2014

Winter Barley Variety Trial

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 WINTER BARLEY VARIETY TRIAL

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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 sourcing 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 concentrated, high-energy feed source for livestock. 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 and livestock feed. Winter barley has not been traditionally grown in the Northeast due to severe winterkill. However, newly developed varieties and a changing climate have encouraged our team to investigate this crop for the area. In 2013-2014, UVM Extension's Northwest Crops and Soils Program conducted a winter barley trial to evaluate the yield and quality of malting and feed barley varieties.

MATERIALS AND METHODS

A winter barley variety trial was initiated at Borderview Research Farm in Alburgh, VT. Winter barley was planted on 20-Sep 2013. Thirty-four winter varieties (Table 1) were planted in a randomized complete block design with three replicates. The varieties McGregor and Thoroughbred are considered feed-grade barley. 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 ac^{-1} with a Great Plains cone seeder. Rows were spaced at 6". All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). Fall populations were taken on 24-Oct 2013 by counting the number of plants in two twelve inch sections. This was also done in the spring on 25-Apr 2014. Winter survival was evaluated by taking the spring population and dividing it by the fall population. All varieties were harvested with an Almaco SPC50 small plot combine on 21-Jul 2014.

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

Variety	Type
02Ab431	2-row
02Ab669	2-row
02Ab671	2-row
06OR-9 (TCFW6-194)	2-row
07OR-64 (TCFW6-235)	6-row
08OR-48 (TCFW6-244)	6-row
2011-F5-141-5 (TCFW6-193)	6-row
2Ab08-X05W061-216	2-row
2Ab09-X05W018-119	2-row
2Ab09-X05W040-125	2-row
AC 07/022/2	2-row
AC 07/041/33	2-row
Alba	6-row
Archer	2-row
Ariane	2-row
Charles	2-row

Etincel	
Flavia	2-row
Hickory	
Joy	2-row
Liga	2-row
Maja	6-row
Maltesse	
McGregor	6-row
Nectaria	
SC11203	
SC11213	
Saturn	6-row
Strider	6-row
Thoroughbred	6-row
VA10B-43	6-row
VA12B-7	6-row
VA12B-8	6-row
Violetta	2-row

Table 2. Winter barley agronomic characteristics and trial information.

Trial information	Alburgh, VT Borderview Research Farm
Soil type	Benson rocky silt loam
Previous crop	organic soybeans
Seeding Rate (lbs ac^{-1})	125
Row spacing (in)	6
Replicates	3
Planting date	20-Sep 2013
Harvest date	21-Jul 2014
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, spring disk & spike tooth harrow

Following the harvest of winter barley, seed was cleaned with a small Clipper cleaner. A one-pound 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 using the Perten Inframatic 8600 Flour Analyzer. In addition, falling number for all barley varieties was determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine. Samples were also analyzed for Deoxynivalenol (DON) using the Veratox DON 2/3 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 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 did not germinate.

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). When this was not possible due to inconsistent sample size across varieties, multiple pairwise comparisons were run with the Tukey-Kramer adjustment.

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 below, 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 AND DISCUSSION

Seasonal precipitation and temperature recorded at a weather station in Alburgh, VT are shown in Table 3. Historical averages are for 30 years of data (1981-2010). Fall conditions were below average in temperature and precipitation. In 2014, April through July brought above average rainfall. There were 3356 Growing Degree Days (GDDs) in 2014, which is 4 more growing-degree-days than the 30-year average.

Table 3. Weather data for winter barley variety trial in Alburgh, VT.

Alburgh, VT	**Sep-13**	**Oct-13**	**Nov-13**	**Mar-14**	**Apr-14**	**May-14**	**Jun-14**	**Jul-14**
Average temperature (°F)	59.3	51.1	35.1	22.2	43	57.4	66.9	69.7
Departure from normal	-1.3	2.9	-3.1	-8.9	-1.8	1	1.1	-0.9
Precipitation (inches)	2.2	2.2	3.2	1.7	4.3	4.9	6.1	5.2
Departure from normal	-1.4	-1.4	0.0	-0.5	1.5	1.5	2.4	1.0
Growing Degree Days (base 32°F)	825	600	176	25	330	789	1041	1171
Departure from normal	-33	98	-8	25	-54	33	27	-27

*Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Average winter barley survival was 70.2% (Table 4). The variety with the highest survival was Liga with 98.6% and the lowest was 07OR-64 (TCFW6-235) with 21.2%. Heading date ranged from 3-Jun to 16-Jun, with the average being 10-Jun.

Table 4. Agronomic characteristics for winter barley variety trial in Alburgh, VT.

