2012

Spring Barley Variety Trial

Heather Darby
University of Vermont, heather.darby@uvm.edu

NW CROPS & SOILS PROGRAM

UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

2012 Spring Barley Variety Trial

Dr. Heather Darby, UVM Extension Agronomist
Conner Burke, Erica Cummings, Hannah Harwood, Rosalie Madden and Susan Monahan
UVM Extension Crops and Soils Technicians
(802) 524-6501

Visit us on the web: http://www.uvm.edu/extension/cropsoil

The UNIVERSITY of VERMONT EXTENSION

2012 SPRING BARLEY VARIETY TRIAL

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

With the revival of the small grains industry in the Northeast and the strength of the localvore movement, craft breweries and distilleries have expressed an interest in local barley for malting. Malting barley must meet specific quality characteristics such as low protein content and high germination. Many farmers are also interested in barley as a concentrate source for their livestock. Depending on the variety, barley can be planted in either the spring or fall. In 2012, UVM Extension conducted two spring barley trials to evaluate the yield and quality of publicly available malting and feed barley varieties.

MATERIALS AND METHODS

A spring barley variety trial was initiated at Borderview Research Farm in Alburgh, VT. Spring barley was planted on 7-Apr. Twelve spring varieties were planted in a randomized complete block design with four replicates (Table 1).The seedbed was prepared by conventional tillage methods. Plots were 5'x 20' and were seeded into a Benson rocky silt loam at 125 lbs. per acre with a Kincaid cone seeder. Rows were spaced at 6". All plots were managed with practices similar to those used by producers in the surrounding areas (Table 3). Populations were measured on 16-May by counting the barley population in 33 cm increments in two rows. Plant heights and test weight were determined on the harvest date. All varieties were harvested with an Almaco SPC50 plot combine on 19-Jul.

Another spring barley variety trial was initiated at Butterworks Farm in Westfield, VT. Spring barley was planted on 18-Apr. Six spring varieties were planted in a randomized complete block design with four replicates (Table 2).The seedbed was prepared by conventional tillage methods. Plots were 5'x 20' and were seeded into a Dixfield sandy loam at 125 lbs. per acre with a Kincaid cone seeder. Rows were spaced at 6". All plots were managed with practices similar to those used by producers in the surrounding areas (Table 3). Populations were measured on 16-May by counting the barley population in 33 cm increments in two rows. Plant heights and test weight were determined on the harvest date. All varieties were harvested with an Almaco SPC50 plot combine on 6-Aug.

Table 1. Spring barley varieties trialed at Borderview Research Farm in Alburgh, VT.

Spring barley variety	Type	Seed source
AC Newdale	2-row	Semican
AC Newport	2-row	Semican
Conlon	2-row	Albert Lea Seeds
Danish Black	2-row	Denmark
Ethiopian Hulless	2-row	Salt Spring Seeds
Formosa	2-row	La CoopFederee
Kawartha	2-row	Eldred Hay and Grain Co.
Pinnacle	2-row	North Dakota State University
Rasmussen	6-row	Albert Lea Seeds
Robust	6-row	Albert Lea Seeds
Scarlett	2-row	Valley Malt
Traditional	2-row	Semican

Table 2. Spring barley varieties trialed at Butterworks Farm in Westfield, VT.

Spring barley variety	Type	Seed source
AC Kinck	2-row	Semican
Conlon	2-row	Albert Lea Seeds
Lacey	6-row	Albert Lea Seeds
Pinnacle	2-row	North Dakota State University
Polaris	6-row	RDR Grains and Seeds Inc.
Robust	6-row	Albert Lea Seeds

Table 3. Agronomic and trial information for spring barley variety trial at both locations.

	Borderview Research Farm Alburgh, VT	Butterworks Farm Westfield, VT
Soil type	Benson rocky silt loam	Dixfield sandy loam
Previous crop	Forage oats	Small grains
Tillage operations	Spring plow, disc and spike-toothed harrow	Spring plow, disc and spike-toothed harrow
Plot area (ft)	5 x 20	5 x 20
Row spacing (in)	6	6
Seeding rate (lbs. ac^{-1})	125	125
Replicates	4	4
Planting date	7-Apr	18-Apr
Harvest date	19-Jul	6-Aug

Following the spring barley harvest, seed was cleaned with a small Clipper fanning mill. A one-pound grain subsample was collected to determine quality. Quality measurements included standard testing parameters used by commercial malt houses. Harvest moisture was determined for each plot using a DICKEY-john M20P moisture meter. Test weight was measured using a Berckes Test Weight Scale, which weighs a known volume of grain. Subsamples were ground into flour using the Perten LM3100 Laboratory Mill and were evaluated for crude protein content and mycotoxin levels. Grains were analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. In addition, falling number for winter barley varieties was determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine. Deoxynivalenol (DON) analysis was performed using the Veratox DON 5/5 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5.0 ppm.

