

# NORTHWEST CROPS & SOILS PROGRAM



## 2022 Hulless Barley Variety Trial



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**2022 HULLESS BARLEY VARIETY TRIAL**  
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Hulless barley (also known as naked barley) has generated interest from specialty food markets. Specialty grains, such as hulless barley, can support local farm viability by diversifying crop rotations and revenue streams. Unlike malting barley, hulless barley is free threshing. This means the hull easily separates from the grain kernel during harvest and cleaning, producing whole grain barley for human consumption. This eliminates the pearling processing necessary to produce culinary barley for food markets. Because it is a whole grain, hulless barley has higher flavor and nutritional value than pearled barley, which goes through an abrasion process to remove the hull and bran. In 2022, the University of Vermont Extension's Northwest Crops and Soils Program continued the third year of a field trial of seventeen heirloom hulless barley varieties with seed provided by Sylvia Davatz of Solstice Seeds (Hartland, VT). Seven additional hulless varieties under development in various breeding programs were provided by Cornell University for evaluation in the 2022 trial.

## MATERIALS AND METHODS

The trial was established at Borderview Research Farm in Alburgh, VT. Plots were managed with practices similar to those used by organic producers in the surrounding area. Four replicates of 24 varieties were planted for evaluation (Table 1). Plots were seeded with a Great Plains Cone Seeder at a rate of 350 live seeds m<sup>-2</sup> on 18-Apr into 5' x 20' plots (Table 2). The previous crop was grain corn and the soil type was Benson rocky silt loam.

**Table 1. Hulless barley varieties, Alburgh, VT, 2022.**

Variety	Source
Arabian Blue	Solstice Seeds
Burbank	Solstice Seeds
Burbank Purple	Solstice Seeds
CDC Ascent	Cornell
CDC Carter	Cornell
CDC Clear	Cornell
CH-2909-162-95	Cornell
Dolma	Solstice Seeds
Dolma Purple	Solstice Seeds
Excelsior	Solstice Seeds
Excelsior Purple	Solstice Seeds
Faust	Solstice Seeds
Glutinous	Cornell
L94	Solstice Seeds
Purple	Cornell
Purple Valley	Cornell
Queen of Sheba	Solstice Seeds
Sangatsuga	Solstice Seeds
Sheba	Solstice Seeds
TB-106	Cornell

Tibetan	Solstice Seeds
Tibetan Purple	Solstice Seeds
Valsergeste	Solstice Seeds
Zwerggeste	Solstice Seeds

**Table 2. Spring hulless barley agronomic information, Alburgh, VT, 2022.**

<b>Trial information</b>	<b>Alburgh, VT Borderview Research Farm</b>
<b>Soil type</b>	Benson rocky silt loam
<b>Previous crop</b>	Corn grain
<b>Seeding rate</b>	350 live seeds m <sup>-2</sup>
<b>Row spacing (in)</b>	6
<b>Planting date</b>	18-Apr
<b>Harvest date</b>	26-Jul
<b>Harvest area (ft)</b>	5 x 20
<b>Tillage operations</b>	Fall plow, disk & spike tooth harrow

Heading date data was collected through the month of June, captured when 50% of the heads had fully emerged. Prior to harvest on 26-Jul, three heights were measured, excluding awns, for three plants per plot. Lodging for each plot was visually assessed using a 0-100 scale, with 0 indicating no lodging and 100 indicating entire plot was too lodged to be harvested.

Grain plots were harvested with an Almaco SPC50 plot combine on 26-Jul. Grain yield, test weight, and moisture were determined at harvest. Grain quality was determined at the E. E. Cummings Crop Testing Laboratory at the University of Vermont (Burlington, Vermont). Samples were ground using the Perten LM3100 Laboratory Mill. Flour was analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Falling number was measured (AACC Method 56-81B, AACC Intl., 2000) on the Perten FN 1500 Falling Number Machine. Grain assortment of plumpness was determined using the Pfeuffer Sorimat using 100g of clean seed and was determined by combining the amount of seed remaining on the 2.78mm and 2.38mm sieves. Deoxynivalenol (DON) analysis was analyzed using Veratox DON 2/3 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption. Percent germination (germination energy) was determined by incubating 100 seeds in 4.0 ml of water for 72 hours and counting the number of seeds that did not germinate.

Variations in agronomic characteristics can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments 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 (LSD's) at the 10% level of probability are shown.

