
Orca	Saved seed, Borderview Research Farm, VT	Medium-late	Yes
Peregion*	University of Minnesota, MN	Medium	Yes
Raquel*	Saved seed, Borderview Research Farm, VT	Medium-late	No
Spanish Tolasna*	Saved seed, Borderview Research Farm, VT	Medium-late	Yes
Tongues of Fire	Saved seed, Borderview Research Farm, VT	Early	No
Tiger's Eye*	University of Minnesota, MN	Early	Yes
Vermont Appaloosa*	Saved seed, Borderview Research Farm, VT	Early	No
Vermont Cranberry	Saved seed, Borderview Research Farm, VT	Early	Yes

The seedbeds at both the Alburgh and Glover locations 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 at the Alburgh site was sod and in Glover, it was a mixture of vegetables and sod. The field in Alburgh was spring plowed, disked and spike tooth harrowed to prepare for planting. At the Glover site, the seedbed was prepared by spring moldboard plowed and followed by disk harrow. In Alburgh, the plots were planted on 1-Jun with a Monosem 2-row planter, at a rate of 7 seeds per foot. In Glover, the trial was seeded on 8-Jun with a White 140 plate planter calibrated for 7 seeds per foot. Prior to planting, bean seed at both trial locations were treated with dry bean inoculant (*Rhizobium leguminosarum biovar phaseoli*). Additionally, starter fertilizer was applied in Alburgh at 150 lbs ac<sup>-1</sup> to the acre of 10-20-20 and in Glover, an organic approved fertilizer called MicroSTART 60 (3-2-3) was applied at 350 lbs ac<sup>-1</sup>. Plot size in Alburgh was 5' x 20' and 5' x 12' in Glover, with 30-inch row spacing at both locations.

**Table 2. General trial management information of the 2016 heirloom dry bean variety trials in Alburgh, VT and Glover, VT.**

<b>Location</b>	<b>Borderview Research Farm, Alburgh, VT</b>	<b>Morningstar Farms, Glover, VT</b>
<b>Soil type</b>	Benson rocky silt loam	Sandy loam
<b>Previous crop</b>	Sod	Mixed vegetables and sod
<b>Tillage operations</b>	Spring plow, disk, & spike tooth harrow	Moldboard plow & disk harrow
<b>Plot size (feet)</b>	5 x 20	5 x 12
<b>Row spacing (inches)</b>	30	30
<b>Replicates</b>	4	4
<b>Starter Fertilizer (lbs ac<sup>-1</sup>)</b>	150 - (10-20-20)	350 – MicroSTART 60 (3-2-3)
<b>Planting date</b>	1-Jun	8-Jun
<b>Seeding rate</b>	7 seed ft <sup>2</sup> (~122,000 seeds ac <sup>-1</sup> )	7 seed ft <sup>2</sup> (~122,000 seeds ac <sup>-1</sup> )
<b>Planter</b>	Monosem 2 row planter	White 140 plate planter
<b>Tinweed</b>	None	Pre-emergence
<b>Cultivation</b>	4-Row Brillion: 6-Jul and 11-Jul	John Deere 4-row C-shank w/ crop shields: weekly for 4 weeks starting 28-Jun
<b>Harvest date</b>	20-Sep	6-Oct

Plant populations were taken at Morningstar Farms on 30-Jun by counting the number of plants in each plot.

In Alburgh, the plots were mechanically cultivated with a 4-row Brillion cultivator on 6-Jul and 11-Jul. At the Glover location, plots were tine weeded prior to bean emergence and a John Deere 4-row C-shank with crop shields was used to cultivate weekly for four weeks starting 28-Jun.

On 8-Jul and 8-Aug, plots were scouted at the Alburgh site and on 19-Jul in Glover. Trials were scouted by using two, 0.5 meter quadrats for disease symptoms and insect damage in each plot. Quadrats were

placed randomly within bean rows. In each quadrat, the number of plants was recorded. The number of plants with disease symptoms and insect damage were recorded. In addition, one plant per quadrat was pulled to examine roots for pest damage. Plants with unknown discoloration or damage were pulled, placed in a labeled plastic bag, refrigerated, and identified at the UVM Plant Diagnostic Laboratory.

At the time of harvest, at both trial locations, plant height, relative maturity, plant vining, lodging, pod distance to ground were determined and 10 pods from each plot were examined for the presence of disease. At both locations, plots were hand harvested and then threshed with a portable thresher with a rasp bar rotor. Beans were then weighed to calculate yields and a DICKEY-John MINI GAC Plus meter was used to determine bean moisture content and test weight. Harvest occurred on 20-Sep and 21-Sep in Alburgh and 6-Oct in Glover.