Each variety was evaluated for seed germination by incubating 100 seeds in 4.0 mL of water for 72 hours and counting the number of seeds that germinated.

Data was analyzed using mixed model analysis 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 hybrids is real or whether it might have occurred due to other variations in the field. Least Significant Differences (LSDs) at the 0.10 level of significance are shown. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Where the difference between two treatments 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 treatments. Treatments that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the example to the right, 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 yields 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

Borderview Research Farm, Alburgh, VT

Weather data is based on a Davis Instruments Vantage Pro2 with Weatherlink data logger and on National Weather Service data from cooperative observer stations in close proximity to Borderview Research Farm. Historical averages are for 30 years of data (1981-2010). In mid-summer 2012, drought-like conditions were experienced, with the growing season seeing 0.6 fewer inches of precipitation than the 30 year average (Table 4). However, the 2012 growing season experienced 3547 Growing Degree Days (GDDs), which are 195 more than the 30 year average.

Table 4. Weather data for spring barley variety trial in Alburgh, VT.

Alburgh, VT	April	May	June	July
Average temperature (°F)	44.9	60.5	67.0	71.4
Departure from normal	0.10	4.10	1.20	0.80
Precipitation* (inches)	2.6	3.9	3.2	3.8
Departure from normal	-0.2	0.5	-0.5	-0.4
Growing Degree Days (base 32°F)	396	884	1046	1221
Departure from normal	12	128	32	23

Based on weather data from Davis Instruments Vantage Pro2 with Weatherlink data logger. Historical averages for 30 years of NOAA data (1981-2010).

*Precipitation data are based on Northeast Regional Climate Center data from an observation station in Burlington,VT.

The average barley height was 84.1 cm, with the variety Traditional having the tallest height, at 93.3 cm (Table 5). Scarlett had the highest plant populations per square foot (25) and per acre (1,079,100), although not statistically different from AC Newdale, Danish Black, Kawartha, Rasmussen, Robust and Traditional.

Table 5. Spring barley agronomic characteristics in Alburgh, VT, 2012.

Variety	Height	May population	May population
	cm	plants ft^{-2}	plants ac^{-1}
AC Newdale	62.4	20*	891000*
AC Newport	85.0	17	752400
Conlon	75.8	18	762300
Danish Black	93.3	22*	940500*
Ethiopian Hulless	89.2	15	643500
Formosa	83.2	19	841500
Kawartha	87.3	22*	940500*
Pinnacle	87.0	16	702900
Rasmussen	81.8	22*	950400*
Robust	91.8	22*	960300*
Scarlett	79.5	**25***	**1079100***
Traditional	**93.3**	22*	960300*
LSD (0.10)	NS	5	216616
Trial mean	84.1	20	868725

*** Varieties that did not perform significantly lower than the top performing variety (bold) in a particular column are indicated with an asterisk.**
NS – no statistical significance was determined between varieties.

Barley yields for this trial averaged 2798 lbs per acre (Table 6). The highest yielding varieties included AC Newdale, AC Newport, Conlon, Ethiopian Hulless, Rasmussen, Robust, Scarlett, and Traditional (Figure 1). Rasmussen was the highest yielding feed barley at almost 2 tons per acre. AC Newdale, a malting barley, was the highest yielding 2-row barley (3492 lbs per acre). High incidence of lodging likely led to low yields of Danish Black barley.

A characteristic of high quality malting barley is low to moderate protein levels, generally 9.0 – 11.0% crude protein. Six-row barley usually has higher protein content ranging from 9.0-12.0%, compared to two-row barley, which ranges from 9.0-11.0%. Most varieties in this trial met the malting standard for protein content, except for Danish Black and Ethiopian Hulless. Lower CP is more desirable from a malting/brewing perspective, as high protein levels can make beer hazy. Higher CP levels are also usually associated with lower starch content. Starch is the principal contributor to brewhouse extract, and higher levels of starch result in more beer produced from a given amount of malt, although some small-scale breweries are minimally concerned with brewhouse extract efficiency.