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 in 9 out of 10 chances that there is a real difference between the two values. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In this example, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 200, which is less than the LSD value of 300. This means that these treatments did not differ in yield. The difference between A and C is equal to 400, which is greater than the LSD value of 300. This means that the yields of these treatments were significantly different from one another.

Treatment	Yield
A	2100*
B	1900*
C	1700
LSD	300

## RESULTS

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are displayed below in Table 3. The growing season was cooler than normal overall, although the month of May was warmer than average. There were 3510 Growing Degree Days (GDDs) in the season, 36 growing degree days less than normal. There were 20.1 inches of precipitation, 4.97 inches more than normal.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2022.**

Alburgh, VT	April	May	June	July
Average temperature (°F)	44.8	60.5	65.3	71.9
Departure from normal	-0.81	2.09	-2.18	-0.54
<b>Precipitation (inches)</b>				
	5.57	3.36	8.19	3.00
Departure from normal	2.50	-0.40	3.93	-1.06
<b>Growing Degree Days (32-95°F)</b>				
	391	883	1000	1236
Departure from normal	-20.0	65.0	-64.0	-17.0

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.

Heading date was recorded throughout the month of June as the date when 50% of the plants in each plot had fully emerged from the boot. The trial average was 18-Jun (Table 4). Foliar diseases reduce photosynthetic leaf area, use nutrients, and increase respiration and transpiration within colonized host tissues. The diseased plant typically exhibits reduced vigor, growth, and seed fill. Earlier occurrence, greater degree of host susceptibility, and longer duration of conditions favorable for disease development will increase the yield loss. Each plot was evaluated for the presence of several individual diseases and disease

symptoms. These individual disease ratings were combined into a single foliar disease rating for statistical analysis. Diseases and symptoms noted in the hulless barley trial were rust, mosaic virus, brown spots and lesions that could be a characteristic of several foliar diseases, and powdery mildew (in order from most severe to least). L94 had the highest incident rate of disease damage at 16.2%. The trial average for foliar damage was 6.06% with CH-2909n-162-95 having the lowest rating at 3.35% and was statistically similar to all but five varieties. Arthropod damage found on this trial were mites, thrips, and cereal leaf beetle (in order from most severe to least). The trial average for foliar damage was 4.65% with Dolma having the lowest rating at 3.30% and was not statistically different from any of the varieties.

Height and lodging information was collected prior to harvest. Taller plants are generally more desirable to outcompete weeds, but barley that grows too tall risks lodging in wet weather. The tallest variety in the 2022 trial was Excelsior Purple at 91.8 cm and was statistically similar to all except nine varieties. The average trial lodging was 51.2%, with Excelsior Purple having the lowest rate of lodging at 18.8%. Harvest moisture below 14% is necessary for grain storage. Grain above this moisture content has to be dried down after harvest, adding time and cost to the farm. All hulless barley varieties tested well above the 14% moisture threshold and required additional drying. Sangatsuga had the lowest harvest moisture at 19.5% and was statistically similar to all other varieties.

Test weight is the measure of grain density, which is determined by weighing a known volume of grain. The industry standard test weight for malting barley is 48 lbs bu<sup>-1</sup>. There is not currently a standard test weight for hulless barleys in US markets, but Canadian grain grading standards call for a test weight of 58 lbs bu<sup>-1</sup> for highest grading, similar to desired test weights for wheat. Test weights for hulless barley are higher than malting barley because the hull is not a component. Hulls are lighter weight and take up volume which would reduce the test weight. Purple had the highest test weight of 58.1 lbs bu<sup>-1</sup>, however not statistically different from the other varieties.

Yields were good across the trial with average yields over a ton per acre (Table 4). CDC Carter had the highest yield at 3392 lbs ac<sup>-1</sup> however was not statistically different from any of the other varieties. The trial mean yield for hulless barley was 2436 lbs ac<sup>-1</sup>.

**Table 4. Spring hulless barley varieties and agronomic characteristics, Alburgh, VT, 2022.**

Variety	Heading date	Disease damage	Arthropod damage	Height	Lodging	Harvest moisture	Test weight	Yield @ 13.5% moisture
		% foliar surface affected	% foliar surface affected	Cm	0-100	%	lbs bu <sup>-1</sup>	lbs ac <sup>-1</sup>
Arabian Blue	14-Jun	5.85*	3.65	64.8	67.5	22.8	54.3	2383
Burbank	13-Jun	10.5	5.30	71.1	46.3	20.5	57.1	2309
Burbank Purple	14-Jun	6.35*	5.85	72.7	41.3	22.6	53.5	2353
CDC Ascent	15-Jun	4.45*	4.70	77.0*	40.0	23.9	55.1	2747

