2022
ORGANIC DRY BEAN VARIETY TRIALS IN VERMONT & NEW YORK
SUMMARY REPORT
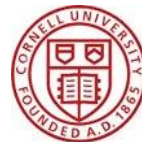

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Materials and Methods

Organic dry bean variety trials were conducted in two northeastern locations (Alburgh, VT and Aurora, NY) to evaluate various market classes to better understand variation in adaptation across a range of northeastern environments. Little evaluation of dry bean market classes has taken place in the Northeast in recent decades despite the increase in consumer demand. Consumers are interested in these dry bean market classes (such as navy, small red, pink, pinto, great northern, cranberry, yellow, and heirloom/specialty) for their distinct culinary characteristics and visual appeal. Entries were chosen based on feedback from local stakeholders to identify varieties with high market demand and value as well as for agronomic performance (Tables 1 & 2).

Table 1. Organic dry bean varieties evaluated at Borderview Research Farm in Alburgh, VT, 2022.

Market class	Variety	Seed source	100-seed weight (g)
Black	Black Tails	Treasure Valley Seeds	20.3
	Zenith	Central Bean Co.	20.9
	Zorro	Treasure Valley Seeds	21.1
Light Red Kidney	California Early	University of California, Davis	48.9
Navy	Alpena	Central Bean Co.	18.0
	Blizzard	Treasure Valley Seeds	20.3
	Merlin	Treasure Valley Seeds	17.3
Pinto	Dr Wood	Kelley Bean Co.	33.1
	Lariat	Treasure Valley Seeds	34.0
	ND Palomino	Treasure Valley Seeds	36.3
Small Red	Cayenne	Central Bean Co.	31.0
	Merlot	Treasure Valley Seeds	28.7
	Rojo Chiquito	Central Bean Co.	22.5
Specialty	Calypso	GenTec Seeds LTD	42.3
	Desert Song	GenTec Seeds LTD	30.9
	Gypsy Rose	GenTec Seeds LTD	27.3
	Jacob's Cattle	GenTec Seeds LTD	48.9
	Soldier	GenTec Seeds LTD	54.6
	Tiger's Eye	GenTec Seeds LTD	50.2
	UC Andino	University of California, Davis	36.8
	UC Southwest Gold	University of California, Davis	27.3
	UC Tiger's Eye	University of California, Davis	52.7
	UCD 1004	University of California, Davis	33.4
	UCD 1005	University of California, Davis	34.7
	UCD Holstein	University of518^@nst48NST California, Davis	45.9
	UCD Jacob's Cattle	University of California, Davis	46.8
Yellow Eye	GTS 1701	GenTec Seeds LTD	43.1

Table 2. Organic dry bean varieties evaluated at Musgrave Research Farm in Aurora, NY, 2022.

Market class	Variety	Seed source	100-seed weight (g)
Black	Black Tails	Treasure Valley Seed	18.9
	Zenith	Central Bean Co.	19.2
	Zorro	Treasure Valley Seed	19.9
Navy	Alpena	Central Bean Co.	14.1
	Blizzard	Treasure Valley Seed	18.3
	Merlin	Treasure Valley Seed	38.3
Pinto	Dr Wood	Kelley Bean Co.	31.7
	Lariat	Treasure Valley Seed	31.4
	ND Palomino	Treasure Valley Seed	16.3
Small Red	Rojo Chiquito	Central Bean Co.	22.8

The VT, dry bean variety trial was planted into a conventionally prepared seedbed. At the NY location, the variety trial was replicated in both a tilled and an organic no-till system. The organic no-till system entailed planting cereal rye the previous fall and terminating the standing cereal rye at anthesis using a front-mounted I&J roller crimper at time of dry bean planting, creating a crimped cereal rye mulch that persists throughout the growing season. Dry beans were then no-till planted into the rolled cereal mulch with no additional weed management.