Test weight, a measure of grain plumpness, is also an indicator used to determine malt quality. The standard barley test weight is 48 lbs. per bushel. AC Newport, Ethiopian Hulless, Formosa and Rasmussen were the only varieties that met the target test weight of barley at 48 lbs. per bushel.

Formosa had the highest falling number at 484 seconds. All other varieties were well above the optimal 220 seconds. Because the falling numbers for the spring barley were generally high, this suggests that there was minimal sprout damage in the field during harvest. Falling number is not a standard quality measurement at malt houses. However, research indicates that a falling number of 220 seconds and greater indicates sound malt barley quality. Falling number is related to the level of sprout damage found in the grain.

Varieties differed significantly in germination rates with an average of 98.3% (Figure 2, Table 6). High germination levels, preferably over 95% (three-day test), are essential for good malting barley. All varieties met the 95% germination requirement except for AC Newdale and Pinnacle. Scarlett had the lowest DON level, and all varieties were below the FDA limit of 1.0 ppm for DON in grains destined for human consumption.

Table 6. Spring barley yield and quality data in Alburgh, VT, 2012.

Variety	Harvest moisture	Yield at 14% moisture	Test weight	Crude protein at 14% moisture	Falling number at 14% moisture	DON	Germination
	%	lbs. ac^{-1}	lbs. bu^{-1}	%	seconds	ppm	%
AC Newdale	14.2	3492*	46.0	9.5	393	0.45	93.5
AC Newport	12.4	3191*	48.4	9.9	483*	0.63	99.8*
Conlon	9.9	3470*	47.1	9.7	362	0.48	97.8
Danish Black	11.4	606	35.8	**14.0***	389	0.68	98.4*
Ethiopian Hulless	14.8	2797*	**54.4***	13.7*	424	0.65	99.5*
Formosa	14.8	2306	48.5	10.3	**484***	0.40	99.3*
Kawartha	10.6	2068	40.3	9.9	444*	0.43	99.6*
Pinnacle	**16.5***	2427	45.8	9.0	437	0.35	94.6
Rasmussen	12.7	**3938***	48.3	9.4	383	0.60	99.4*
Robust	12.0	2869*	47.0	10.0	415	0.55	99.0*
Scarlett	12.7	3005*	46.3	9.7	475*	**0.33**	**100.0***
Traditional	11.5	3404*	46.0	9.6	411	0.55	98.5*
LSD (0.10)	1.0	1461	1.6	0.9	44	NS	2.2
Trial mean	12.8	2798	46.1	10.4	425	0.51	98.3

*** Varieties that did not perform significantly lower than the top performing variety (bold) in a particular column are indicated with an asterisk.**
NS – no statistical significance was determined between varieties.

