



# 2023 Organic Spring Barley Variety Trial



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## 2023 ORGANIC SPRING BARLEY VARIETY TRIAL

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With the revival of the small grains industry in the Northeast and the strength of the locavore movement, craft breweries and distilleries have expressed an interest in sourcing local barley for malting. Malting barley must meet specific quality characteristics such as low protein content and high germination. Depending on the variety, barley can be planted in either the spring or fall, and both two- and six-row barley can be used for malting. In 2023, UVM Extension Northwest Crops & Soils Program conducted a spring malting barley trial to evaluate yield and quality of fifteen varieties.

### MATERIALS AND METHODS

In 2023, a spring barley variety trial was initiated at Borderview Research Farm in Alburgh, VT. The experimental plot design was a randomized complete block with four replications. The treatments were fifteen spring malting barley varieties, listed in Table 1.

**Table 1. 15 spring barley varieties evaluated at Borderview Research Farm in Alburgh, VT, 2022.**

Spring Barley Variety	Type	Seed Source
AAC Connect	2-row	Agriculture and Agri-Food Canada (Brandon)
Esma	2-row	Ackermann (Germany)
Excelsior Gold	2-row	Cornell University
Explorer	2-row	Secobra (France)
Firefox	2-row	Ackermann (Germany)
Klarinette	2-row	Secobra (France)
KWS Fantex	2-row	KWS (Germany)
KWS Jessie	2-row	KWS (Germany)
KWS Kellie	2-row	KWS (Germany)
KWS Willis	2-row	KWS (Germany)
ND Gensis	2-row	North Dakota State University
Newdale	2-row	Agriculture and Agri-Food Canada
Pinnacle	2-row	North Dakota State University
Quest	6-row	University of Minnesota
Revanche	2-row	Ackermann (Germany)

All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The previous crop planted at the site was industrial hemp. In April, the trial area was prepared for planting with a Pottinger TerraDisc®. The plots were seeded with a Great Plains NT60 Cone Seeder on 14-Apr at a seeding rate of 350 live seeds m<sup>-2</sup> into a Benson rocky silt loam. Plot size was 5' x 20'.

**Table 2. Agronomic and trial information for spring barley variety trial, 2023.**

<b>Trial Information</b>	<b>Borderview Research Farm Alburgh, VT</b>
Soil type	Benson rocky silt loam
Previous crop	Industrial hemp
Tillage operations	Pottinger TerraDisc®
Harvest area (ft)	5x20
Row spacing (in)	6
Seeding rate (live seeds m <sup>-2</sup> )	350
Replicates	4
Planting date	14-Apr
Harvest date	20-Jul

Heights and lodging were recorded on 19-Jul prior to harvest. Heights were measured, excluding awns, in centimeters for three plants in each plot. Lodging was assessed by visual estimate as the percentage of plants in each plot that were too lodged to be harvested. On 20-Jul, the plots were harvested using an Almaco SPC50 small plot combine.

Following the harvest of spring barley, seed was cleaned with a small Clipper cleaner (A.T. Ferrell, Bluffton, IN). Quality measurements included standard testing parameters used by commercial malt houses. Plot yield was weighed. Harvest moisture was determined for each plot using a DICKEY-John Mini GAC moisture and test weight meter. Generally, the heavier the barley is per bushel, the higher malting quality. A one-pound subsample was collected to determine quality. Samples were evaluated for crude protein and starch content using a Perten Inframatic 9500 NIR Grain Analyzer. The samples were then ground into flour using the Perten LM3100 Laboratory Mill. Falling number for all barley varieties were determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain. It is measured by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of the tube. Falling numbers greater than 200 indicate low enzymatic activity and sound quality sample. A falling number lower than 200 indicates high enzymatic activity and poor quality. Grain assortment of plumpness was determined using the Pfeuffer Soritmat 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.

All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate cultivar means when the F-test was 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 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. In this example, 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.

Variety	Yield
A	3161
B	3886*
C	<b>4615*</b>
<b>LSD</b>	<b>889</b>

This means that these varieties did not differ in yield. The difference between A and C is equal to 1454, which 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.

## RESULTS

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are displayed in Table 3. This growing season was wetter than past years with a total of 22.1 inches, 6.90 inches more than normal. The average temperature of the growing season for spring barley (April to July) was 7.01°F below the 30-year average. The number of growing degree days (GDDs) was 44 above normal.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2023.**

Alburgh, VT	April	May	June	July
Average temperature (°F)	48.3	57.1	65.7	72.2
Departure from normal	-1.28	-1.76	-0.24	-3.73
Precipitation (inches)	4.94	1.98	4.40	10.8
Departure from normal	1.87	-1.78	0.14	6.69
Growing Degree Days (32-95°F)	524	766	1027	1274
Departure from normal	112	-53	-37	22

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 (1991-2020) for Burlington, VT.