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 ( $p < 0.10$ ). In Alburgh, diseased pods, moisture, and test weight were analyzed using the PROC MIXED procedure in SAS using the Tukey-Kramer adjustment, which means that each variety was analyzed with a pairwise comparison. There were significant differences among the two locations for most parameters, and therefore, data from each location is reported independently.

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. Wheat varieties that were not significantly lower in performance than the highest variety in a particular column are indicated with an asterisk. In the example below, 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*
<b>LSD</b>	<b>889</b>

## RESULTS

Seasonal precipitation and temperature recorded at a weather station in close proximity to the Alburgh trial site is shown in Table 3. The weather during the 2016 growing season was warmer and drier than average. Below average rainfall was recorded in June, July, August, and September totaled 5.35 inches below the 30-year average. In Alburgh, there was an accumulation of 2222 Growing Degree Days (GDDs), which is 195 GDDs above the 30-year average.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2016.**

<b>Alburgh, VT</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>
Average temperature (°F)	65.8	70.7	71.6	63.4
Departure from normal	0.01	0.13	2.85	2.90
Precipitation (inches)	2.81	1.79	2.98	2.47
Departure from normal	-0.88	-2.37	-0.93	-1.17
Growing Degree Days (50-86°F)	481	640	663	438
Departure from normal	7.2	1.4	81.9	104

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.

Historical averages are for 30 years of data provided by the NOAA (1981-2010) for Burlington, VT. Alburgh precipitation data from 8/17/16-10/31/16 was missing and replaced by data provided by the NOAA for Highgate, VT.

Seasonal precipitation and temperature recorded at a weather station in close proximity to the Glover trial site is shown in Table 4. The 2016 growing season at the Glover location brought cooler than average temperatures in June and July followed by warmer temperatures in August, September, and October. Above average rainfall was recorded in the months of June, July, and August that totaled three inches higher the 30-year average. Below average rainfall was recorded in September and October. In Glover, there was an accumulation of 2171 Growing Degree Days (GDDs), which is 83 GDDs above the 30-year average.

**Table 4. Temperatures and precipitation summary for Glover, VT, 2016.**

<b>Saint Johnsbury, VT</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>
Average temperature (°F)	63.8	69.3	69.2	61.6	49.0
Departure from normal	-1.81	-0.62	1.35	1.60	1.80
Precipitation (inches)	4.63	5.19	5.54	1.50	3.35
Departure from normal	0.62	1.07	1.32	-1.89	-0.52
Growing Degree Days (50-86°F)	431	597	591	401	151
Departure from normal	-37.3	-21.2	39.1	72.5	30.2

Based on National Weather Service data from cooperative observation stations in Saint Johnsbury, VT.

Historical averages are for 30 years of NOAA data (1981-2010) from St. Johnsbury, VT.

### Heirloom Dry Bean Scouting

Several plant pests were identified through scouting the trials this season (Table 5, Table 6). Root rots, primarily, Fusarium, Rhizoctonia, and Pythium root rot, were present at both trial locations. In Alburgh, ‘Kenealy Yellow Eye’ had the lowest root rot severity (0.50 %) and ‘King of the Early’ had the highest severity at 41.3 %. At the Glover trial location, ‘Hutterite Soup’ had the lowest root rot infection severity (0.00 %) and ‘Raquel’ had the highest with 56.3 % severity. Alternaria leaf spot (*Alternaria Aaternata*) was confirmed at both trial locations, however the severity was minimal. A bean mosaic virus was observed at the Alburgh trial site however, the exact virus was not determined. Anthracnose (*Glomerella lindemuthiana*) infection was seen on five dry bean varieties: Spanish Tolasna, Vermont Cranberry, Jacob’s Cattle, Tiger’s Eye, and Tongues of Fire. Common bacterial blight (*Xanthomonas axonopodis* pv. *phaseoli*) was identified in all of the varieties, in varying degrees, at both trial locations. ‘Light Red Kidney’ had the lowest severity at the Alburgh trial site (5.00%) and in Glover, Raquel and ‘Spanish Tolasna’ had the lowest severity (0.50%). Interestingly, Light Red Kidney also had the lowest Potato leafhopper severity. In contrast, Hutterite Soup had the highest amount of common bacterial blight (77.5%) and one of the highest severities for potato leafhopper (100%) (Table 7).