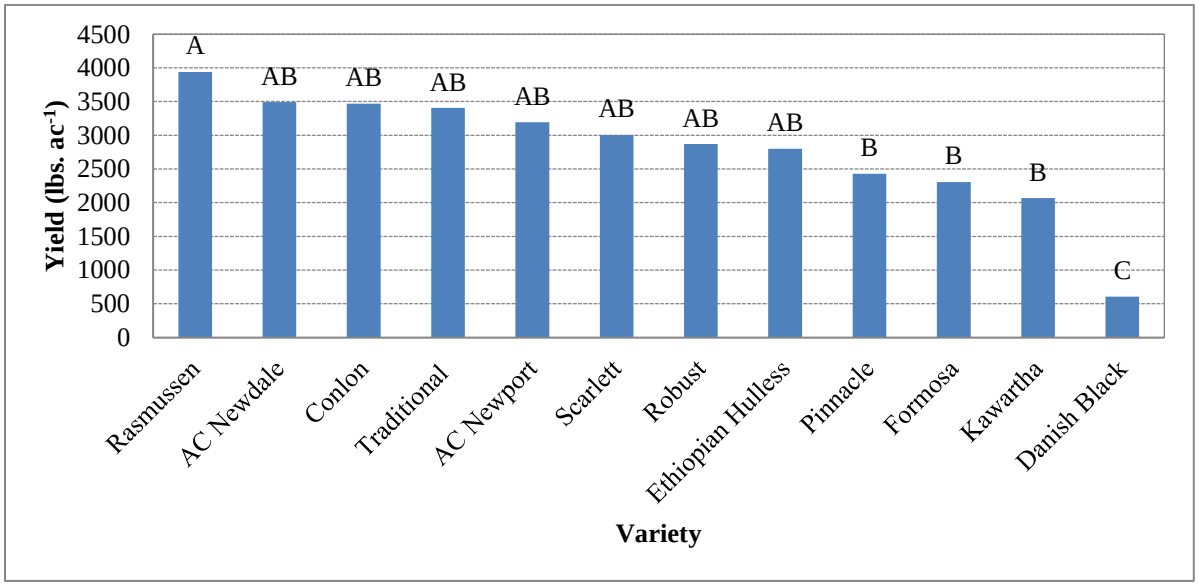

Figure 1. Yield data for varieties trialed in Alburgh,VT, 2012. Letters represent varieties that are statistically similar.

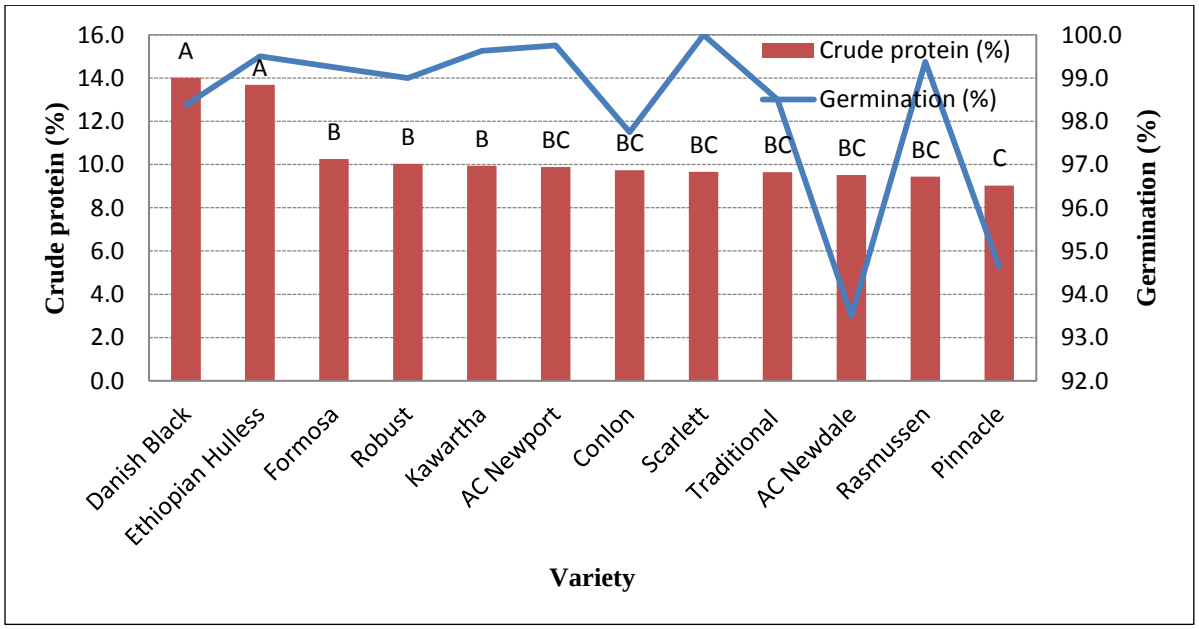

Figure 2. Crude protein and germination data for varieties trialed in Alburgh, VT, 2012. Letters represent crude proteins that are statistically similar.

Butterworks Farm Westfield, VT

Weather data is based on Northeast Region Climate Center data from an observation station in Westfield, VT (Table 7). The 2012 growing season experienced 4264 Growing Degree Days (GDDs), which are 102 more than the 30 year average.

Table 7. Weather data for spring barley variety trial in Westfield, VT.

Westfield, VT	April	May	June	July	August
Average temperature (°F)	41.8	56.7	63.0	67.9	68.1
Departure from normal	-0.9	1.9	-0.8	-0.1	2.0
Precipitation (inches)	3.2	3.6	4.0	3.6	2.8
Departure from normal	0.4	0.0	0.0	-0.7	-1.8
Growing Degree Days (base 32^{o}F)	336	769	928	1112	1119
Departure from normal	4	64	-25	-4	63

Based on Northeast Region Climate Center data from observation stations in Westfield, VT.
Historical averages for 30 years of NOAA data (1981-2010).

AC Kinck had the tallest height 83.5 cm, with the trial average being 72.6 cm (Table 8). Plant populations did not differ significantly among varieties.

