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2012 Winter Barley Variety Trial

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2012 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 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 high-energy concentrate source for their 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. In 2011-2012, UVM Extension conducted a winter barley trial to evaluate the yield and quality of publicly available 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 21-Sep 2011. Sixteen winter varieties were planted in a randomized complete block design with three replicates (Table 1). The varieties McGregor and Thoroughbred are considered feed-grade barley; and all others are intended for human consumption. The variety Streaker and Dan are both winter hulless barley. The seedbed was prepared by conventional tillage methods. Plots were 3' x 25' and were seeded into a Benson rocky silt loam at 125 lbs ac^{-1} 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 2). Fall populations measured on 24-Oct 2011 by counting the barley population in 33 cm increments in two rows. Plots were weeded on 24-May 2012, and covered with bird netting on 8-Jun 2012. All varieties were harvested with an Almaco SPC50 plot combine on 6-Jul 2012.

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

Winter barley variety	Type	Seed source
Alba	2-row	Oregon State University
Dan	6-row	Virginia Agricultural Experimental Station
Maja	6-row	Oregon State University
Mathias	6-row	Oregon State University
McGregor	6-row	Seedway
N071DH_13	6-row	Oregon State University
OR101	6-row	Oregon State University
OR818	6-row	Oregon State University
Short10-11	6-row	Oregon State University
Streaker Mix	6-row	Oregon State University
Strider	6-row	Oregon State University
Thoroughbred	6-row	Virginia Agricultural Experimental Station
VA06H25	2-row	Virginia Agricultural Experimental Station
Verdant	6-row	Oregon State University
Wincrisp-2	6-row	Oregon State University
Wincrisp-6	6-row	Oregon State University

When the barley was in the soft dough state, spikes in a 1.08 ft^2 area were counted. Heights were also recorded for each plot at the soft dough stage.

Table 2. Agronomic and trial information for winter barley variety trial.

	Winter barley
Soil type	Benson rocky silt loam
Previous crop	Forage oats
Tillage operations	Fall plow, disc, and spike-toothed harrow
Plot area (ft)	3 x 25
Row spacing(in)	6
Seeding rate	125 lbs ac^{-1}
Replicates	3
Planting date	21-Sep 2011
Harvest date	6-Jul 2012

Following the winter barley harvest, seed was cleaned with a small Clipper fawning mill. At this time, peak biomass yield was determined by sampling whole barley plants within a known area. 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 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 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

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 Burlington, VT. October 2011 brought excessive rainfall and floods to Vermont, saturating many fields and delaying planting and early spring growth on many farms. In mid-summer 2012, drought-like conditions were experienced, with the overall growing season seeing 3.1 less inches of precipitation than the 30 year average (Table 3). However, the 2011-2012 growing season experienced 5,956 Growing Degree Days (GDDs), which is 897 more than the 30-year average.

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

	2011				2012						
Alburgh, VT	September	October	November	December	January	February	March	April	May	June	July
Average temperature (°F)	62.8	50.1	43.4	29.5	22.2	26.0	39.7	44.9	60.5	67.0	71.4
Departure from normal	2.2	1.9	5.2	3.6	3.4	4.5	8.6	0.1	4.1	1.2	0.8
Precipitation* (inches)	5.6	3.5	1.4	2.2	1.5	0.7	1.5	2.6	3.9	3.2	3.8
Departure from normal	1.9	-0.1	-1.7	-0.1	-0.6	-1.1	-0.8	-0.2	0.5	-0.5	-0.4
Growing Degree Days (base 32°F)	932	578	344	110	55	59	331	396	884	1046	1221
Departure from normal	74	76	142	91	55	59	205	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 from June-September 2012 is based on Northeast Regional Climate Center data from an observation station in Burlington,VT.

Table 4. Winter barley agronomic characteristics in Alburgh, VT.