### Spring Barley Yield and Quality

Heights and lodging were measured prior to harvest. Taller plants can be desirable for better competition against weeds; however, very tall plants can be prone to lodging. Excelsior Gold was the tallest variety, with a height of 91.3 cm, statistically similar to Quest and Pinnacle. Revanche had the most lodging, at 62.5%, which was statistically higher compared to all other varieties. Comparatively, Excelsior Gold, Pinnacle, and Firefox were the top performers with 0% lodging. Yield and quality varied slightly between varieties of spring barley (Table 4; Figure 1). ND Genesis had the highest yield at 3990 lbs ac<sup>-1</sup>. This was statistically similar to Explorer, Firefox, Quest, Excelsior Gold, AAC Connect, Esma, Pinnacle, and Klarinette, which all yielded above 3292 lbs ac<sup>-1</sup>. All varieties were above 12% moisture content at harvest and required drying for storage. None of the barley varieties met the industry standard of 48 lbs bu<sup>-1</sup> for test weight. Excelsior Gold had the highest test weight at 47.6 lbs bu<sup>-1</sup>, statistically similar to four

other varieties: ND Genesis, Esma, Explorer, and KWS Kellie. Revanche had the highest rate of lodging and the lowest yield.

**Table 4. Agronomic and harvest results for the 15 spring barley varieties trialed in Alburgh, VT, 2023.**

Variety	Height	Lodging	Yield at 13.5% moisture	Harvest moisture	Test weight
	cm	%	lbs ac <sup>-1</sup>	%	lbs bu <sup>-1</sup>
AAC Connect	83.2	3.75*†	3611*	14.8*	45.6
Esma	67.8	17.3*	3568*	14.4*	46.3*
Excelsior Gold	<b>91.3*</b>	<b>0.00*</b>	3630*	15.9	<b>47.6*</b>
Explorer	66.9	17.8*	3843*	15.2	46.3*
Firefox	78.7	0.00*	3823*	16.8	44.5
Klarinette	66.8	5.75*	3456*	14.6*	45.4
KWS Fantex	65.8	13.8*	3236	14.0*	44.3
KWS Jessie	65.1	17.5*	3181	<b>14.0*</b>	44.6
KWS Kellie	67.6	4.25*	3027	15.1	46.1*
KWS Willis	74.0	27.5	3031	14.8*	43.4
ND Genesis	84.5	5.00*	<b>3990*</b>	17.4	46.4*
Newdale	78.2	3.75*	2891	14.8*	45.7
Pinnacle	87.4*	0.00*	3528*	17.2	45.9
Quest	91.2*	0.50*	3813*	14.4*	44.3
Revanche	71.1	62.5	2648	14.2*	41.7
LSD (0.10)‡	4.65	20.4	697	1.07	1.51
Trial Mean	76.0	11.9	3418	15.2	45.2

† Varieties with an asterisk (\*) are not significantly different than the top performer in **bold**.

‡ LSD; least significant differences at p=0.10.

**Table 5. Quality results for the 15 spring barley varieties trialed in Alburgh, VT, 2023.**

Variety	Protein at 12% moisture	Starch	Falling number	Germination	Plumpness	DON
	%	%	seconds	%	%	ppm
AAC Connect	9.20	56.6	208	94.0	91.9	0.60
Esma	8.41	57.3*†	260	97.0*	96.5*	0.20*
Excelsior Gold	9.55	56.0	256	94.0	<b>96.9*</b>	0.60
Explorer	8.80	57.0*	247	98.0*	96.2*	0.50*
Firefox	8.91	56.4	224	90.5	94.9*	0.90
Klarinette	8.52	57.4*	319*	95.3	96.8*	<b>0.20*</b>
KWS Fantex	8.11	57.4*	<b>345*</b>	96.8*	96.3*	0.30*
KWS Jessie	8.27	<b>57.5*</b>	294*	97.0*	96.3*	0.20*
KWS Kellie	8.68	57.1*	282*	96.3*	95.1*	0.30*
KWS Willis	8.57	57.1*	323*	95.8	94.8*	0.30*
ND Genesis	8.97	56.6	245	94.5	96.1*	0.80
Newdale	9.16	56.6	276	96.3*	88.1	0.50*
Pinnacle	8.59	56.8	241	91.8	96.4*	0.70
Quest	<b>10.1*</b>	55.5	335*	<b>99.0*</b>	95.0*	0.90
Revanche	8.37	57.3*	293*	95.5	95.3*	0.30*
LSD (0.10)‡	0.44	0.63	63.0	3.22	2.24	0.38
Trial Mean	8.81	56.8	277	95.4	95.1	0.50

† Varieties with an asterisk (\*) are not significantly different than the top performer in **bold**.

‡ LSD; least significant differences at p=0.10.

