NORTHWEST CROPS & SOILS PROGRAM

2023 Organic Dry Bean Variety Trial

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2023 ORGANIC 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 locally sourced dry beans has far exceeded the supply. Farmers are also looking for high-value crops to diversify their rotations. Modern breeding efforts have expanded the market classes that can be direct harvested, lowering the barrier to entry by reducing the need for specialized equipment. Despite the growing interest, there has been little evaluation of alternative market classes, such as navy, small red, pinto, yellow, and heirloom/specialty beans. These alternative market classes are valued by consumers for their culinary characteristics and visual appeal. To support and expand organic dry bean production throughout the northeast, the University of Vermont Extension Northwest Crops and Soils Program initiated a research trial to evaluate twenty-eight organic dry bean varieties from different market classes to identify varieties suitable for organic production in the Northeast.

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 twenty-eight dry bean varieties. Varietal information can be found in Table 1 below.

Table 1. Varietal information for the twenty-eight dry bean varieties planted in Alburgh, VT, 2023.

Variety	Seed Source	Market class
Alpena	Central Bean Co.	Navy
Black Tails	Treasure Valley Seeds	Black
Blizzard	Treasure Valley Seeds	Navy
Cayenne	Treasure Valley Seeds	Small Red
Charro	Michigan State University	Pinto
Cowboy	ADM Edible Bean Specialties, Inc.	Pinto
Desert Song	GenTec Seeds LTD	Specialty
Eclipse	Central Bean Co.	Black
GTS 1701	GenTec Seeds LTD	Specialty
Gypsy Rose	GenTec Seeds LTD	Specialty
Jacob's Cattle	GenTec Seeds LTD	Specialty
Lariat	Central Bean Co.	Pinto
Max	ADM Edible Bean Specialties, Inc.	Pinto
Merlin	Treasure Valley Seeds	Navy
Merlot	Central Bean Co.	Small Red
Orca	Central Bean Co.	Specialty
Pencil Pod Soldier	GenTec Seeds LTD	Specialty
Rojo Chiquito	Central Bean Co.	Small Red
Tiger's Eye	GenTec Seeds LTD	Specialty
UC 1004	University of California, Davis	Specialty

UC 1005	University of California, Davis	Specialty
UC Andino	University of California, Davis	Specialty
UC Holstein	University of California, Davis	Specialty
UC Jacob's Cattle	University of California, Davis	Specialty
UC Southwest Gold	GenTec Seeds LTD	Specialty
UC Tiger's Eye	GenTec Seeds LTD	Specialty
Zenith	Central Bean Co.	Black
Zorro	Seneca Grain & Bean	Black

Trial management details can be found in Table 2. Dry beans were planted on 31-May with a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA). The seeding rate varied by market class. Black, navy, and small red beans were planted at 125,000 seeds ac^{-1}. Pinto beans and specialty beans were planted at 95,000 seeds ac^{-1} and 100,000 seeds ac^{-1} respectively. Prior to planting, the seed was treated with dry bean inoculant (*Rhizobium leguminosarum biovar phaseoli*). The plot size was 10 ft x 20 ft, with 4 rows at 30-inch spacing. Plant emergence was measured by counting the number of plants in two 1-m sections in each plot on 12-Jun. An early season disease assessment was also done on 12-Jun. Plots were scouted for damping off, which can manifest as a reduced crop stand (plants don't emerge) or seedling death after emergence. In two 1-m sections, the number of wilted or dead plants out of 20 total plants were recorded to calculate a disease incidence rating for each plot. Starting in early July, plots were monitored for signs of flowering initiation. Days to flower were recorded at the date at which approximately 50% of plants in a plot had at least one opened flower. A mid-season disease assessment was done on 2-Aug. A visual estimate of the percentage of leaf cover that exhibits symptoms of the pest or disease was recorded. The modified Cobb scale for intensity of infection was used and is described in Table 3. Observed diseases included white mold (*Sclerotinia sclerotiorum*), anthracnose (*Colletotrichum lindemuthianum*), common bacterial blight (*Xanthomonas campestris pv. phaseoli*), bacterial brown spot (*Pseudomonas syringae pv. syringae*), halo blight (*Pseudomonas syringae pv. phaseolicola*), and bean common mosaic. Insect pest damage observed included potato leafhopper, flea beetle, Japanese beetle, and bean leaf beetle. At this time, plants had begun to exhibit symptoms of excessive moisture (i.e., wilting, or yellowing leaves). The modified Cobb scale was also used to assess severity of symptoms related to excessive moisture to determine if there were any differences between varieties.

Table 2. Trial management information for the organic dry bean variety trial, Alburgh, VT, 2023.