Management details for the studies are shown in Table 3. The experimental design was a randomized complete block with four replications. All soil fertility deficiencies were addressed prior to planting in accordance with state and regional soil test results. For the no-till variety trial, cereal rye (var. ND Gardner) was planted at the Aurora, NY location on 11-Sep 2021 at a rate of 160 lbs ac^{-1} (3 million pure live seeds ac^{-1}). Prior to cover crop planting, 5-4-3 dry poultry manure was applied at a rate of 1,000 lbs ac^{-1}. In the tilled system, primary and secondary tillage were used to prepare an adequate seedbed for dry bean planting. Dry beans were planted on 31-May 2022 at the Alburgh, VT location, and on 15-Jun 2022 at the Aurora, NY location. At planting, 25 lbs N ac^{-1} were applied as starter fertilizer. Dry beans were planted in 30-in rows at a depth of 1.5 to 2.5-in. Plant populations were based on seed size and market class and then adjusted for germination. Smaller seeded varieties were planted at a target seeding rate of 110,000 pure live seeds ac^{-1} and large seeded varieties were planted at a target seeding rate of 85,000 pure live seeds ac^{-1}. Weeds were managed before and after dry bean emergence according to best organic practices. Growth habit was assessed, and each entry was given a rating according to the growth habit classifications for dry beans (Table 4). The growth habit classification for each dry bean variety for both locations are listed in Tables 5 & 6 below. Statistical analysis was not conducted on growth habit.

Table 3. Management details for dry bean variety trials at both trial locations, 2022.

Location	Borderview Research Farm, Alburgh, VT	Musgrave Research Farm, Aurora, NY
Soil type	Benson rocky silt loam, over shaly limestone, 8 to 15 % slopes	Lima silt loam, 3-8% slopes
Previous crop	Spring wheat	Cereal rye/buckwheat cover crop
Tillage operations	Pottinger TerraDisc	Tilled trial: Moldboard plow, disc, rolling harrow, cultimulcher
Plot size	10ft x 20ft	10ft x 45ft
Cover crop information	N/A	Cereal rye (var. ND Gardner) planted 11-Sep 2021 at 160 lbs ac^{-1}
Weed management	Tilmor Power Ox two-wheel tractor with finger weeder and hand weeding on 15, 22, 29-Jun and 20, 27-Jul 2022	Tilled trial: Inter-row cultivation 2x with John Deere S-tine cultivator
Dry bean planting date	31-May 2022	15-Jun 2022
Dry bean harvest date	9, 15, and 21-Sep 2022	26-Oct 2022

Table 4. Growth habit classifications for dry beans.

Growth habit classification	Description
I	Determinate bush
IIa	Indeterminate; completely upright with no vine or weak vine
IIb	Indeterminate; inclined upright with substantial vine
III	Indeterminate prostrate

Table 5. Growth habits of dry bean varieties evaluated in Alburgh, VT, 2022.

Variety	Market class	Observed growth habit
Black Tails	Black	IIb
Zenith	Black	IIb
Zorro	Black	IIa
California Early	Light Red Kidney	I
Alpena	Navy	IIb
Blizzard	Navy	IIb
Merlin	Navy	IIa
Dr Wood	Pinto	IIb
Lariat	Pinto	III
ND Palomino	Pinto	III
Cayenne	Small Red	IIb
Merlot	Small Red	III
Rojo Chiquito	Small Red	IIb
Calypso	Specialty	I
Desert Song	Specialty	IIb
Gypsy Rose	Specialty	III
Jacob's Cattle	Specialty	I
Soldier	Specialty	IIa
Tiger's Eye	Specialty	IIb
UC Andino	Specialty	IIa
UC Southwest Gold	Specialty	IIa
UC Tiger's Eye	Specialty	IIb
UCD 1004	Specialty	IIa
UCD 1005	Specialty	I
UCD Holstein	Specialty	IIa
UCD Jacob's Cattle	Specialty	IIa
GTS 1701	Yellow Eye	III

Table 6. Growth habits of dry bean varieties evaluated in Aurora, NY, 2022.

Variety	Market class	Observed growth habit
Black Tails	Black	IIa
Zenith	Black	IIa
Zorro	Black	IIa
Alpena	Navy	IIa
Blizzard	Navy	IIa
Merlin	Navy	IIa
Dr Wood	Pinto	IIb
Lariat	Pinto	IIa
ND Palomino	Pinto	IIb
Rojo Chiquito	Small Red	IIa

Days to maturity was measured by recording the date at which the majority of plants in each plot had reached maturity (growth stage R9: mature, at least 80% of the pods showing yellow and mostly ripe, only 30-40% of leaves still green). Plants were harvested about 5 days after 95% of pods were brown or yellow. At the Alburgh, VT location, dry beans were harvested on 9, 15, and 21-Sep 2022 due to differences in harvest maturity between entries. At the Aurora, NY location, all entries were harvested on 26-Oct 2022. At harvest, plant populations, pod height, lodging, and yield were assessed. Evaluations were done within two 1-m representative row lengths per plot from the center two rows. Pod height is the distance (cm) from the soil surface to the bottom of the lowest pod from 5 randomly selected plants in each of the two 1-m row lengths. Plots were given a lodging score on a 1 to 5 scale, where 1 means almost all plants are erect and 5 means all planted are down. Then all plants were removed and counted from the two 1-m row lengths and dried for 7 days at 60°C. Plants were then threshed to obtain and record seed yield. Yield was adjusted to 14% moisture to standardize results.