CDC Carter	15-Jun	3.50*	4.90	89.3*	26.3	26.0	53.4	<b>3392</b>
CDC Clear	15-Jun	5.90*	4.15	89.0*	45.0	25.0	55.4	2744
CH-2909n-162-95	14-Jun	<b>3.35*</b>	6.15	87.1*	45.0	20.5	50.7	2936
Dolma	15-Jun	6.50*	<b>3.30</b>	80.8*	31.3	21.5	52.8	2448
Dolma Purple	13-Jun	5.05*	4.70	70.2	71.3	20.2	53.0	2053
Excelsior	15-Jun	6.75*	3.85	83.1*	56.3	25.6	54.2	1957
Excelsior Purple	18-Jun	3.60*	4.40	<b>91.8*</b>	<b>18.8</b>	24.2	54.6	2864
Faust	13-Jun	3.60*	4.90	84.7*	31.3	25.2	55.2	2223
Glutinous	13-Jun	4.70*	4.15	74.2	35.0	23.4	54.9	2112
L94	12-Jun	16.2	3.65	74.9	48.8	22.0	52.5	2146
Purple	14-Jun	3.35*	4.30	79.1*	41.3	26.0	<b>58.1</b>	2315
Purple Valley	13-Jun	8.00	5.20	79.8*	83.8	25.6	55.4	2189
Queen of Sheba	13-Jun	7.70	5.80	65.2	88.3	23.7	54.8	2261
Sangatsuga	16-Jun	5.55*	4.50	67.0	20.0	<b>19.5</b>	53.6	2363
Sheba	13-Jun	6.60*	4.65	77.5*	76.3	22.9	54.7	2174
TB-106	16-Jun	4.40*	4.15	79.3*	43.8	26.0	55.7	2614
Tibetan	14-Jun	7.10*	4.85	67.8	63.8	25.0	56.3	2378
Tibetan Purple	14-Jun	4.60*	5.90	77.8*	75.0	23.1	53.4	2852
Valsergeste	13-Jun	4.70*	5.05	63.3	80.0	25.2	55.3	2593
Zwerggeste	15-Jun	7.25	3.45	85.6*	60.3	23.5	54.4	2049
LSD (p=0.10)	NS	3.84	NS	15.7	NS	NS	NS	NS
Trial mean	18-Jun	6.06	4.65	77.2	51.2	23.5	54.5	2436

†Treatments that are followed by an asterisk (\*) performed statistically similar to the top performer shown in **bold**.  
NS, no significant difference.

Protein concentrations averaged 11.8%, which is ideal for malting barley (which needs to be between 10-12% for optimum malting). The highest protein variety was Queen of Sheba at 13.4%, statistically similar to twelve other varieties (Table 5, Figure 1).

The falling number indicates the level of enzymatic activity in the grain. It is determined by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of a test-tube. Falling numbers between 300 - 350 indicate low enzymatic activity and sound quality grain. A falling number lower than 200 indicates high enzymatic activity and poor quality grain as a result of pre-harvest sprouting damage. Falling number above 400 is suitable, but may slow fermentation when used for baking. Falling number was generally good across the trial. The trial average for falling number was 407, ranging from 292 to 495. There were no significant differences between the varieties.

CDC Ascent had the highest plumpness at 88.7% and was not statistically different from any of the other varieties. Glutinous had the highest germination rate at 99.5% and was statistically similar to fifteen other

varieties. All but four varieties (Arabian Blue, Burbank, Dolma, Zwerggeste) were above the industry standard of 95% for germination.