Location	Borderview Research Farm, Alburgh, VT
Soil type	Covington silty clay loam, 0 to 3% slopes
Previous crop	Corn silage
Tillage operations	Pottinger TerraDisc
Plot size (ft)	10 x 20
Row spacing (inches)	30
Replicates	4
Planting date	31-May
Seeding rate (pure live seeds ac^{-1})	Black, navy, & small red: 125,000 Pinto: 95,000 Specialty: 100,000
Harvest dates	1-Sep, 5-Sep, 6-Sep, 12-Sep, 20-Sep, 21-Sep, 28-Sep, and 3-Oct

Table 3. Modified Cobb scale for intensity of infection.

	Description
0	No visible infection
1	1-5% leaf area infected
2	6-10% leaf area infected
3	11-25% leaf area infected
4	26-40% leaf area infected
5	65-100% leaf area infected
Source: Stavely (1985).	

On 22-Aug, a late season disease assessment was done to evaluate the pods for incidence and severity of white mold and anthracnose in a 1-m section of each plot. For incidence, the modified Cobb scale was used to estimate the percentage of pods in a section that exhibit disease symptoms. For example, a score of 1 indicates that 1-5% of the pods present in the section exhibit symptoms of disease. For severity, the modified Cobb scale was used to estimate the percentage necrosis of those affected pods. For example, a score of 2 indicates 6-10% necrosis of the diseased pods. Starting in late August, plants were scouted as they approached maturity. Days to maturity were recorded for each plot when 50% percent of plants in a plot had at least one dry pod. All plots were hand harvested as they reached maturity, about 5 days after 95% of pods were brown, on 1-, 5-, 6-, 12-, 20-, 21-, 28-Sep, and 3-Oct. At harvest, lodging was measured by visual assessment for the whole plot on a scale of 1 to 5, where 1 meant all plants were erect and 5 meant all plants were horizontal. Pod height was measured by selecting 5 plants at random from two 1-m sections within the center two rows of each plot and measuring the distance from the soil surface to the bottom of the lowest pod. Stand counts were measured by counting the total number of plants from the two 1-m sections at harvest. All plants within the two 1-m sections were hand-pulled and then hung to dry in a well-ventilated space. Once dry, the beans were threshed using a portable Almaco thresher with a rasp bar rotor. Beans were then weighed to calculate yields and tested for harvest moisture and test weight using a DICKEY-John Mini-GAC Plus moisture and test weight meter. To capture differences in seed quality, an assessment was done to measure the number of unmarketable seed after threshing. Two random samples of 100 seeds were taken from each plot, and the number of unmarketable seeds was recorded.

Data were analyzed using the general linear model procedure in 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 where the F-test was considered significant, at $p<0.10$. Variations in genetics, soil, weather, and other growing conditions can result in variations in yield and quality. Statistical analysis makes it possible to determine whether a difference between treatments is significant or whether it is due to natural variations in the plant or field. At the bottom of each table, an LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. This means that when the difference between two varieties within a column is equal to or greater than the LSD value for the column, there is a real difference between the varieties 90% of the time. Varieties that are not statistically lower in performance than the highest value in a particular column are indicated with an asterisk.

In the example to the right, variety C was significantly different from variety A, but not from variety B. The difference between C and B is 1.5 which is less than the LSD value of 2.0 and so these varieties were not statistically different 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 yields of these varieties were significantly different from one another. The asterisk indicates that that variety B was not statistically lower than the top yielding variety, indicated in bold.

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

RESULTS

Weather data were recorded with a Davis Instruments Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 4). Below average temperatures and increased precipitation persisted for most of the dry bean growing season. There was a total of 23.8 inches of rain from June to September. There was a total of 2184 accumulated Growing Degree Days (GDDs), which is slightly below the 30-year average.

Table 4. Weather data for Alburgh, VT, 2023.

	2023			
Alburgh, VT	June	July	Aug	Sep
Average temperature (°F)	65.7	72.2	67.0	63.7
Departure from normal	-1.76	-0.24	-3.73	1.03
Precipitation (inches)	4.40	10.8	6.27	2.40
Departure from normal	0.14	6.69	2.73	-1.27
Growing Degree Days (50-86°F)	483	712	540	449
Departure from normal	-41	17	-101	62

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.

Results of early season assessments are shown in Table 5. Varieties were planted at different seeding rates based on market class, so percent emergence was calculated to determine if there were statistical differences in emergence between varieties. Dry bean emergence ranged from 15.9% (Merlin) to 87.1% (Rojo Chiquito), and the trial average was 61.2%. Rojo Chiquito had the best percent emergence and was not statistically different from five varieties: UC Andino, Merlot, Zorro, Tiger's Eye, Gypsy Rose, and Charro. The following varieties had less than 50% emergence: UC Holstein, Orca, Pencil Pod Soldier, and Merlin. Disease incidence at emergence was very low, with an average of less than 1 out of 20 plants that were wilted or dead, and seventeen varieties had zero disease incidence. There were no statistical differences in disease incidence between varieties. Flowering date is reported as the number of days after 1-Jan (i.e., 1-Jul = 182 days). The average flowering date was 12-Jul and spanned 10 days: from 6-Jul to 16-Jul. UC Tiger's Eye had the earliest flower date, 187 days, or 6-Jul. This was not statistically different from Tiger's Eye, Jacob's Cattle. UC Holstein, GTS 1701, or Max.