**Table 5. 2016 Heirloom dry bean disease severity in Alburgh, VT.**

Variety	Root rots	Anthracnose	Common bacterial blight	Alternaria leaf spot	Mosaic virus
	%	%	%	%	%
Black Calypso	8.75	<b>0.00</b>	50.0	2.50	25.0
Hutterite Soup	7.50	<b>0.00</b>	77.5	<b>0.00</b>	7.50
Jacob's Cattle	5.00	5.00	50.0	<b>0.00</b>	35.0
Jacob's Cattle Gold	21.3	<b>0.00</b>	47.5	<b>0.00</b>	20.0
Kenealy Yellow Eye	<b>0.50</b>	<b>0.00</b>	45.0	<b>0.00</b>	50.0
King of the Early	41.25	<b>0.00</b>	47.5	<b>0.00</b>	15.0
Lowe’s Champion	6.25	<b>0.00</b>	35.0	1.25	8.00
Lina Sisco	5.00	<b>0.00</b>	35.0	<b>0.00</b>	25.0
Light Red Kidney	13.8	<b>0.00</b>	<b>5.00</b>	1.75	<b>1.75</b>
Marifax	1.25	<b>0.00</b>	30.0	2.50	15.0
Orca	2.50	<b>0.00</b>	30.0	<b>0.00</b>	23.8
Peregion	13.8	<b>0.00</b>	6.25	<b>0.00</b>	3.00
Raquel	25.0	<b>0.00</b>	23.8	1.25	21.3
Spanish Tolasna	2.50	2.50	41.3	2.50	30.0
Tiger's Eye	5.00	7.50	37.5	<b>0.00</b>	32.5
Tongues of Fire	2.50	22.5	70.0	<b>0.00</b>	40.0
Vermont Appaloosa	18.8	<b>0.00</b>	32.5	<b>0.00</b>	55.0
Vermont Cranberry	20.0	2.50	20.0	<b>0.00</b>	7.50

Values shown in **bold** are of the highest value or top performing.

**Table 6. 2016 Heirloom dry bean disease severity in Glover, VT.**

Variety	Root Rots	Common bacterial blight	Alternaria Leaf spot
	%	%	%
Black Calypso	10.0	4.25	<b>0.00</b>
Hutterite Soup	<b>0.00</b>	0.75	<b>0.00</b>
Jacob's Cattle Gold	27.5	2.50	2.50
Kenearly Yellow Eye	27.5	2.50	<b>0.00</b>
Lowe's Champion	7.50	2.75	<b>0.00</b>
Lina Sisco	53.8	1.25	3.75
Marifax	25.0	1.00	<b>0.00</b>
Peregrion	1.25	1.25	<b>0.00</b>
Raquel	56.3	<b>0.50</b>	<b>0.00</b>
Spanish Tolasna	23.8	<b>0.50</b>	0.50
Tiger's Eye	12.5	5.50	<b>0.00</b>
Vermont Appaloosa	8.75	1.50	<b>0.00</b>

Values shown in **bold** are of the highest value or top performing.

Injury of certain heirloom dry bean varieties from potato leafhopper feeding was observed at both trial locations, and the most severe injury was recorded in Alburgh (Table 7, Figure 1). Potato leafhoppers feed with piercing-sucking mouthparts on host plant vascular tissue (Image 1). This restricts phloem and eventual xylem flow to the rest of the leaf resulting in leaf edge yellowing and curling. At high infestation levels, stunted internodes can be observed. Visual damage caused by potato leafhopper is called “hopperburn” (Image 2). Hopperburn is not present until 5-7 days after leafhopper feeding has occurred. The first sign is yellowing of the leaf at the tip followed by necrosis and leaf curling. These symptoms are the result of the plant shutting down photosynthesis in the leaf in response to leafhopper feeding. As this pest weakens a plant, it becomes more vulnerable to disease. In Alburgh, ‘Lowe’s Champion’ and ‘Peregrion’ had low potato leafhopper damage; all the other varieties had severities above 40% (Table 7). At the Glover location, the potato leafhopper was not nearly as severe, 3.0% - 15.0%.



**Table 7. 2016 Heirloom dry bean Potato leafhopper damage in Alburgh, VT and Glover, VT.**

Variety	Alburgh, VT	Glover, VT
	Potato leafhopper damage	Potato leafhopper damage
	%	%
Black Calypso	78.8	8.75
Hutterite Soup	100	4.25
Jacob's Cattle	72.5	-
Jacob's Cattle Gold	76.3	9.25
Keneary Yellow Eye	100	15.0
King of the Early	67.5	-
Lowe's Champion	<b>7.50*</b>	<b>3.00</b>
Lina Sisco	58.8	6.75
Light Red Kidney	58.8	-
Marifax	56.3	10.0
Orca	41.3	-
Peregrine	10.0*	12.5
Raquel	71.3	3.75
Spanish Tolasna	57.5	6.25
Tiger's Eye	61.3	11.3
Tongues of Fire	97.5	-
Vermont Appaloosa	62.5	10.0
Vermont Cranberry	48.8	-
<i>LSD (0.10)</i>	22.4	NS
<i>Trial Mean</i>	62.6	8.40

Values shown in **bold** are of the highest value or top performing.