Variety	Spring population plants m^{-2}	Winter survival %	Heading date	Height in
02Ab431	194*	80.9	11-Jun	52.9
02Ab669	168	66.0*	15-Jun*	50.9
02Ab671	136	52.1	14-Jun*	54.9
06OR-9 (TCFW6-194)	186*	80.1*	9-Jun	**69.7***
07OR-64 (TCFW6-235)	54	21.2	12-Jun*	53.4
08OR-48 (TCFW6-244)	133	49.6	12-Jun*	67.3*
2011-F5-141-5 (TCFW6-193)	265*	87.0*	6-Jun	48.1
2Ab08-X05W061-216	90	43.6	12-Jun*	63.0*
2Ab09-X05W018-119	179	83.0*	15-Jun*	51.1
2Ab09-X05W040-125	147	66.4*	14-Jun*	55.6
AC 07/022/2	86	44.7	8-Jun	45.0
AC 07/041/33	226*	93.8*	12-Jun*	47.3
Alba	**276***	98.4*	14-Jun*	57.4
Archer	151	68.2*	12-Jun*	64.0*
Ariane	186*	77.1*	11-Jun	55.0
Charles	204*	74.5*	7-Jun	47.2
Etincel	129	53.0	11-Jun	46.7
Flavia	140	68.1*	8-Jun	54.8
Hickory	154	63.8	11-Jun	54.3
Joy	161	68.4*	**16-Jun***	56.1
Liga	272*	**98.6***	12-Jun*	54.0
Maja	226*	91.1*	6-Jun	62.4*
Maltesse	251*	88.0*	11-Jun	49.0
McGregor	211*	80.4*	6-Jun	57.7
Nectaria	133	57.5	11-Jun	46.8
SC11203	237*	92.8*	12-Jun*	53.1
SC11213	151	76.8*	11-Jun	49.6
Saturn	190*	72.8*	5-Jun	64.1*
Strider	222*	92.8*	8-Jun	60.7*
Thoroughbred	140	39.5	5-Jun	51.6
VA10B-43	179	60.6	3-Jun	51.0
VA12B-7	179	63.4	5-Jun	54.4
VA12B-8	147	59.4	3-Jun	54.7
Violetta	176	74.2*	5-Jun	62.9*
Trial Mean	176	70.2	10-Jun	54.9
LSD (0.10)	95.0	33.2	4.1	11.6

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

The variety Saturn was the highest yielding, producing on average 2670 lbs per acre, nearly two times the trial mean. However, this variety did not perform differently statistically than 060R-9 (TCFW6-194), 2011-F5-141-5 (TCFW6-193), 2AB09-X05W040-125, and VA12B-8 (Table 5). VA12B-8 had the highest falling number of 326 seconds and Charles had the lowest falling number of 117 seconds. High falling number would indicate low sprout damage and potentially seed with good germination. Overall falling numbers were low and indicated that the barley may not be appropriate for malting. This would also be supported by the low test weight of all varieties. Test weight of barley should be at least 48 lbs per bushel and the trial average was 40 lb per bushel. All winter barley varieties had DON levels above the USDA acceptable limit of 1ppm except for 02AB431 and 2AB09-X05W040-125, which had DON levels of 0.8 ppm.

Table 5. Yield and quality data for winter barley variety trial in Alburgh, VT.

Variety	Yield lbs ac^{-1}	Moisture %	Test Weight lbs bu^{-1}	Crude Protein @ 12% moist %	Falling Number seconds	DON ppm
02Ab431	1687	12.5	44.2*	7.4	205	0.8
02Ab669	1252	15.4*	43.7*	8.2	263	1.3
02Ab671	1331	13.1	43.8*	7.9	220	1.6
06OR-9 (TCFW6-194)	2000*	13.1	37.2	9.0	287*	1.9
07OR-64 (TCFW6-235)	315	17.8*	29.7	8.8	151	3.6
08OR-48 (TCFW6-244)	1024	13.7	37.0	8.9	224	**9.0***
2011-F5-141-5 (TCFW6-193)	1859*	14.4	37.3	9.2*	219	1.5
2Ab08-X05W061-216	948	**18.2***	35.7	**10.2***	191	2.6
2Ab09-X05W018-119	1062	16.1*	**45.2***	7.5	262	1.1
2Ab09-X05W040-125	1916*	15.8*	42.3*	8.3	187	0.8
AC 07/022/2	1215	13.1	41.8*	8.5	264	1.7
AC 07/041/33	1000	12.8	40.2*	8.9	251	1.3
Alba	1309	12.8	37.3	8.7	315*	1.2
Archer	1598	14.2	39.3	8.6	243	2.2
Ariane	1637	12.6	37.2	9.9*	271*	1.8
Charles	1533	11.4	42.8*	8.5	117	1.0
Etincel	1393	12.3	38.2	9.0	241	2.2
Flavia	1559	11.0	43.0*	8.8	259	1.6
Hickory	1063	12.9	40.0*	8.8	189	2.1
Joy	1065	15.8*	41.3*	8.9	244	1.9
Liga	1370	14.5	40.7*	8.3	236	1.4
Maja	1367	11.7	39.0	9.2*	250	2.5
Maltesse	1341	12.2	43.3*	9.1*	269*	2.1
McGregor	1029	13.0	30.0	9.2*	237	4.4
Nectaria	936	12.8	42.5*	9.7*	254	2.3
SC11203	716	14.2	38.8	9.9*	275*	2.8
SC11213	1079	14.3	41.8*	9.8*	243	2.0
Saturn	**2670***	10.8	40.8*	8.8	301*	1.5
Strider	1782	10.4	40.7*	9.0	282*	3.9
Thoroughbred	1010	11.8	40.7*	9.4*	254	3.2
VA10B-43	1459	12.3	39.8	10.0*	256	4.9
VA12B-7	1490	11.7	44.5*	9.5*	321*	2.0
VA12B-8	1973*	12.2	44.0*	9.8*	**326***	1.1
Violetta	1059	13.7	35.8	10.1*	233	3.2
Trial Mean	1354	13.4	40.0	9.0	245	2.3
LSD (0.10)	837	3.3	5.2	1.1	59.7	1.8

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

For malting purposes, high quality barley typically has low to moderate protein levels ranging from 9.0 – 11.0%. In general, six-row barley varieties usually have higher protein content ranging from 9.0-12.0%, compared to two-row barley varieties, which range from 9.0-11.0%. Only half of the winter barley varieties met the minimum malting standard for protein content, however none of the varieties were over 12% (Figure 1). 2AB08-X05W061-216 had the highest protein content of 10.2%. Lower crude protein is more desirable from a malting/brewing perspective, as high protein levels can make beer hazy. Higher crude protein 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.

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