Table 5. Percent emergence, disease incidence at emergence, and flowering date for organic dry bean varieties, Alburgh, VT, 2023.

Variety	Emergence	Disease incidence at emergence	Flowering date
	%	# out of 20 plants	Days after 1-Jan
Alpena	66.9	0.25	194
Black Tails	66.4	0.50	196
Blizzard	67.4	0.25	195
Cayenne	59.5	0.00	196
Charro	71.3*	0.00	198
Cowboy	62.2	0.00	192
Desert Song	50.5	0.00	193
Eclipse	70.1	0.13	196
GTS 1701	61.7	0.00	190*
Gypsy Rose	71.7*	0.00	195
Jacob's Cattle	59.1	0.00	188*
Lariat	56.6	0.25	195
Max	70.6	0.13	190*
Merlin	15.9	0.00	196
Merlot	72.2*	0.00	196
Orca	38.5	0.00	194
Pencil Pod Soldier	29.9	0.00	192
Rojo Chiquito	**87.1**†	0.13	196
Tiger's Eye	71.7*	0.00	188*
UC 1004	53.8	0.00	195
UC 1005	71.0	0.13	191
UC Andino	77.0*	0.25	195
UC Holstein	49.1	0.00	189*
UC Jacob's Cattle	59.1	0.00	195
UC Southwest Gold	67.7	0.00	191
UC Tiger's Eye	53.1	0.13	**187**
Zenith	60.5	0.50	195
Zorro	72.2*	0.00	196
LSD (p = 0.10) ‡	15.9	NS§	3.12
Trial mean	61.2	0.09	193

†Values in **bold** indicate the top performer for the production metric and varieties with an asterisk * performed statistically similarly to the top performer.
‡LSD –Least significant difference at p=0.10.
§NS –No significant difference between treatments.

Results of the mid-season disease assessment are shown in Table 6. Overall, the severity of disease infection was low at this point in the season, which was about two months prior to dry bean harvest. White mold infection was statistically greater in Max and UC Tiger's Eye, with severity ratings of 1.75 and 1.25

respectively. Anthracnose and halo blight severity was not statistically different between varieties. Common bacterial blight and bacterial brown spot were the most prevalent and had the highest average severity ratings, 1.16 and 1.68 respectively. The variety Max had the most severe common bacterial blight infection, but was not statistically different from Pencil Pod Soldier, GTS 1701, UC Southwest Gold, Cayenne, Orca, and Tiger's Eye. The varieties Blizzard and Pencil Pod Soldier had the most severe bacterial brown spot infection but were not statistically different from Black Tails, GTS 1701, Jacob's Cattle, Zenith, Cayenne, Zorro, and Max. Bean common mosaic was most severe in Pencil Pod Soldier and Jacob's Cattle was not statistically different.

Table 6. Mid-season assessment of disease severity in organic dry bean varieties, Alburgh, VT, 2023.

Variety	White mold	Anthracnose	Common bacterial blight	Bacterial brown spot	Halo blight	Bean common mosaic
	% of total leaf area					
	Modified Cobb scale (0-5)†					
Alpena	0.00	0.00	0.50	1.75	0.50	0.00
Black Tails	0.50	0.00	0.75	2.50*	0.75	0.25
Blizzard	0.00	0.00	1.00	**2.75**	1.00	0.00
Cayenne	0.00	0.25	1.75*	2.00*	0.75	0.00
Charro	0.00	0.00	0.50	1.75	0.00	0.50
Cowboy	0.00	0.00	0.75	0.75	0.50	0.00
Desert Song	0.00	0.00	1.00	1.50	0.75	0.25
Eclipse	0.00	0.00	1.50	1.75	0.25	0.00
GTS 1701	0.50	0.25	2.00*	2.50*	0.75	0.50
Gypsy Rose	0.00	0.00	0.75	1.50	0.50	1.25
Jacob's Cattle	0.00	0.00	1.50	2.50*	1.75	1.75*
Lariat	0.00	0.00	0.00	1.50	0.50	0.50
Max	**1.75**‡	0.00	**2.50**	2.00*	0.75	0.00
Merlin	0.00	0.00	1.00	1.25	0.50	0.50
Merlot	0.00	0.00	1.50	1.75	1.50	0.50
Orca	0.00	0.00	1.75*	1.75	0.75	0.00
Pencil Pod Soldier	0.00	0.00	2.25*	**2.75**	1.00	**2.00**
Rojo Chiquito	0.00	0.00	1.00	1.75	0.25	0.00
Tiger's Eye	0.50	0.00	1.75*	1.75	0.50	0.50
UC 1004	0.00	0.00	1.00	0.75	0.25	0.25
UC 1005	0.25	0.00	0.75	0.50	0.00	0.25
UC Andino	0.00	0.00	0.75	0.75	0.50	1.00
UC Holstein	0.00	0.00	0.50	1.00	0.75	0.75
UC Jacob's Cattle	0.00	0.00	0.25	0.50	0.75	1.00
UC Southwest Gold	0.50	0.00	2.00*	1.75	0.75	0.25
UC Tiger's Eye	1.25*	0.00	1.50	1.75	0.00	0.00
Zenith	0.00	0.25	1.50	2.25*	0.25	0.25
Zorro	0.00	0.00	0.50	2.00*	1.00	0.00