**Table 5. Spring hulless barley varieties and quality parameters, Alburgh, VT, 2022.**

Variety	Crude protein @ 12% moisture	Falling number	Plumpness	Germination
	%	seconds	%	%
Arabian Blue	12.7*	451	78.2	94.3
Burbank	11.8*	424	78.9	94.8
Burbank Purple	11.4	326	69.2	96.8*
CDC Ascent	10.3	417	<b>88.7</b>	95.3
CDC Carter	11.2	472	83.2	98.3*
CDC Clear	11.5	400	84.6	96.3*
CH-2909n-162-95	12.3*	363	77.2	96.0*
Dolma	11.0	292	54.9	91.0
Dolma Purple	12.1*	466	69.0	96.3*
Excelsior	12.4*	329	77.4	97.5*
Excelsior Purple	11.2	377	83.4	99.3*
Faust	11.8*	398	80.7	95.3
Glutinous	11.6	397	84.5	<b>99.5*</b>
L94	10.8	354	46.1	96.3*
Purple	11.3	457	58.2	99.3*
Purple Valley	12.8*	<b>495</b>	84.0	95.8
Queen of Sheba	<b>13.4*</b>	486	64.7	98.3*
Sangatsuga	10.0	322	62.5	97.3*
Sheba	12.8*	415	64.8	97.0*
TB-106	10.1	390	68.3	98.8*
Tibetan	12.6*	446	75.1	98.0*
Tibetan Purple	12.1*	427	73.2	95.5
Valsergeste	13.0*	481	75.0	99.0*
Zwerggeste	11.9*	391	71.4	91.8
LSD (p= 0.10)	1.62	NS	NS	3.60
Trial mean	11.8	407	73.1	96.5

†Treatments that are followed by an asterisk (\*) performed statistically similar to the top performer shown in **bold**.  
NS, no significant difference.

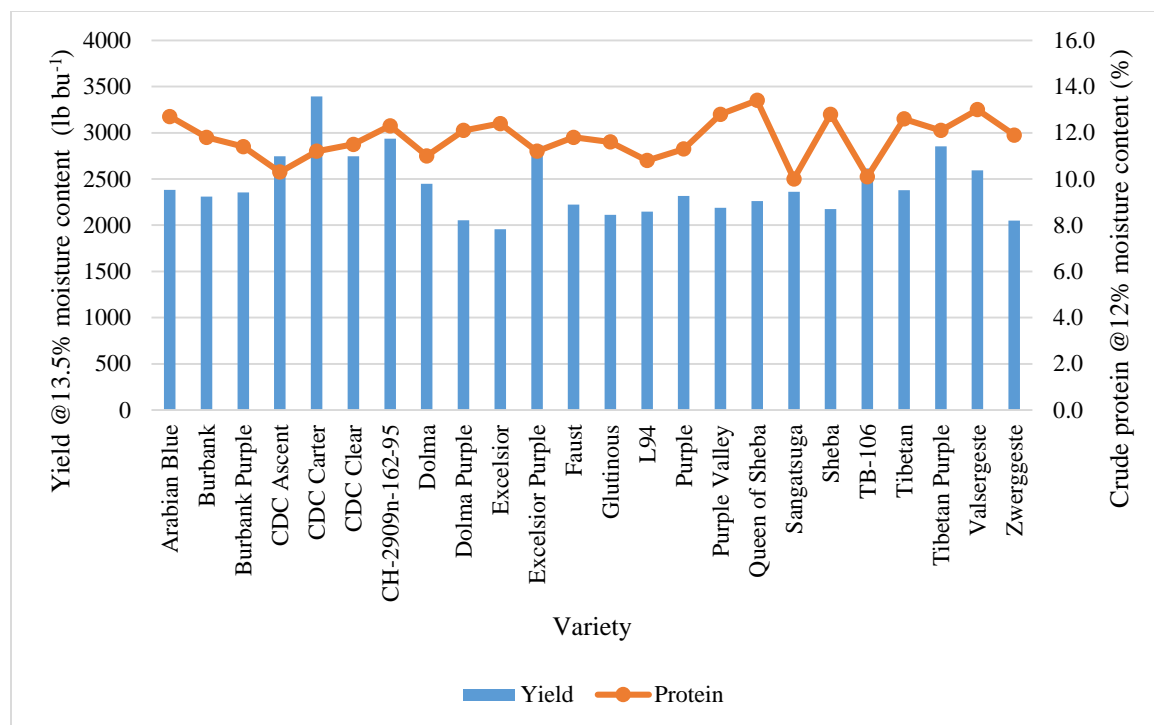


Figure 1. Spring hulless barley yield and protein, Alburgh, VT, 2022.

## DISCUSSION

Market outreach has been generating demand for hulless barley in recent years. Hulless barley in general shows potential as a specialty food grain in the Northeast. Though this data is only based on a single growing season, agronomic performance shows potential for hulless barley as a crop in Vermont and the Northeast. This was only the third year that enough seed was available to conduct multiple replications and quality analysis for this trial. More research is needed to better understand ideal quality parameters for hulless barley that can be achieved in Vermont, including test weight, protein and falling number and the yield potential of these varieties. The 2022 results are encouraging that many of these varieties are suitable for production in the Northeast. This trial will be continued in 2023, and with seed for all varieties already in stock, we will be able to plant all varieties at the same time and evaluate them on an equal basis.



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