



2021 Organic Spring Barley Variety Trial



Dr. Heather Darby, UVM Extension Agronomist
Sophia Wilcox Warren and Hillary Emick
UVM Extension Crop and Soil Technicians
(802) 524-6501

Visit us on the web at <http://www.uvm.edu/nwcrops>

2021 ORGANIC 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 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 2021, UVM Extension, in collaboration with the Eastern Spring Malting Barley Nursery (ESBN) testing network, conducted a spring malting barley trial to evaluate yield and quality of 25 varieties. Some varieties that had not performed well or are no longer commercially available were dropped from the trial and new varieties were added.

MATERIALS AND METHODS

In 2021, 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 twenty-five spring malting barley varieties, listed in Table 1.

Table 1. Twenty-five spring barley varieties trialed at Borderview Research Farm in Alburgh, VT, 2021.

Spring barley variety	Type	Seed source
2ND32529	2-row	North Dakota State University
2ND36638	2-row	North Dakota State University
2ND36642	2-row	North Dakota State University
2ND37111	2-row	North Dakota State University
2ND37130	2-row	North Dakota State University
2ND37568	2-row	North Dakota State University
AAC Connect	2-row	Agriculture and Agri-Food Canada (Brandon)
AAC Synergy	2-row	Agriculture and Agri-Food Canada (Brandon)
Brunilda	2-row	Ackermann (Germany)
CU198	2-row	Cornell University
Esma	2-row	Ackermann (Germany)
Excelsior Gold	2-row	Cornell University
Explorer	2-row	Secobra (France)
Fangio	2-row	Secobra (France)
Firefox	2-row	Ackermann (Germany)
Focus	2-row	Secobra (France)
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 Genesis	2-row	North Dakota State University
Newdale	2-row	Agriculture and Agri-Food Canada
Pinnacle	2-row	North Dakota State University
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 soybeans. In April, the trial area was plowed, disked and spike tooth harrowed to prepare for planting. The plots were seeded with a Great Plains NT60 Cone Seeder on 9-Apr at a seeding rate of 300 live seeds m⁻² into a Benson rocky silt loam. Plot size was 5' x 20'.

Table 2. Agronomic and trial information for spring barley variety trial, 2021.

Trial Information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Soybeans
Tillage operations	Spring plow, disc, and spike tooth harrow
Harvest area (ft)	5 x 20
Row spacing (in)	6
Seeding rate (live seeds m ⁻²)	300
Replicates	4
Planting date	9-Apr
Harvest date	5-Aug

On 5-Aug, 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. The samples were then ground into flour using the Perten LM3100 Laboratory Mill, and were evaluated for crude protein content using the Perten Inframatic 8600 Flour Analyzer. 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 350 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. Each sample was run in duplicate.

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. 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.

Variety	Yield
A	3161
B	3886*
C	4615*
LSD	889

RESULTS

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are displayed in Table 3. This growing season was much drier than past years with a total precipitation of 10.16 inches—4.99 inches less than normal. The average temperature of the growing season (April to July) was 0.99° F below normal. The drier growing season is most likely due to 3583 total growing degree days, marking 36 days less than normal.

Table 3. Temperature and precipitation summary for Alburgh, VT, 2021.

Alburgh, VT	April	May	June	July
Average temperature (°F)	48.1	58.4	70.3	68.1
Departure from normal	2.52	-0.03	2.81	-4.31
<hr/>				
Precipitation (inches)	3.52	0.66	3.06	2.92
Departure from normal	0.45	-3.10	-1.20	-1.14
<hr/>				
Growing Degree Days (32-95°F)	497	818	1149	1119
Departure from normal	85	-1	86	-134

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.

Spring Barley Yield and Quality

Yield and quality varied slightly between varieties of spring barley (Table 4, Figure 1). KWS Fantex had the highest yield at 4309 lbs ac⁻¹. This was statistically similar to 2ND32529, 2ND36638, 2ND36642, AAC Connect, Esma, Excelsior Gold, Explorer, KWS Jessie, KWS Willis, ND Genesis, and Newdale, which all yielded above 3511 lbs ac⁻¹. All varieties were above 14% moisture content at harvest and required drying down for storage.