Results

Weather data are summarized in Tables 7 & 8 below. 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. In Alburgh, VT, the 2022 growing was cooler than normal with above average rainfall. There was a total of 20.5 inches of precipitation from June to September, 5 inches above average. The cooler temperatures resulted in a total of 2,106 accumulated Growing Degree Days (GDDs), 139 less than normal. The wet field conditions were challenging for timely weed management and mechanical cultivation, resulting in increased weed pressure especially later in the season. Weather data in Aurora, NY were recorded with a Hobo Rx3000 Remote monitoring station. Temperatures in Aurora, NY were warmer than normal in May, July, August, and October. There was a total of 19.1 inches of rain during the dry bean growing season, about 2.5 inches below average. The warmer temperatures resulted in 2,766 accumulated Growing Degree Days, 189 above average. Despite this, there was higher than average precipitations for the months of August and September, resulting in delayed plant dry down in many plots due to re-greening later pod set.

Table 7. Weather data for Alburgh, VT, 2022.

Alburgh, VT	2022			
	Jun	**Jul**	**Aug**	**Sep**
Average temperature (°F)	65.3	71.9	70.5	60.7
Departure from normal	-2.18	-0.54	-0.20	-1.99
Precipitation (inches)	8.19	3.00	4.94	4.40
Departure from normal	3.93	-1.06	1.40	0.73
Accumulated Growing Degree Days (50-86°F)	459	1133	1763	2106
Departure from normal	-64.0	-84.0	-95.0	-139

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.

Table 8. Weather data for Aurora, NY, 2022.

Aurora, NY	2022					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Average temperature (°F)	60.9	66.4	71.9	71.0	62.3	53.0
Departure from normal	3.30	-0.30	1.00	1.50	-0.60	1.40
Precipitation (inches)	3.09	3.32	2.01	4.99	5.38	0.72
Departure from normal	-0.09	-0.32	-1.80	1.52	1.39	-3.16
Accumulated Growing Degree Days (50-86°F)	396	889	1552	2199	2599	2766
Departure from normal	125	109	118	151	156	189

Based on weather data from Musgrave Research Station weather station and 30-year averages from Northeast RCC CLIMOD2

The results of the organic dry bean variety trial at the Alburgh, VT location are listed below in Table 9. The top performers for each metric are marked with two asterisks (**) and any entry that was not statistically different (p=0.10) are marked with one asterisk (*). The earliest maturing entry was UC Southwest Gold, reaching R9 stage 85 days after planting. This was not statistically different from five other entries, Cayenne, Desert Song, GTS 1701, California Early, and Merlot. Dr Wood, Soldier, UC Andino, UCD Holstein, and UCD Jacobs Cattle took the longest to mature, reaching R9 stage 113 days after planting, almost a month after the earliest maturing entry. Harvest populations ranged from 17,260 plants ac^{-1} (Calypso) to 86,301 plants ac^{-1} (UCD Holstein), and the trial average was 56,198 plants ac^{-1}. Dry bean yield at 14% moisture ranged from 569 lbs ac^{-1} (Calypso) to 3,451 lbs ac^{-1} (Blizzard). The top performer was not statistically different from nineteen entries. The trial average score for lodging at harvest was 2.28, and UCD Holstein and Zenith had the lowest lodging score (1.00). This was not statistically different from all but four entries. There was an average pod height of 3.30 cm. Zenith had the greatest pod height (7.80cm) and was not statistically different from eleven entries.

Table 9. Organic dry bean variety trial performance summary, Alburgh, VT, 2022.