\* Dry beans that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

NS-Treatments were not significantly different from one another.

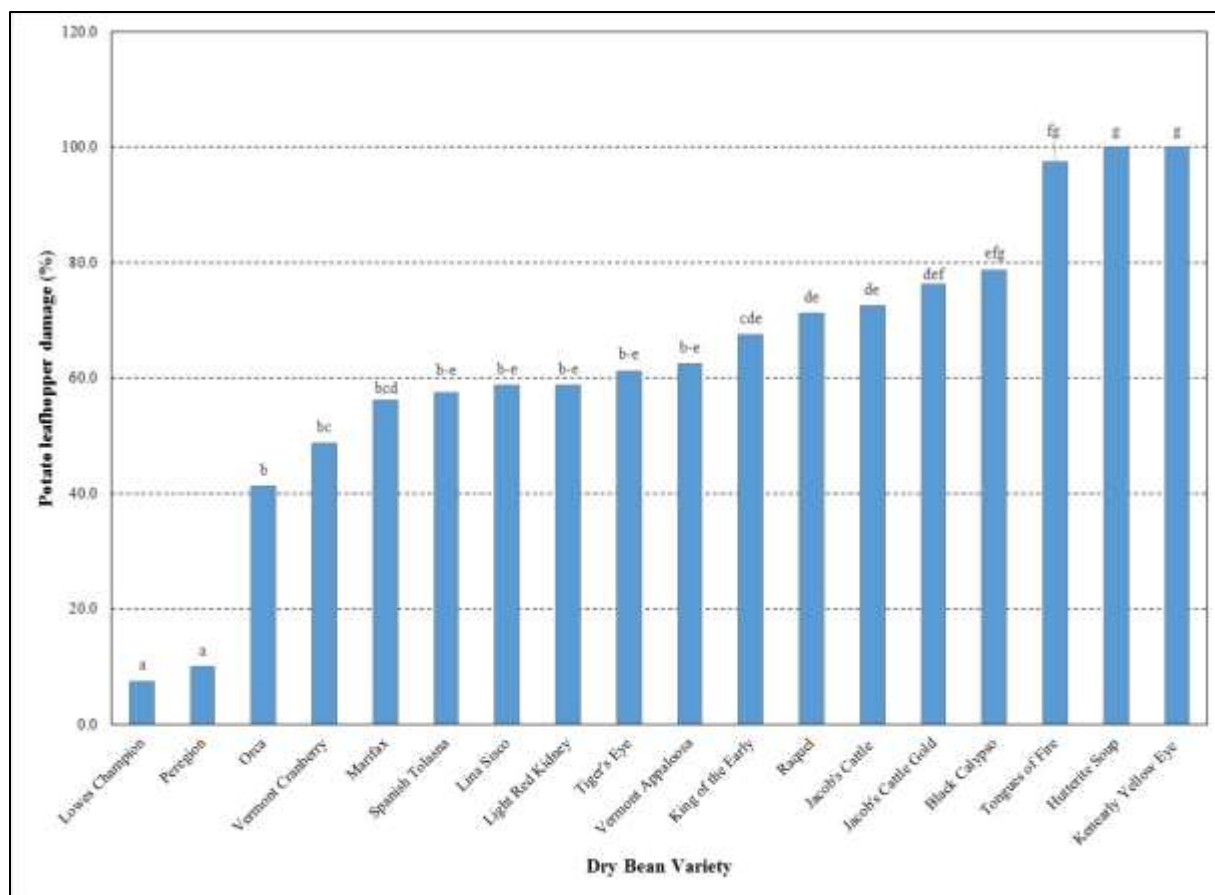
'-' indicates varieties not grown at the Glover, VT trial site.



**Image 1. Potato leafhoppers on heirloom dry beans, Alburgh, VT.**



**Image 2. Dry bean "hopperburn", Alburgh, VT.**



**Figure 1. 2016 Potato leafhopper damage of heirloom dry bean varieties in Alburgh, VT**  
Varieties with the same letter did not differ significantly in yield.