Table 8. Spring barley agronomic characteristics in Westfield, VT, 2012.

Variety	Height	May population	May population
	cm	ft^{-2}	lbs. ac^{-1}
AC Kinck	**83.5***	34	1475100
Conlon	66.6	38	1643400
Lacey	72.0	30	1326600
Pinnacle	64.3	33	1435500
Polaris	69.6	29	1277100
Robust	79.9*	**43**	**1851300**
LSD (0.10)	10.4	NS	NS
Trial mean	72.6	34	1501500

* Varieties that did not perform significantly lower than the top performing variety (bold) in a particular column are indicated with an asterisk.
NS – no statistical significance was determined between varieties.

Barley yields for the trial averaged 2380 lbs. per acre (Table 9).The highest yielding varieties included AC Kinck, Lacey and Robust (Figure 3). The highest yielding feed barley was Robust at 3000 lbs. per acre. AC Kinck, a malting barley, was the highest yielding 2-row barley (2546 lbs. per acre).

All varieties in this trial met the malting standard for protein content (9.0-11.0%) except for Conlon, Lacey and Robust. The only variety in this trial to meet the target test weight (48 lbs. per bushel) was Lacey (Table 9). Polaris had the highest falling number at 428, but all other varieties were also well above the optimal level of 220 seconds, indicating minimal sprout damage.

Varieties varied significantly in germination with an average of 98.4% (Figure 4). However, all varieties met the 95% cut-off essential for good malting barley. Pinnacle had the lowest DON level, but all other varieties were also below the FDA limit of 1.0 ppm for DON in grains destined for human consumption.

Table 9. Spring barley yield and quality data in Westfield, VT, 2012.

Variety	Harvest moisture	Yield at 14% moisture	Test weight	Crude protein at 14% moisture	Falling number at 14% moisture	DON	Germination
	%	lbs. ac^{-1}	lbs. bu^{-1}	%		ppm	%
AC Kinck	**15.4**	2546*	44.6	10.8	328	0.6	98.1*
Conlon	11.6	1833	47.5*	11.2*	376	0.2	**99.1***
Lacey	12.6	2615*	**48.0***	11.3*	387	0.4	98.9*
Pinnacle	12.3	2128	44.6	10.3	419*	**0.1**	96.9
Polaris	12.3	2156	46.6*	10.8	**428***	0.2	98.8*
Robust	12.2	**3000***	47.4*	**11.7***	412*	0.2	98.6*
LSD (0.10)	NS	523	1.9	0.7	31	NS	1.1
Trial mean	12.7	2380	46.5	11.0	392	0.3	98.4

* Varieties that did not perform significantly lower than the top performing variety (bold) in a particular column are indicated with an asterisk.
NS – no statistical significance was determined between varieties.