Market class	Variety	Days to maturity	Harvest population	Lodging	Pod height	Yield@14% moisture
		DAP[1]	plants ac-1	1-5 rating[2]	cm	lbs ac-1
Black	Black Tails	97.0	73024*	2.75*	6.83*	3205*
	Zenith	100	57755	1.00**	7.80**	2809*
	Zorro	109	68377*	2.00*	6.75*	2632*
Light Red Kidney	California Early	94.0*	57091	1.50*	3.20*	2471*
Navy	Alpena	97.0	58419*	1.75*	3.33*	3081*
	Blizzard	99.0	62402*	2.00*	6.43*	3451**
	Merlin	102	73024*	2.00*	4.75*	3016*
Pinto	Dr Wood	113	53108	3.25*	3.23*	2601*
	Lariat	96.0	55100	2.50*	7.08*	2897*
	ND Palomino	97.0	40495	2.00*	2.48	2699*
Small Red	Cayenne	90.0*	47134	1.50*	4.98*	2462*
	Merlot	93.0*	63730*	3.00*	5.50*	2322*
	Rojo Chiquito	109	71032*	2.75*	5.23*	2686*
Specialty	Calypso	105	17260	1.75*	0.25	569
	Desert Song	95.0*	48461	4.50	0.70	2171*
	Gypsy Rose	99.0	65058*	4.25	1.40	1964
	Jacob's Cattle	100	36512	3.75	0.93	1068
	Soldier	113	59747*	3.00*	1.15	2308*
	Tiger's Eye	109	43151	2.00*	1.30	626
	UC Andino	113	37575	1.64*	1.45	2527*
	UC Southwest Gold	85.0**	45142	1.75*	1.18	1978
	UC Tiger's Eye	105	53108	1.50*	1.35	1842
	UCD 1004	107	54234	1.13*	0.99	3057*
	UCD 1005	106	39186	1.47*	1.12	2245*
	UCD Holstein	113	86301**	1.00**	2.40	2390*
	UCD Jacob's Cattle	113	75016*	1.75*	2.95	2903*
Yellow Eye	GTS 1701	89.0*	61075*	3.50	1.80	1987
Level of significance		p=0.10				
Trial mean		101	56198	2.28	3.30	2371

The top performers for each metric are marked with two asterisks (**) & any entry that was not statistically different (p=0.10) are marked with one asterisk (*).

[1] Days after planting

[2] Lodging scale- 1= almost all plants erect, 2= either all plants leaning slightly or a few plants down, 3= either all plants leaning moderately (45°angle) or 25-50% down, 4= either all plants leaning considerably or 50-80% down, 5= all plants down

The results of the organic dry bean variety trials at the Aurora, NY location are listed below in Tables 10 and 11. The top performers for each metric are marked with two asterisks (**) and any entry that was not statistically different (p=0.10) are marked with one asterisk (*). The earliest maturing variety was Lariat, reaching R9 stage 109 days after planting in the tilled trial and 116 days in the no-till trial. The varieties Dr Wood, ND Palomino and Rojo Chiquito took the longest to mature, reaching R9 stage between 121 and 136 days after planting. At harvest, Zorro had the highest population in both trials, 94,036 plants ac-1 in the tilled trial and 64,024 in the no-till trial. Dry bean yield at 14% moisture ranged from 1741 lbs ac-1 (ND Palomino) to 3,758 lbs ac-1 (Dr Wood) in the tilled trial. In the no-till trial, yields ranged from 803 lbs ac-1 (ND Palomino) to 2155 lbs ac-1 (Dr Wood). The variety ND Palomino had the most lodging in the tilled trial with a score of 4.00. In the no-till trial, ND Palomino, Lariat and Dr Wood all had the highest lodging ratings at 2.75. Dr Wood had the greatest pod height, 4-cm, in the tilled trial and Black Tails had the greatest pod height, 3.00 cm, in the no-till trial.

Table 10. Organic dry bean variety trial performance summary, Aurora, NY, 2022 – Tilled Trial.

Market class	Variety	Days to maturity	Harvest population	Lodging	Pod height	Yield@14% moisture
		DAP[1]	plants ac[-1]	1-5 rating[2]	cm	lbs ac[-1]
Black	Black Tails	115*	85366*	1.75*	1.95	2535*
	Zenith	116*	56021	1.25**	0.78	2716*
	Zorro	125	9403**	3.00	0.83	2449
Navy	Alpena	113*	78697*	1.75*	1.13	2989*
	Blizzard	119*	69360*	2.50	2.45	2387
	Merlin	118*	82698*	1.25*	2.05	3053*
Pinto	Dr Wood	121	74695*	3.25	4.23**	3758**
	Lariat	109**	54687	3.25	2.00	3529*
	ND Palomino	136	43350	4.00	0.03	1741
Small Red	Rojo Chiquito	126	86033	2.50	1.55	2591*
Level of significance		p=0.10				
Trial Mean		120	72494	2.45	1.70	2775

The top performers for each metric are marked with two asterisks (**) & any entry that was not statistically different (p=0.10) are marked with one asterisk (*).