Table 4. Harvest results for the 25 spring barley varieties trialed in Alburgh, VT, 2021.

Variety	Yield at 13.5% moisture	Harvest moisture	Test weight	Protein at 12% moisture	Falling number	Germination	Plumpness
	lbs ac ⁻¹	%	lbs bu ⁻¹	%	seconds	%	%
2ND32529	3699*	15.8	44.5	9.9*	98	85.2	99*
2ND36638	3698*	15.4*	44.8	10.7	204	94.2	100*
2ND36642	3770*	15.1*	46.3*	10.7	213	94.8*	100*
2ND37111	2828	15.4	44.7	10.5	296*	99.5*	99*
2 ND 37130	2945	16.2	43.6	10.2	233	99.5*	99*
2ND37568	2732	16.3	42.8	10.2	281*	99.3*	99*
AAC Connect	3990*	15.6*	44.1	10.8	62	99.0*	98
AAC Synergy	3386	15.7*	46.1*	11.1	90	97.3*	99*
Brunilda	2999	15.7*	46.0*	11.0	103	75.0	99*
CU198	3207	16.5	46.4*	10.9	205	96.0*	99*
Esma	3579*	15.7*	46.7*	10.7	174	97.3*	98
Excelsior Gold	3996*	14.8*	44.3	11.4	248*	97.0*	100*
Explorer	3575*	15.9	45.3	11.0	218	97.5*	99*
Fangio	2531	17.0	43.8	10.7	208	88.8	99*
Firefox	3770*	16.0	45.1	9.6*	303*	95.8*	99*
Focus	2810	16.7	45.1	10.3	207	95.8*	99*
Klarinette	2710	16.9	44.7	10.5	172	95.5*	99*
KWS Fantex	4309*	15.5*	45.0	10.4	283*	94.3	99*
KWS Jessie	3511*	15.8	45.1	9.9*	200	95.5*	99*
KWS Kellie	2561	15.5*	46.0*	10.6	180	96.8*	99*
KWS Willis	3943*	15.9	46.0*	9.9*	280*	96.8*	100*
ND Genesis	3824*	15.3*	45.6*	9.8*	91	95.5*	100*
Newdale	3701*	15.7*	46.3*	11.4	90	96.5*	98
Pinnacle	3047	15.2*	42.5	9.8*	142	89.8	99*
Revanche	2997	15.6*	46.4*	9.7*	253*	97.5*	100*
LSD (0.10)	904.13	0.789	1.347	0.592	59.598	0.048	0.006
Trial Mean	3365	15.8	45.1	10.5	310	94.8	0.992

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

None of the barley varieties met the industry standard of 48 lbs bu⁻¹ for test weight. Esma had the highest test weight at 46.7 lbs bu⁻¹, statistically similar to nine other varieties that were also above 45.6 lbs bu⁻¹

for test weight. Three varieties (AAC Synergy, Excelsior Gold, Newdale) were above 11% crude protein and did not meet the industry standard for crude protein (between 9% and 11% for malting barley). All other varieties were within the industry standard for crude protein. All varieties except 2ND37111, 2ND37130, 2ND37568, Excelsior Gold, Firefox, KWS Fantex, KWS Fantex, KWS Willis, and Revanche had falling numbers below 220, indicating low enzymatic activity in these varieties. All varieties except 2ND32529, 2ND36638, Brunilda, Fangio, KWS Fantex, and Pinnacle were above the industry standard of 95% germination rate. All varieties were above industry standards for plumpness of >80% for a two-row barley.

One trial rep of the barley was tested for DON. However, all of the plots that were tested were below the FDA standard of 1 ppm, meaning they were all suitable for human consumption (data not shown).