LSD (p = 0.10) ¥	0.71	NS§	0.88	0.81	NS	0.70
Trial Mean	0.19	0.03	1.16	1.68	0.63	0.44

†Modified Cobb scale for intensity of infection is described in Table 3.

‡ Values in **bold** indicate the top performer for the production metric and varieties with an asterisk (*) performed statistically similarly to the top performer.

§NS –No significant difference between treatments.

¥ LSD –Least significant difference at p=0.10.

The severity of insect damage observed during the mid-season assessment is summarized in Table 7 below. Like disease infection, insect damage was quite low in this year's trial. Potato leafhopper, flea beetle and bean leaf beetle damage were observed, but there were no significant differences between varieties. Japanese beetle damage differed significantly between varieties. Merlin had the most Japanese beetle damage, but was not statistically different from fifteen varieties. Excessive rainfall throughout the month of July resulted in some plants exhibiting symptoms of moisture stress, but there was high variability throughout the field and there were no statistical differences between varieties.

Table 7. Severity of insect damage and moisture stress for organic dry bean varieties, Alburgh, VT, 2023.

Variety	Potato leafhopper	Flea beetle	Japanese beetle	Bean leaf beetle	Moisture stress
	Modified Cobb scale (0-5)†				
Alpena	0.00	0.00	1.00	0.25	0.25
Black Tails	0.25	0.00	1.75*	1.00	0.50
Blizzard	0.25	0.25	1.50*	0.25	0.50
Cayenne	0.75	0.25	1.50*	0.50	0.00
Charro	0.00	0.00	1.75*	0.75	0.00
Cowboy	0.00	0.25	1.25	1.00	0.00
Desert Song	1.00	0.00	0.75	0.75	0.00
Eclipse	0.25	0.50	1.50*	0.75	0.00
GTS 1701	0.00	0.00	1.00	0.25	0.75
Gypsy Rose	0.00	0.25	1.75*	0.50	0.00
Jacob's Cattle	0.75	0.25	1.50*	0.50	0.00
Lariat	0.00	0.00	0.75	0.75	0.00
Max	0.50	0.00	0.75	0.50	0.50
Merlin	0.25	0.50	**2.00**‡	0.75	0.25
Merlot	0.50	0.50	1.50*	1.00	0.00
Orca	0.25	0.00	0.75	1.00	0.50
Pencil Pod Soldier	0.25	0.25	1.75*	1.00	0.00
Rojo Chiquito	0.00	0.25	1.50*	0.75	1.00
Tiger's Eye	0.00	0.00	1.00	0.25	0.00
UC 1004	0.50	0.00	1.50*	0.50	0.00
UC 1005	0.00	0.50	1.25	0.50	0.00
UC Andino	0.00	0.25	1.00	1.00	0.00

UC Holstein	0.00	0.50	1.50*	1.00	0.75
UC Jacob's Cattle	0.00	0.00	1.75*	0.50	0.00
UC Southwest Gold	1.00	0.00	0.75	0.75	0.50
UC Tiger's Eye	0.50	0.75	0.75	0.50	0.00
Zenith	0.75	0.00	1.75*	0.75	0.00
Zorro	0.00	0.00	1.50*	0.50	1.00
LSD (p = 0.10)¥	NS§	NS	0.73	NS	NS
Trial Mean	0.28	0.19	1.32	0.66	0.23

†Modified Cobb scale for intensity of infection is described in Table 3.

‡Values in **bold** indicate the top performer for the production metric and varieties with an asterisk (*) performed statistically similarly to the top performer.

§NS –No significant difference between treatments.

¥LSD –Least significant difference at p=0.10.