### ***Heirloom Dry Bean Harvest – Alburgh, VT***

In Alburgh, there were significant differences in plant height. The tallest variety was Light Red Kidney at 38.3 cm. Other tall varieties included: ‘Lowe’s Champion,’ Kenearly Yellow Eyes, ‘Orca,’ Peregrino, Spanish Tolasna, ‘Vermont Appaloosa,’ ‘Jacob’s Cattle Gold,’ ‘Jacob’s Cattle,’ and ‘Marifax.’ The shortest variety was ‘Tongues of Fire’ at 25 cm. There was no significant difference in lodged plants. Only two varieties, Hutterite Soup and Peregrino lodged minimally (7.50%). Although not significant, the variety with greatest pod distance to ground was Kenearly Yellow Eye (2.33 cm). Several varieties had pods touching or nearly touching the ground. This can promote the spread of disease and can lead to premature sprouting of the beans in the pods. The primary pod diseases observed were Aschochyta and Anthracnose. The variety with the lowest pod disease severity was Peregrino (7.50%) while ‘Black Calypso’ had the highest at 52.5%. The severity of diseased pods was not found to be significant.

**Table 8. 2016 Heirloom dry bean pre-harvest measurements, Alburgh, VT.**

Variety	Plant height	Lodged	Pod distance to ground	Pod disease
	cm	%	cm	%
Black Calypso	28.2	<b>0.00</b>	1.17	52.5
Hutterite Soup	28.5	7.50	1.17	22.5
Jacob's Cattle Gold	32.6*	<b>0.00</b>	0.75	30.0
Jacob's Cattle	32.4*	<b>0.00</b>	1.83	30.0
Kenearly Yellow Eye	34.9*	<b>0.00</b>	<b>2.33</b>	25.0
King of the Early	30.6	<b>0.00</b>	0.50	47.5
Lowe's Champion	36.3*	<b>0.00</b>	1.08	32.5
Lina Sisco	29.5	<b>0.00</b>	0.00	20.0
Light Red Kidney	<b>38.3*</b>	<b>0.00</b>	0.17	37.5
Marifax	32.2*	<b>0.00</b>	0.08	32.5
Orca	34.7*	<b>0.00</b>	0.25	22.5
Peregrion	34.2*	7.50	0.00	<b>7.50</b>
Raquel	31.3	<b>0.00</b>	0.08	32.5
Spanish Tolasna	34.0*	<b>0.00</b>	0.83	37.5
Tongues of Fire	25.0	<b>0.00</b>	0.00	40.0
Tiger's Eye	31.5	<b>0.00</b>	0.00	30.0
Vermont Appaloosa	33.3*	<b>0.00</b>	0.00	35.0
Vermont Cranberry	27.4	<b>0.00</b>	0.00	42.5
<i>LSD (0.10)</i>	6.15	NS	NS	NS
<i>Trial Mean</i>	31.9	0.83	0.57	32.1

Values shown in **bold** are of the highest value or top performing.

\* Dry beans that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

NS-Treatments were not significantly different from one another.

In Alburgh, there were significant differences in the yield, harvest moisture, and test weight (Table 9). The highest yielding variety was Peregrion (2264 lbs ac<sup>-1</sup>) and the lowest yielding was Tongues of Fire with 242 lbs ac<sup>-1</sup> (Figure 2). The variety with the lowest harvest moisture was King of the Early (19.0%) and the highest moisture at harvest was Tongues of Fire (36.0%). All of the harvest moistures were above the recommend level for proper storage and therefore, all varieties had to be dried down to below 14% moisture. The variety with the highest test weight was Hutterite Soup (60.9 lbs bu<sup>-1</sup>). Other varieties with high test weights include: Kenearly Yellow Eye (60.8 lbs bu<sup>-1</sup>), Peregrion (60.4 lbs bu<sup>-1</sup>), Lowe's Champion (60.0 lbs bu<sup>-1</sup>), Black Calypso (59.1 lbs bu<sup>-1</sup>), 'Vermont Cranberry' (59.0 lbs bu<sup>-1</sup>), Spanish Tolasna (58.3 lbs bu<sup>-1</sup>), King of the Early (58.2 lbs bu<sup>-1</sup>), and Marifax (58.0 lbs bu<sup>-1</sup>). However, only four