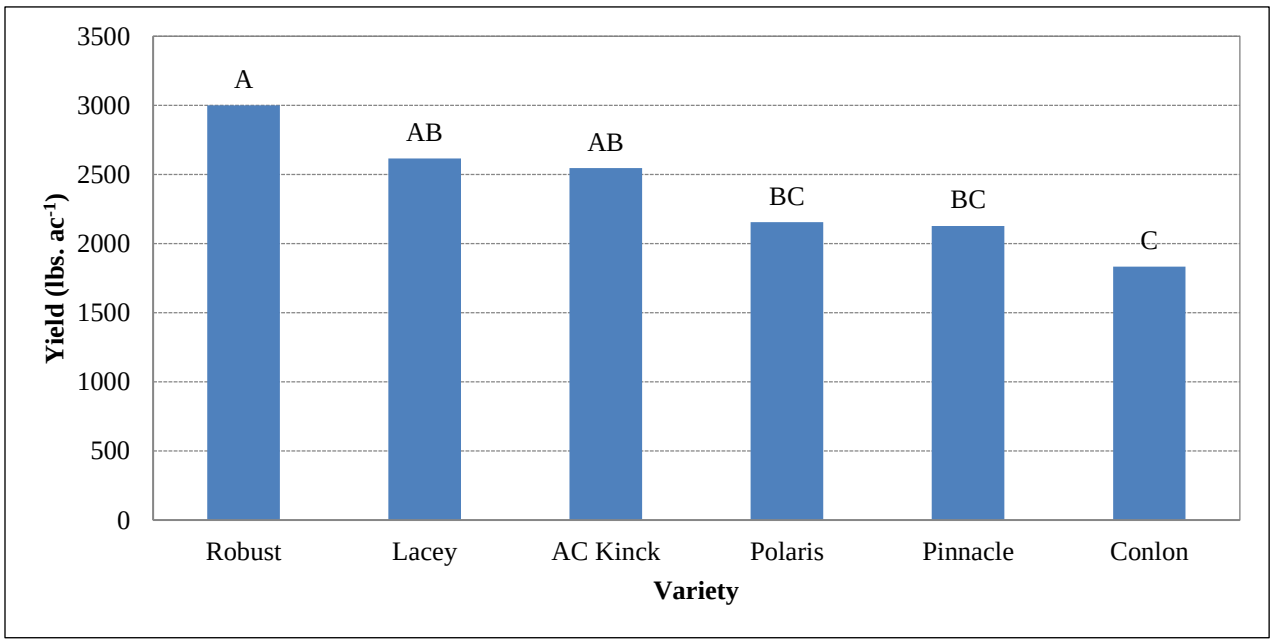

Figure 3. Yield data for varieties trialed in Westfield, VT, 2012. Letters represent varieties that are statistically similar.

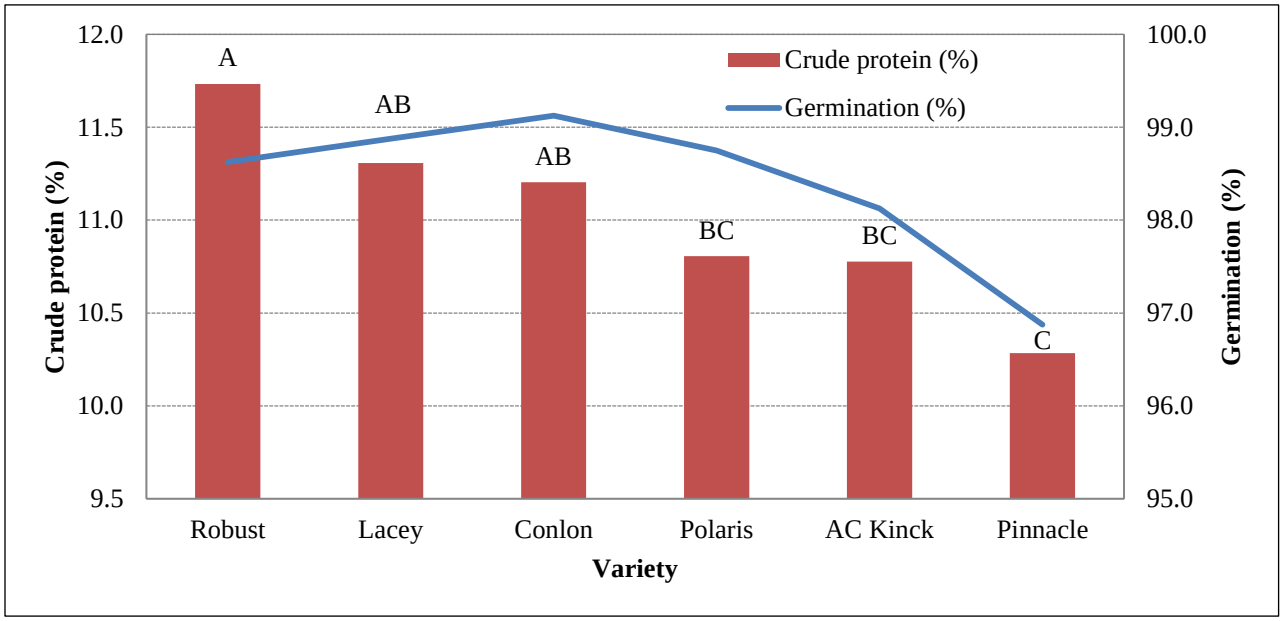

Figure 4. Crude protein and germination data for varieties trialed in Westfield, VT, 2012. Letters represent crude protein percentages that are statistically similar.

ACKNOWLEDGEMENTS

UVM Extension would like to thank Roger Rainville of Borderview Research Farm in Alburgh, VT, and Jack Lazor of Butterworks Farm in Westfield, VT, for hosting these trials. We would also like to thank Katie Blair, Chantel Cline, and Savanna Kittell-Mitchell for their assistance with data collection and entry. The information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned or criticism of unnamed products is implied.

UVM Extension helps individuals and communities put research-based knowledge to work.