Maturity date was statistically different between varieties (Table 8). The earliest maturing variety was Cowboy, which reached maturity on 30-Aug (242 days). This was not statistically different from seven other varieties. Days to maturity ranged from 30-Aug to 26-Sep (242 to 269 days). Late season scouting occurred at the end of August, just as the shorter season varieties were approaching maturity. Pods were assessed for the incidence and severity of white mold and anthracnose. The varieties did not differ significantly in terms of white mold incidence or severity. On average, less than 1% of pods exhibited symptoms of white mold, and there was only 1-5% necrosis of white mold infected pods. There was a statistically significant difference in the incidence and severity of anthracnose. Cayenne and UC Southwest Gold had the highest anthracnose incidence and were not statistically different from just three varieties: Blizzard, Tiger's Eye, and UC Tiger's Eye. Cayenne also had significantly higher anthracnose severity and was not statistically different from UC Southwest Gold and Tiger's Eye.

Table 8. Maturity date and incidence and severity of white mold and anthracnose for organic dry bean varieties, Alburgh, VT, 2023.

Variety	Days to maturity	White mold incidence	White mold severity	Anthracnose incidence	Anthracnose severity
	Days after 1-Jan	% of infected pods	% necrosis of affected pods	% of infected pods	% necrosis of affected pods
		Modified Cobb scale (0-5)†			
Alpena	245*	0.25	0.75	0.25	0.25
Black Tails	244*	0.50	0.75	0.50	0.50
Blizzard	247	0.25	1.00	1.25*	0.50
Cayenne	246	0.50	2.25	**1.50**	**1.75**
Charro	250	0.25	1.25	0.00	0.00
Cowboy	**242**‡	1.25	2.50	0.75	0.75
Desert Song	247	0.75	1.25	0.00	0.00
Eclipse	245*	0.50	0.75	0.75	0.50
GTS 1701	259	0.25	0.50	0.25	0.25
Gypsy Rose	253	0.50	1.00	0.00	0.00
Jacob's Cattle	250	1.25	3.25	0.75	1.00

Lariat	246	1.25	2.75	0.00	0.00
Max	243*	1.25	2.50	0.25	0.25
Merlin	257	0.00	0.00	0.75	0.75
Merlot	250	1.00	1.00	0.50	0.50
Orca	250	1.00	1.25	0.75	0.75
Pencil Pod Soldier	261	0.25	0.50	0.50	0.50
Rojo Chiquito	253	0.50	1.25	0.50	0.50
Tiger's Eye	251	1.50	2.75	1.00*	1.25*
UC 1004	262	0.25	0.25	0.00	0.00
UC 1005	252	0.50	0.75	0.00	0.00
UC Andino	269	0.00	0.00	0.00	0.00
UC Holstein	261	0.25	1.25	0.00	0.00
UC Jacob's Cattle	265	0.50	2.25	0.00	0.00
UC Southwest Gold	243*	1.50	3.50	**1.50**	1.50*
UC Tiger's Eye	244*	0.50	2.50	1.00*	1.00
Zenith	246*	0.50	1.00	0.25	0.50
Zorro	251	1.00	1.25	0.50	0.50
LSD (p = 0.10)§	4.47	NS¥	NS	0.61	0.58
Trial Mean	251	0.64	1.43	0.48	0.48

†Modified Cobb scale for intensity of infection is described in Table 3.

‡ Values in **bold** indicate the top performer and varieties with an asterisk (*) performed statistically similarly to the top performer.

§LSD –Least significant difference at p=0.10.

¥NS –No significant difference between treatments.

Harvest characteristics are summarized in Table 9. Plant lodging was measured on a scale from 1 to 5. Blizzard, UC 1005, UC Holstein, and Charro all had a lodging rating of 1, which means all of the plants were upright. The varieties Alpena, Black Tails, UC 1004, UC Jacob's Cattle, and Cayenne were statistically similar to the top performers. The distance from the bottom of the lowest pod to the soil surface (pod height) varied between varieties and ranged from 1.43 cm to 20.4 cm. Gypsy Rose had pods that were further from the ground than all other varieties. The average seed moisture at harvest was 23.9%, and additional drying was required for all varieties to reach a safe storage temperature. Blizzard had the lowest harvest moisture, 20.0%, and was not statistically different from twelve varieties. Rojo Chiquito had the highest harvest population, and was not statistically different from Black Tails, Eclipse, or UC Southwest Gold. The trial average test weight was 56.6 lbs bu^{-1}, but varieties were not compared with statistical analysis. Many plots did not have a large enough sample to measure test weight. The average dry bean yield in 2023 was 2120 lbs ac^{-1}, at 14% seed moisture. Cayenne had the highest yield, 2,955 lbs ac^{-1}, and the varieties UC Andino, Lariat, Charro, Alpena, Black Tails, Eclipse, Zenith, Cowboy, and Zorro were not statistically different. To look for differences in seed quality, the percentage of unmarketable seed was calculated for each variety and then used to adjust the seed yield to represent marketable seed. Zenith had the lowest quantity of unmarketable seed, 1.13%, and was statistically similar to ten varieties. Unmarketable seed ranged from only 1.13% to 21.6%. The average adjusted seed yield at 14% moisture was 1898 lbs ac^{-1}, which is about 200 lbs less than the yield at harvest. Lariat had the highest adjusted seed yield, 2726 lbs ac^{-1}, but was not statistically different from ten other varieties.