[1] Days after planting

[2] Lodging scale- 1= almost all plants erect, 2= either all plants leaning slightly or a few plants down, 3= either all plants leaning moderately (45°angle) or 25-50% down, 4= either all plants leaning considerably or 50-80% down, 5= all plants down

Table 11. Organic dry bean variety trial performance summary, Aurora, NY, 2022 – No-Till Trial.

Market class	Variety	Days to maturity	Harvest population	Lodging	Pod height	Yield@14% moisture
		DAP[1]	plants ac[-1]	1-5 rating[2]	cm	lbs ac[-1]
Black	Black Tails	124*	50019*	1.00*	3.00**	1672*
	Zenith	126*	55354*	1.00*	1.73*	1409
	Zorro	131	64024**	1.00*	2.25*	1558*
Navy	Alpena	120*	44684*	1.00*	1.53*	1084
	Blizzard	123*	39349	1.00*	2.93*	1274
	Merlin	135	32012	1.25*	2.68*	1159
Pinto	Dr Wood	128*	44017*	2.75	1.15	2155**
	Lariat	116**	40015*	2.75	2.37*	1684*
	ND Palomino	139	26010	2.75	1.30	803
Small Red	Rojo Chiquito	128*	64024*	1.02*	2.25*	1640*
Level of significance		p=0.10				
Trial mean		127	44684	1.55	2.00	1444

The top performers for each metric are marked with two asterisks (**) & any entry that was not statistically different (p=0.10) are marked with one asterisk (*).

[1] Days after planting

[2] Lodging scale- 1= almost all plants erect, 2= either all plants leaning slightly or a few plants down, 3= either all plants leaning moderately (45°angle) or 25-50% down, 4= either all plants leaning considerably or 50-80% down, 5= all plants down

Discussion

At the Alburgh, VT location despite cool, wet conditions during the growing season, many of the entries performed well in this trial. Days to maturity ranged from 85 to 113 day after planting. The cool, wet conditions made timely weed management challenging especially as the dry beans approached harvest maturity. Weed pressure was not measured in this trial but did result in reduced yields for varieties that had poor emergence. For example, Calypso (specialty/heirloom), a late maturing variety with poor germination, had significant weed pressure resulting in low yields. There was a range of early to late maturing varieties that achieved top yields indicated a broad range of adaptability. The lowest yielding varieties were generally the specialty/heirloom varieties indicating a price premium may be needed to justify production. The top yielding varieties were navy and black bean varieties, but specialty varieties like UCD 1004 and UCD Jacobs Cattle had comparable yields.

At the Aurora, NY location periods of cool weather in June may have resulted in poor emergence and lower plant populations in the organic no-till trial, resulting in mean plant populations 38% lower than the tilled trial. A drier than normal June and July followed by above average precipitation in August and September caused many varieties, particularly in the tilled trial, to put on new vegetative growth and flowers later in the season, causing excessive vining and uneven maturity. As a result, days to maturity were longer than normal in most entries, and harvest was delayed until late October due to delayed dry down in many plots. Despite these anomalies, yields overall were high in the tilled trial. Yields were much lower in the organic no-till trial, in part due to much lower plant populations for most varieties. Overall, variety yield rankings were similar between no-till and tilled trials, with the possible exceptions of the navy varieties, which ranked relatively higher in the tilled trial. Weed pressure was low in the tilled trial and moderate to high in the organic no-till plots.

It is important to remember that these data represent only one year of research at two site locations. But the results of this year's research trials suggest that several dry bean varieties including some specialty or heirloom varieties can perform well in the Northeast. The shorter growing season and increase in erratic weather conditions make varietal selection even more crucial, and more research needs to be done to better understand how dry beans of different market classes perform in our region. Traditional dry bean production relies on tillage and cultivation for weed management and harvest, which can deplete the soil, and this has led to increased interest in organic no-till dry bean production. This research suggests that some market classes such as blacks or pintos perform well in a no-till system. These research trials will be repeated at both site locations in the 2023 growing season.

Acknowledgements