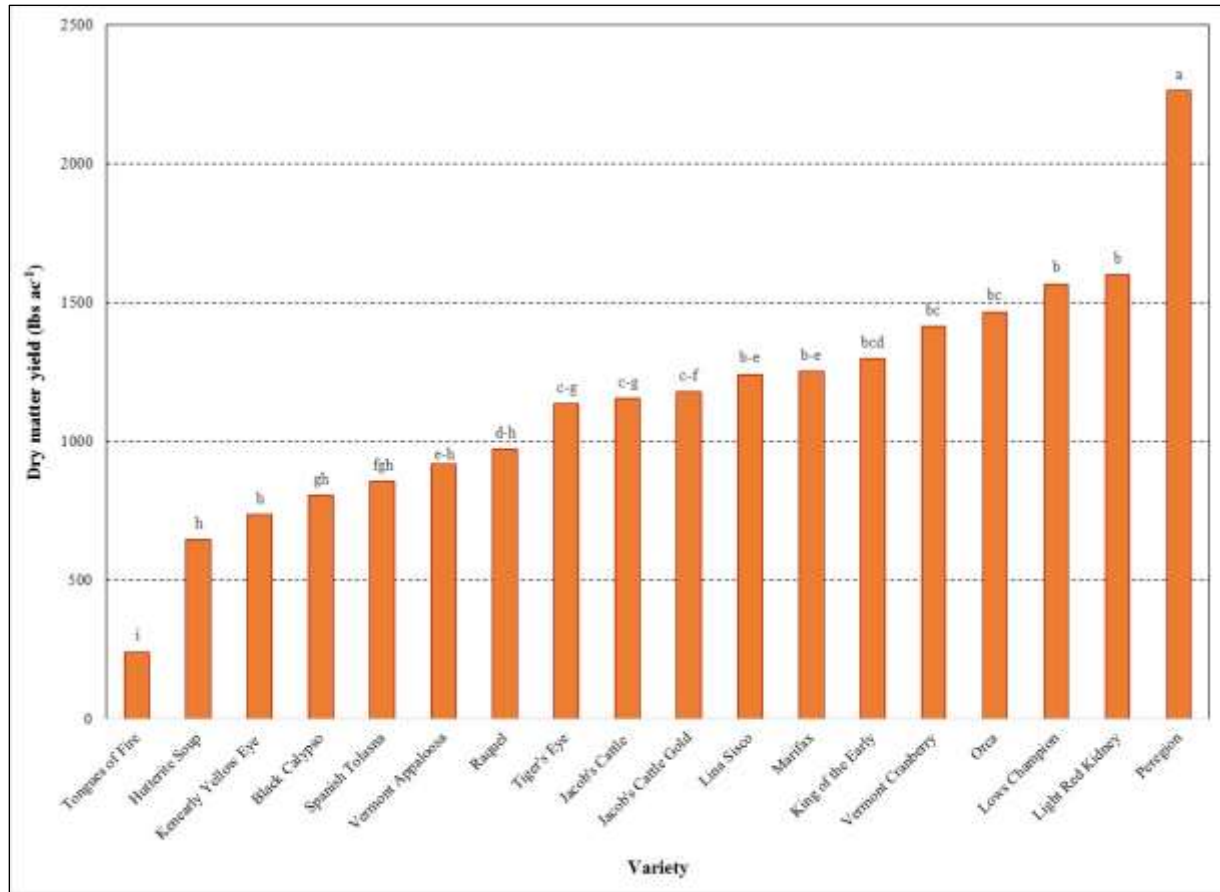
varieties (Hutterite Soup, Keneary Yellow Eye, Peregrion, and Lowes Champion) had test weights that met or exceeded industry standards of 60 lbs bu<sup>-1</sup>.

**Table 9. 2016 Heirloom dry bean harvest measurements, Alburgh, VT.**

Variety	Dry matter yield	Harvest moisture	Test weight
	lbs ac <sup>-1</sup>	%	lbs bu <sup>-1</sup>
Black Calypso	806	19.9*	59.1*
Hutterite Soup	646	25.5*	<b>60.9*</b>
Jacob's Cattle Gold	1179	27.0	54.1
Jacob's Cattle	1155	22.0*	57.3
Keneary Yellow Eye	734	19.8*	60.8*
King of the Early	1297	<b>19.0*</b>	58.2*
Lowe's Champion	1567	23.6*	60.0*
Lina Sisco	1241	19.8*	55.4
Light Red Kidney	1601	20.9*	55.4
Marifax	1252	23.0*	58.0*
Orca	1466	31.2	54.5
Peregrion	<b>2264*</b>	23.9*	60.4*
Raquel	973	26.3	54.5
Spanish Tolasna	856	25.7	58.3*
Tongues of Fire	242	36.0	43.6
Tiger's Eye	1135	20.6*	53.2
Vermont Appaloosa	920	21.9*	57.3
Vermont Cranberry	1412	23.0*	59.0*
<i>LSD (0.10)</i>	362	6.37	3.44
<i>Trial Mean</i>	1153	23.8	56.7

Values shown in **bold** are of the highest value or top performing.