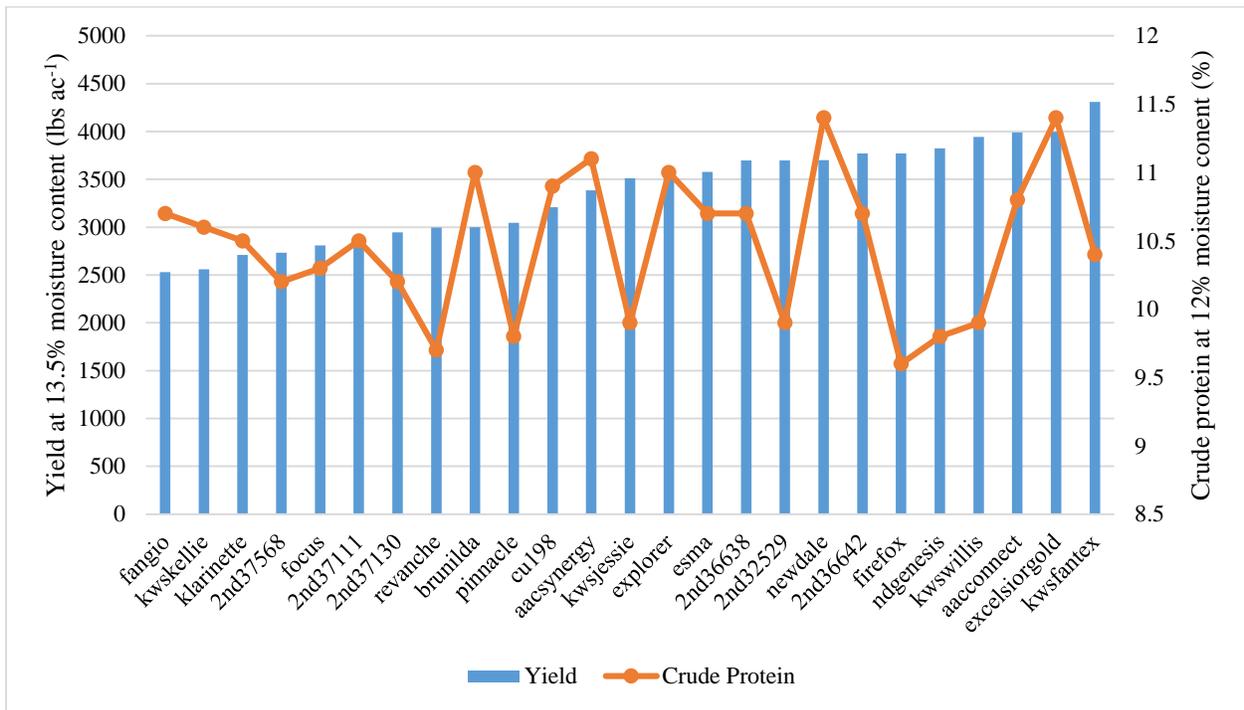


Figure 1. Yield and crude protein for the 25 spring barley varieties trialed in Alburgh, VT, 2021.

DISCUSSION

Overall, most varieties performed well with high quality and adequate yields. 2019 and 2020 had slightly higher yields than 2021's average yield of 3365 lbs ac⁻¹. However, the 2021 average yield is higher than the grand mean yield from 2011-2017 of 2289 lbs ac⁻¹.

In terms of quality parameters, most varieties performed within the industry standard of crude protein content, with only three varieties slightly over 11% crude protein. All but three varieties performed at a statistically similar plumpness, and most varieties performed at a statistically similar germination rate.

No varieties out-performed the others. All varieties that were statistically similar as high yielding varieties performed highly in other quality parameters. It is important to note that these results represent only one year of data. As farmers make variety 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 2022.

ACKNOWLEDGEMENTS

Thank you to the American Malting Barley Association, Brewers Association, Northeast SARE, and the U.S. Wheat and Barley Scab Initiative for their financial contributions to this project. UVM Extension would like to thank the Uniform Eastern Spring Malting Barley Nursery and Borderview Research Farm and staff in Alburgh. We would also like to acknowledge Henry Blair, John Bruce, Catherine Davidson, Ivy Krezinski, Rory Malone, Lindsey Ruhl, Laura Sullivan, and Sara Ziegler for their assistance with data collection and entry. This information is presented with the understanding that no product discrimination is intended and neither endorsement of any product mentioned, nor criticism of unnamed products, is implied.

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



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. University of Vermont Extension, Burlington, Vermont. University of Vermont Extension, and U.S. Department of Agriculture, cooperating, offer education and employment to everyone without regard to race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or familial status.