Table 9. Harvest characteristics for organic dry bean varieties, Alburgh, VT, 2023.

Variety	Lodging	Pod height	Harvest population	Harvest moisture	Test weight	Yield at 14% moisture	Unmarketable seed	Adjusted yield at 14% moisture
	1-5 rating†	cm	plants ac^{-1}	%	lbs bu^{-1}	lbs ac^{-1}	%	lbs ac^{-1}
Alpena	1.25*	5.54	70369	25.9	59.8	2717*	2.63*	2643*
Black Tails	1.50*	11.1	75016*	25.3	60.8	2670*	1.88*	2616*
Blizzard	**1.00‡**	5.14	61738	**20.0**	59.0	2187	3.50*	2110*
Cayenne	1.75*	5.88	70369	21.9*	56.5	**2955**	16.0	2517*
Charro	**1.00**	12.7	69705	20.3*	60.2	2748*	5.38*	2613*
Cowboy	2.00	4.04	52444	28.0	56.6	2603*	13.3	2279*
Desert Song	4.25	7.35	60411	22.3*	55.5	1889	13.1	1657
Eclipse	2.00	9.84	80990*	26.8	59.4	2656*	3.50*	2582*
GTS 1701	3.75	7.34	51781	22.2*	56.0	1345	21.6	1061
Gypsy Rose	4.75	**20.4**	64394	21.2*	59.3	1637	16.5	1405
Jacob's Cattle	3.25	2.93	50453	21.2*	53.0	1232	12.3	1127
Lariat	3.50	14.1	45806	26.1	57.0	2936*	8.13*	**2726**
Max	4.50	1.43	60411	25.9	55.8	2117	20.8	1707
Merlin	3.50	5.56	18588	21.2*	58.8	1246	16.1	1072
Merlot	4.50	13.8	55764	22.7*	55.2	1771	15.3	1524
Orca	2.75	9.38	48461	23.8	57.2	1763	17.4	1440
Pencil Pod Soldier	3.00	4.43	36512	23.1*	53.1	1683	13.8	1437
Rojo Chiquito	2.25	9.03	**89620**	24.1	57.7	1904	4.88*	1812
Tiger's Eye	3.50	3.43	49789	20.9*	51.8	1596	19.8	1278
UC 1004	1.75*	3.84	48461	27.2	55.3	1709	5.13*	1590
UC 1005	**1.00**	3.85	50453	26.4	56.3	2145	21.1	1674
UC Andino	2.25	2.48	72360	25.6	55.3	2941*	20.9	2350*
UC Holstein	**1.00**	7.50	62402	27.0	53.5	2089	10.9	1836
UC Jacob's Cattle	1.75*	5.88	63730	21.0*	53.3	2009	15.4	1795
UC Southwest Gold	3.75	3.56	76343*	28.1	52.6	1993	14.9	1741
UC Tiger's Eye	3.25	3.48	46470	21.0*	52.5	1701	8.88*	1551
Zenith	2.25	6.54	51781	28.3	61.8	2610*	**1.13**	2579*
Zorro	2.50	10.2	55764	21.5*	61.0	2506	3.38*	2423*
LSD (p = 0.10)§	0.86	3.16	16015	3.28	N/A¥	747	8.22	721
Trial Mean	2.63	7.17	58585	23.9	56.6	2120	11.7	1898

†Lodging scale: 1=all plants erect; 5=all plants horizontal

‡ Values in **bold** indicate the top performer for the production metric and varieties with an asterisk * performed statistically similarly to the top performer.

§LSD –Least significant difference at p=0.10.

¥N/A -Statistical analysis not conducted.

DISCUSSION

In the 2023 growing season, the UVM Extension Northwest Crops and Soils Program (NWCS) conducted an organic dry bean variety trial at Borderview Farm in Alburgh, VT to evaluate different market classes for overall yield and seed quality. Excessive rainfall and wet field conditions in July and August made timely weed management challenging. Plants in saturated areas of the field displayed symptoms of wilted and yellowing leaves. There was no statistical difference in how varieties responded to wet conditions as the field conditions varied considerably throughout the field. There was minimal insect damage observed in this year's trial. While there were statistical differences in the amount of Japanese beetle damage between varieties, at these low levels of damage, it is unlikely that this insect damage would result in yield reductions. Poor emergence and low stand count likely impacted yields. For example, Pencil Pod Soldier and Merlin had the lowest percent emergence and populations at harvest, which resulted in some of the lowest seed yields.