Variety	October population plants ac^{-1}	Spikes ft^{-2}	Height in	Peak biomass yield lb ac^{-1}
Alba	982,207	44	26.7	7076
Dan	780,262	**63***	30.0*	8935*
Maja	911,789	34	28.6	6446
Mathias	894,387	40	29.6	7918*
McGregor	1,043,317	54*	30.5*	9238*
N071DH_13	1,052,220	48*	31.9*	7067
OR101	1,034,818	49*	31.9*	8840*
OR818	1,122,233	41	27.3	9468*
Short10-11	903,290	19	28.7	4485
Streaker Mix	1,174,844	43	26.1	8718*
Strider	**1,525,719***	56*	25.6	**9479***
Thoroughbred	1,008,512	39	28.6	6830
VA06H25	859,178	32	29.0	6936
Verdant	1,174,844	37	**33.0***	5892
Wincrisp-2	736,554	61*	25.4	5643
Wincrisp-6	1,183,748	32	23.9	5308
LSD (0.10)	311,214	16	3.0	2152
Trial Mean	1,024,245	43	28.6	7392

*Barley that did not perform significantly lower than the top performing treatment (in bold) in a particular column is indicated with an asterisk.

The trial averaged 43 spikes per ft^2 at harvest (Table 4). Peak biomass yield was highest in the Strider variety at 9,479 lbs per acre, and statistically similar to Dan, Mathias, McGregor, OR101, OR818, and Streaker Mix. High total biomass would reflect varieties with significant potential to produce both grain and straw crops.

Barley yields for the trial averaged 2762 lbs per acre. The highest yielding varieties included Thoroughbred, N071DH_13, Alba, OR101 OR818, and McGregor. Thoroughbred was the highest yielding feed barley with over 2 tons per acre. Alba, a malting barley, was the highest yielding 2-row barley.

A characteristic of quality malting barley is low to moderate protein levels, generally 9.0 - 11.2% crude protein at 14% moisture (Table 5). Six-row barley usually has higher protein content ranging from 9.24-12.3%, compared to two-row barley, which ranges from 9.24-11.9%. Overall, all varieties in this trial met the malting standard for protein content. 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.

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. Dan, Streaker Mix, and Thoroughbred were the only varieties that met the target test weight of barley at 48 lbs per bushel.

Dan had the highest falling number at 355 (Table 5). All other varieties were close to the optimal 220 seconds, with the exception of OR818, Short10-11, Streaker Mix, and Wincrisp-2. Because the falling numbers for the winter 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 93.4% (Table 5). High germination levels, preferably over 95% (three-day test), are essential for good malting barley. All varieties met the 95% germination cut-off except Alba, NO17DH_13, Short10-11, Strider, Verdant, and Wincrisp-2.

Maja 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 5. Winter 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
	%	lb ac^{-1}	lb bu^{-1}	%	seconds	ppm	%
Alba	14.2*	3575*	44.7	10.4*	335*	0.10*	90.2
Dan	16.1*	2779	**59.0***	9.5	**355***	0.23*	99.5
Maja	12.8	2772	46.2	9.6	261	**0.07***	97.5
Mathias	10.7	2792	43.3	10.6*	344*	0.27	97.0
McGregor	14.8*	3641*	44.0	8.7	326*	0.07*	98.0
N071DH_13	15.3*	3095*	44.0	9.7	312*	0.23*	53.7
OR101	12.7	3695*	43.3	9.8	283*	0.30	98.7
OR818	15.0*	3020*	44.5	9.4	150	0.30	99.3
Short10-11	**16.3***	850	41.8	11.0*	204	0.30	93.8
Streaker Mix	12.8	2467	49.5*	9.7	172	0.30	97.3
Strider	14.9*	2702	42.0	9.7	313*	0.47	94.8
Thoroughbred	14.9*	**4041***	48.5*	8.8	312*	0.23*	**99.8**
VA06H25	12.2	2700	46.7	8.9	264	0.33	98.3
Verdant	13.7*	1400	41.3	10.2*	345*	0.40	94.5
Wincrisp-2	14.2*	2536	46.5	**11.3***	121	0.17*	87.0
Wincrisp-6	12.2	2128	42.0	10.7*	255	0.37	95.5
LSD (0.10)	2.9	1031	2.4	1.2	79.0	0.03	
Trial Mean	13.9	2762	45.5	9.9	271.9	0.26	93.4

*Barley that did not perform significantly lower than the top performing treatment (in bold) in a particular column is indicated with an asterisk.

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