\* Dry beans that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.



**Figure 2. 2016 Heirloom dry bean yields, Alburgh, VT.**  
 Varieties with the same letter did not differ significantly in yield.

***Heirloom Dry Bean Harvest – Glover, VT***

Plant population, plant height, pod distance to ground, and pod disease severity were all significantly different at the Glover trial location (Table 10). ‘Red Calypso’ had the highest plant population (65,703 plants ac<sup>-1</sup>) and the lowest plant population was Lowe’s Champion (4175 plants ac<sup>-1</sup>). The tallest plant variety at this location was Jacob’s Cattle Gold (46.8 cm). Other tall varieties were Raquel (44.0 cm) and Spanish Tolasna (42.5 cm). The greatest pod distance to ground was Jacob’s Cattle Gold (10.3 cm) and this variety had one of the lowest pod disease severities (15.0%) as well. Several varieties that had higher pod distance from the ground and also lower pod disease severity included Marifax, Kenearly Yellow Eye, and Raquel. Peregion was the exception with a pod distance to ground of 0.58 cm and pod disease severity of 15%.

**Table 10. 2016 Heirloom dry bean plant populations and pre-harvest measurements in Glover, VT.**

Variety	Plant population	Plant height	Pod distance to ground	Pod disease
	# per ac <sup>-1</sup>	cm	cm	%
Black Calypso	29222	36.9	5.25	42.5
Hutterite Soup	28859	36.3	1.25	27.5*
Jacob's Cattle Gold	39658	<b>46.8*</b>	<b>10.3*</b>	<b>15.0*</b>
Kenearly Yellow Eye	25047	37.5	8.92*	17.5*
Lowe's Champion	4175	33.8	1.00	30.0*
Lina Sisco	39386	35.4	4.25	57.5
Marifax	37026	36.1	9.75*	20.0*
Peregion	<b>65703*</b>	38.8	0.58	<b>15.0*</b>
Raquel	32035	44.0*	7.75*	25.0*
Spanish Tolasna	32307	42.5*	5.58	35.0*
Tiger's Eye	46283	31.5	1.25	77.5
Vermont Appaloosa	35302	41.3	3.92	52.5
<i>LSD (0.10)</i>	8857	5.07	4.36	26.1
<i>Trial Mean</i>	34583	38.4	4.98	34.6

Values shown in **bold** are of the highest value or top performing.

\* Dry beans that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

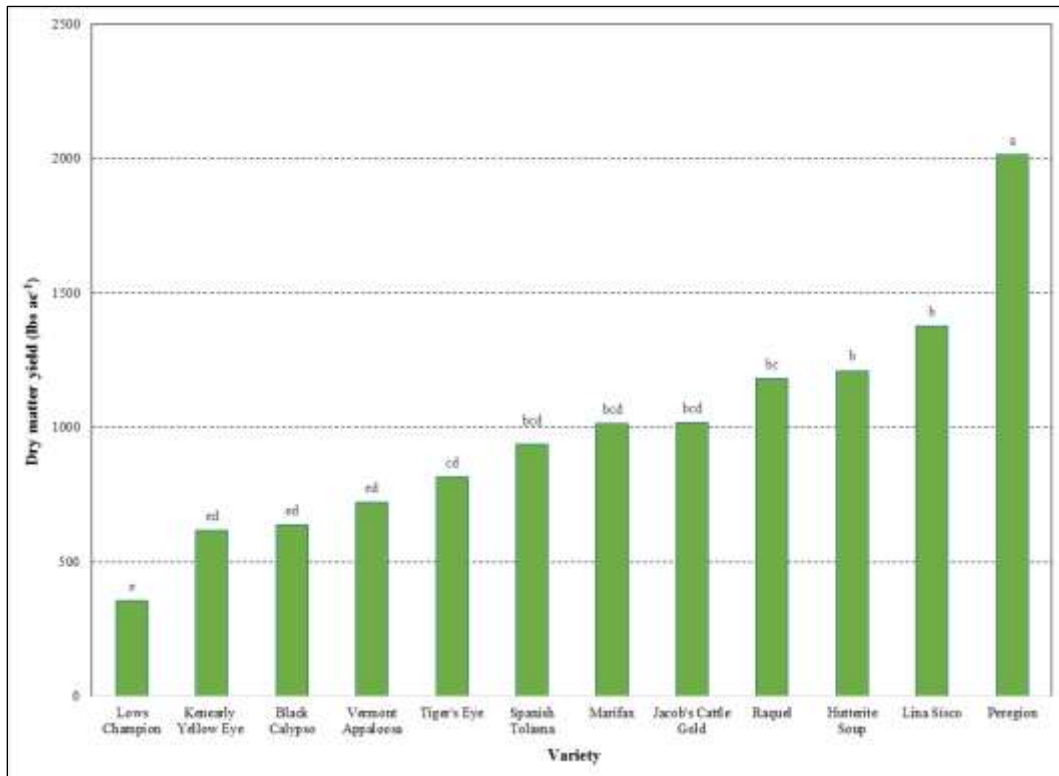
In Glover, harvest yield, moisture, and test weight differed significantly by variety (Table 11). The highest yielding variety was Peregion (2016 lbs ac<sup>-1</sup>). The lowest yielding harvested variety was Lowe's Champion (355 lbs ac<sup>-1</sup>) (Figure 3). The varieties with the lowest moistures at harvest were Black Calypso, Marifax, and 'Tiger's Eye' at 22.8%. All varieties were above the recommended storage moisture of 14% and therefore had to be dried down. Peregion had the highest test weight of 58.9 lbs bu<sup>-1</sup>. Other varieties with high test weights include: Hutterite Soup (58.8 lbs bu<sup>-1</sup>), Vermont Appaloosa (58.3 lbs bu<sup>-1</sup>), Marifax (58.3 lbs bu<sup>-1</sup>), and Kenearly Yellow Eye (58.1 lbs bu<sup>-1</sup>). However, all varieties were below industry standards of 60 lbs bu<sup>-1</sup>.