Pod height is helpful when determining if a variety may be direct harvested successfully because pods that sit low to the ground may be difficult to harvest with a combine. Lodging is another important factor that must be considered because varieties that are more susceptible to lodging are less suitable to direct harvest. Gypsy Rose had the greatest pod height (20.4 cm off the ground), but also had the most severe lodging (4.75). Pods that are closer to the soil may also be more prone to disease. For example, Max had severe lodging (4.50) and very low pod height (1.43 cm), and this was one of the varieties that had statistically greater white mold, common bacterial blight, and bacterial brown spot infection.

In 2023 dry bean yields were good, with an average yield at 14% moisture of 2120 lbs ac^{-1}. There was a yield reduction of about 200 lbs when adjusted for unmarketable seed. Of the top yielding varieties, UC Andino was the only specialty variety, and the remaining were small red, pinto, navy, and black beans. There was a statistical difference in harvest population between varieties, but this did not necessarily result in higher yields. Many top yielding varieties like Charro, Cowboy, Lariat, UC Andino, and Zenith had harvest populations that were significantly lower than the top performer. Seed size contributes to this. Charro, Cowboy, and Lariat are all pinto beans, which are larger in size and weigh more than a black or navy bean for example. Despite having the highest harvest population, Rojo Chiquito was not a top yielding variety, and was below average for yield at harvest and adjusted seed yield, even with only 4.88% unmarketable seed. This trend was the same for UC Southwest Gold, which also had one the highest harvest populations. Figure 1 shows the adjusted seed yield compared to the percentage of unmarketable seed by variety. Interestingly, while many of the top yielding varieties had some of the lowest percentages of unmarketable seed, there were varieties with moderately high amounts of unmarketable seed that still produced high yields and were statistically similar to the top performers. UC Andino for example had 20.9% unmarketable seed, but was still one of the top yielding varieties, even after yield was adjusted to account for any unmarketable seed. Similarly, Cayenne had the highest yield at harvest, but 16% unmarketable seed. After the yield was adjusted, it was not statistically different from the top performer. Unsurprisingly, varieties that had higher levels of disease during the mid- and late season disease assessments tended to have a higher percentage of unmarketable seed after harvest. These varieties include UC Southwest Gold, Tiger's Eye, Cayenne, GTS 1701, Max, and Pencil Pod Soldier. In 2023, overall levels of disease were moderately low, but in years where disease pressure is much higher, it is important to select varieties that are less susceptible to disease.

The first varieties reached harvest maturity almost one month before the latest maturing varieties. Figure 2 below shows the relationship between seed yield and days to maturity by variety. The top yielding varieties were some of the earliest to reach maturity, between 29-Aug and 8-Sep, except for UC Andino which had the latest average maturity (26-Sep). These data suggest that in the northern Vermont climate, varieties that mature earlier in the season will produce higher yields, and it may be riskier to select longer season varieties. It is important to remember that these data represent only one year of research at one location, and the NWCS program plans to repeat this trial again in 2024 to better understand which market classes of organic dry beans are best suited for the Northeast.