Only four varieties (Quest, Excelsior Gold, AAC Connect, Newdale) were within the industry standard of 9-11% for crude protein for malting barley (Table 5). However, three of these four varieties (Excelsior Gold, AAC Connect, Newdale) were not statistically similar to the top performer, Quest. The variety with the highest starch content was KWS Jessie at 57.5%, with seven other varieties being statistically similar to this high starch content. All varieties had falling numbers above 200 seconds, indicating sufficient enzymatic activity. The highest falling number, 345 seconds, was found in the variety KWS Fantex. All varieties except Firefox, Pinnacle, AAC Connect, Excelsior Gold, and ND Genesis were above the industry standard of 95% germination rate. All varieties were above industry standards for plumpness of >80%, although two varieties (AAC Connect, Newdale) were not statistically similar to the rest of the varieties. Three replications for each variety were tested for DON. Klarinette, Esma, and KWS Jessie had the lowest DON levels at 0.2 ppm. It is important to note that although none of the varieties averaged above the 1 ppm threshold for DON concentrations for human consumption, several of the individual plot samples tested were above the 1 ppm threshold: ND Genesis at 1.3 ppm, Pinnacle at 1.0 ppm, Firefox at 1.1 ppm, and Quest at 1.0 and 1.4 ppm.

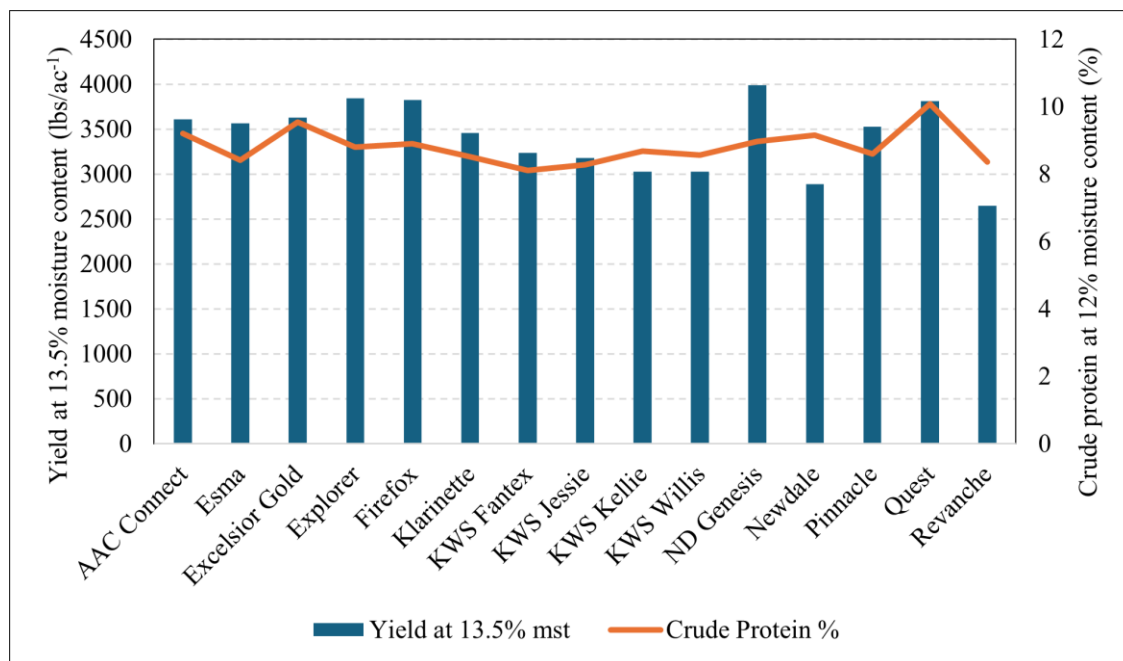


Figure 1. Yield and crude protein for the fifteen spring barley varieties trialed in Alburgh, VT, 2023.

## DISCUSSION

Overall, most varieties performed well with good quality and adequate yields, especially considering the above average precipitation that fell during the growing season. The 2023 trial did not include any varieties that exceeded the 1 ppm threshold for DON, although there were some statistically close DON levels at 0.9 ppm for the Quest and Firefox varieties. Klarinette, Eisma, and KWS Jessie had the lowest DON levels at 0.2 ppm each.

In terms of quality parameters, all varieties performed within industry standards for plumpness and falling number. All varieties had a plumpness greater than 80%, and all varieties had a falling number greater than 200. Ten of the fifteen varieties were within the industry standard for germination, with a rate above 95%. While four varieties were within the industry standard for crude protein of 9-11%, Quest was statistically different from the rest at 10.1%. The highest starch content was found in KWS Jessie at 57.5%, with seven other varieties being statically similar. As referenced in Figure 1 above, Quest and Excelsior Gold had the highest yields and highest quality in terms of protein. It is important to note that these results represent only one year of data. As farmers make varietal selections, they should make sure to evaluate data from test sites that are similar to their own region as possible. It is our intention to continue this research in 2024.

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