**Table 11. 2016 Heirloom dry bean yield and quality, Glover, VT.**

Variety	Dry matter yield	Harvest moisture	Test weight
	lbs ac-1	%	lbs bu-1
Black Calypso	637	<b>22.8*</b>	54.6
Hutterite Soup	1212	26.5	58.8*
Jacob's Cattle Gold	1018	32.8	55.3
Kenearly Yellow Eye	617	23.5*	58.1*
Lows Champion	355	26.8	56.8
Lina Sisco	1378	23.3*	56.8
Marifax	1014	<b>22.8*</b>	58.3*
Peregrin	<b>2016*</b>	25.6*	<b>58.9*</b>
Raquel	1182	30.0	54.7
Spanish Tolansa	938	32.0	54.3
Tiger's Eye	815	<b>22.8*</b>	52.1
Vermont Appaloosa	724	25.0*	58.3*
<i>LSD (0.10)</i>	446	3.56	1.80
<i>Trial Mean</i>	992	26.1	56.4

Values shown in **bold** are of the highest value or top performing.

\* Dry beans that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.



**Figure 3. 2016 Heirloom dry bean yields, Glover, VT.**

Varieties with the same letter did not differ significantly in yield.

## DISCUSSION

It is important to remember that the results only represent one year of data. Seed quality continues to be an important issue in dry bean production. Before variety trials were planted, percent seed germination was determined for each variety and seeding rates adjusted and those varieties with low germination rates were eliminated from the 2016 trials. The one exception was Lowe's Champion (62% germination), which was kept in because it was a new variety for our trials. Even with adjusting for the low germination this variety had poor stand establishment (4175 plants ac<sup>-1</sup>) indicating there might have been other seed quality issues.

The overall warmer and drier conditions throughout the 2016 growing season, in both trial locations, resulted in higher dry bean yields and quality. Weed pressure was minimal because timely cultivation was possible this season. We did observe that several of the bush varieties produced vines (Hutterite Soup, Orca, Peregrine, Spanish Tolasna, and Vermont Cranberry) which may have been in response to the drought conditions.

Severe potato leafhopper damage was observed in Alburgh. Potato leafhopper populations were high throughout Vermont during the 2016 growing season. Interestingly, Hutterite Soup, Kenealy Yellow Eye, and Tongues of Fire appeared to be particularly susceptible to leafhopper damage whereas Light Red Kidney and Peregrine were relatively tolerant. As a result of the leafhopper damage "hopperburn", we saw an increase in secondary plant disease infections, primarily common bacterial bean blight. Overall, the variety Peregrine outperformed all the other heirloom dry bean varieties for both yield and quality at both trial locations. Other heirloom dry bean varieties that performed relatively well this season across trial sites for both yield and quality included Lina Sisco and Marifax.

More research needs to be done to determine which varieties thrive in our climate and therefore, the Northwest Crops and Soils team plans to repeat this trial in 2017 at both trial locations.

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