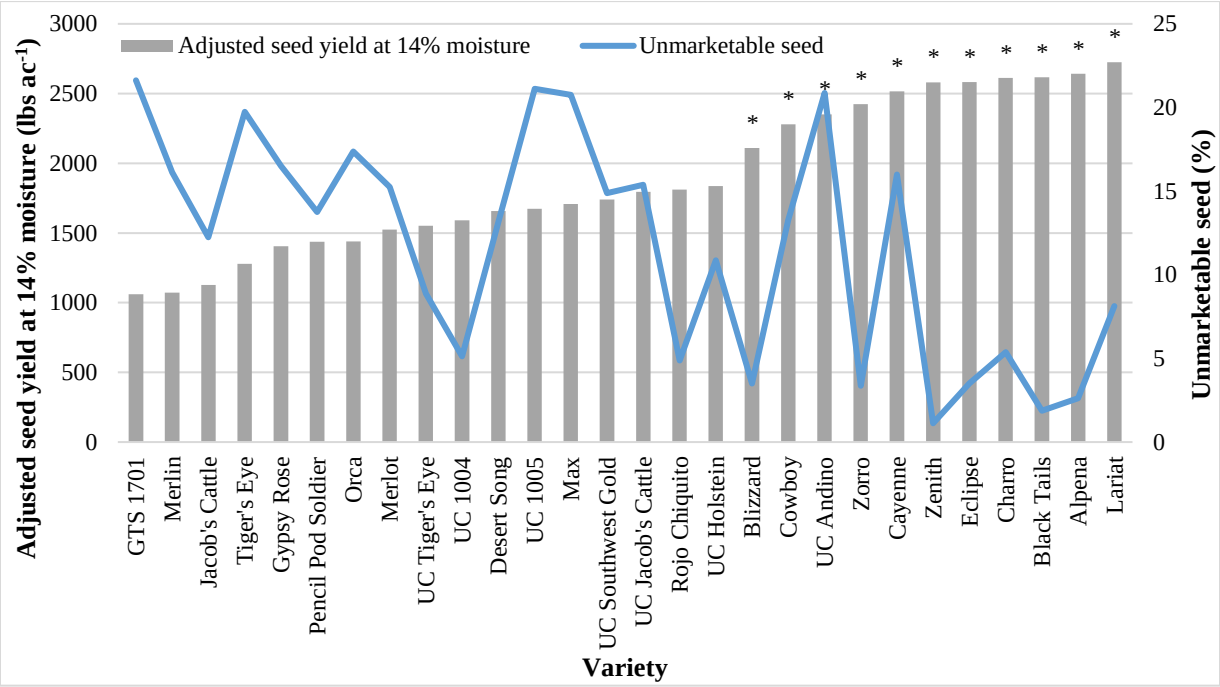

Figure 1. Adjusted seed yield and unmarketable seed by variety, Alburgh, VT, 2023.
An asterisk * indicates that variety was not statistically different from the top yielding variety (p=0.10).

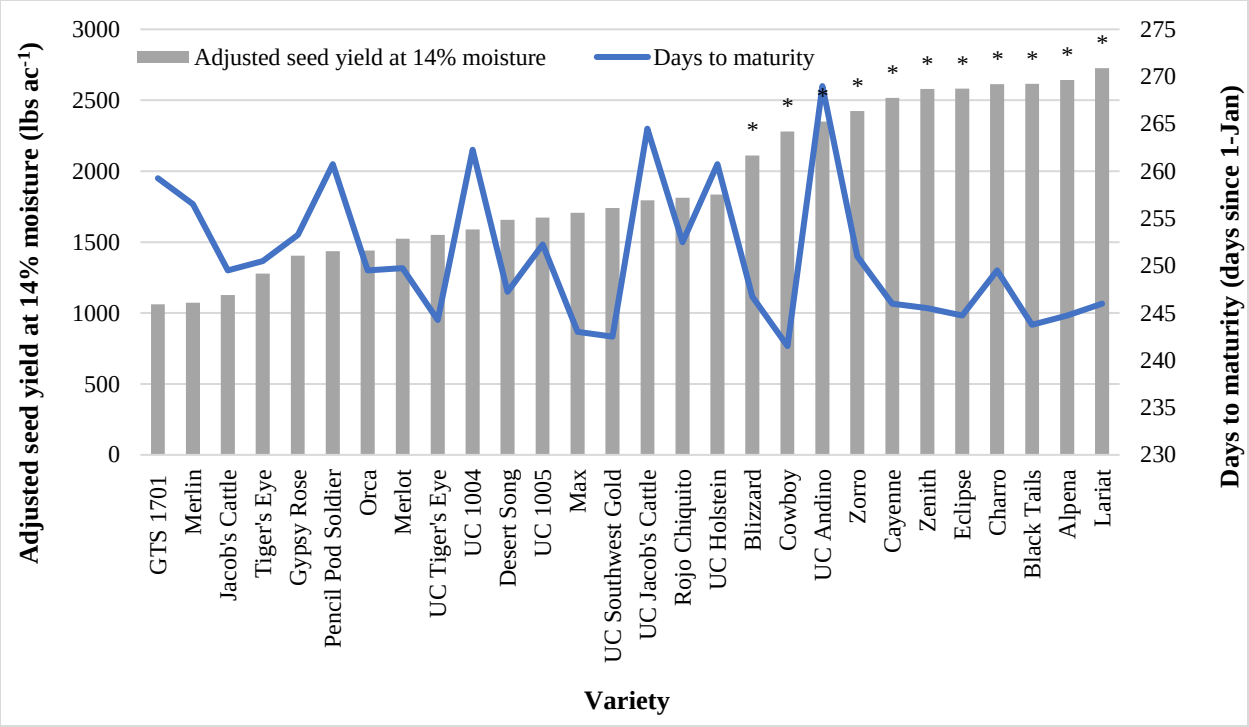

Figure 2. Adjusted seed yield and days to maturity by variety, Alburgh, VT, 2023.
An asterisk * indicates that variety was not statistically different from the top yielding variety (p=0.10).

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