NORTHWEST CROPS & SOILS PROGRAM

2013 Spring Barley Variety Trial

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2013 SPRING 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. In 2012-2013, UVM Extension conducted a spring barley trial to evaluate the yield and quality of publicly available malting and feed barley varieties.

MATERIALS AND METHODS

A spring barley variety trial was initiated at Borderview Research Farm in Alburgh, VT. Spring barley was planted on 29-Apr 2013 with a Kincaid cone seeder at a rate of 125 lbs ac^{-1} into a Benson rocky silt loam. The experimental plot design was a randomized complete block with four replications (Table 2). The treatments were varieties, listed in Table 1. Plot size was 5' x 20'. The seedbed was prepared by conventional tillage methods. Barley populations were measured by counting the number of plants in two 33 cm segments in two different rows per plot on 4-Jun. Barley height was measured and plots harvested on 29-Jul and 30-Jul with an Almaco SPC50 small plot combine.

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

Spring barley variety	Type	Seed source
AC Newport	2-row	Semican
Conlon	2-row	Albert Lea Seeds
Danish Black	2-row	Denmark
Famosa	2-row	La CoopFederee
Klinck	6-row	RDR Grains et Semences
Lacey	6-row	Albert Lea Seeds
Newdale	2-row	Semican
Pinnacle	2-row	North Dakota State University
Polaris	6-row	RDR Grains et Semences
Rasmussen	6-row	Albert Lea Seeds
Robust	6-row	Albert Lea Seeds
Scarlett	2-row	Valley Malt

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

Trial Information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	corn
Tillage operations	Spring plow, disc, and spike tooth harrow
Plot area (ft)	5 x 20
Row spacing (in)	6
Seeding rate	125 lbs ac^{-1}
Replicates	4
Planting date	29-Apr
Harvest date	29-Jul, 30-Jul

Following the harvest of spring 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. Means were compared through multiple pairwise comparisons with the Tukey-Kramer adjustment due to inconsistent sample size across varieties. Variation in yield and quality can occur because of differences in variety genetics, soil characteristics, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids is due to varietal differences or could have occurred due to other variations in the field.

RESULTS

June 2013 brought above average rainfall to Vermont, saturating many fields at crucial developmental periods druing the season. These conditions lead to poor performance, disease and fungal proliferation, and excessive mycotoxin production. Weather data (Table 3) is based on National Weather Service data from cooperative observer stations in South Hero, and Burlington, VT, which are in close proximity to the Borderview Research Farm. Historical averages are for 30 years of data (1971-2000).

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

	Sep 2012	Oct 2012	Nov 2012*	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013
Average temperature (°F)	60.8	52.4	36.7	28.7	20.6	21.9	32.1	43.6	59.1	64.0	71.7
Departure from normal (°F)	0.2	4.2	-1.5	2.8	1.8	0.4	1.0	-1.2	2.7	-1.8	1.1
Precipitation (inches)	5.36	4.13	0.68	3.49	0.6	1.08	1.04	2.12	4.79	9.23*	1.89
Departure from normal	1.72	0.53	-2.44	1.12	-1.45	-0.68	-1.17	-0.7	1.34	5.54	-2.26
Growing Degree Days (base 32°F)	896	652	144	535	47.3	21.4	88.5	349	848	967	1235
Departure from normal	38	150	-40.4	535	47.3	21.4	88.5	-35.6	91.4	-47	36.8

*Based on National Weather Service data from cooperative stations in South Hero, VT

All varieties were similar in plant height with a trial average of 30.0 inches (Table 4). Newdale and Scarlett had the lowest harvest moisture. This indicates that these varieties matured slightly earlier than other varieties allowing for more complete drying at the end of the season. Rasmussen was the highest yielding variety, although all other varieties performed statistically similarly (Table 4, Figure 1). AC Newport had the highest test weight, although only statistically different from Danish Black, Pinnacle, and Scarlett. The test weights recorded in this trial, with the exception of AC Newport, did not meet the barley test weight of 48 lbs per bushel. Danish Black had the highest protein content, although only statistically different from Lacey and Pinnacle (Table 4, Figure 1). All varieties had DON levels above the FDA limit of 1 ppm. Danish Black had the lowest germination rate of 75.0%, although this criterion was not statistically tested (Table 4).

Table 4. Spring barley agronomic characteristics, yield, and quality data in Alburgh, VT.

Variety	Population	Height	Harvest moisture	Yield @ 13.5% moisture	Test weight	Crude protein @ 12% moisture	DON	Germination
	plants ac^{-1}	in	%	lbs ac^{-1}	lbs bu^{-1}	%	ppm	%
AC Newport	726,948	31.8	11.8abc	2509	**48.3a**	10.0ab	3.73abc	94.0
Conlon	866,362	30.7	11.6abc	1785	47.6a	9.5ab	2.44a	95.0
Danish Black	856,404	31.5	10.6abc	322	36.5c	**11.6a**	8.93def	75.0
Famosa	965,944	25.9	10.2abc	1901	44.8ab	9.80ab	4.05abc	97.5
Klinck	**1,015,735**	31.9	13.3a	2076	43.0ab	10.3ab	6.70bcde	88.0
Lacey	**1,015,735**	28.1	11.5abc	2260	43.8ab	9.02b	7.63cdef	94.0
Newdale	955,986	27.1	**9.30c**	2178	44.5ab	9.27ab	2.80ab	97.0
Pinnacle	736,906	28.1	12.0abc	2039	40.0bc	9.05b	5.18abcd	92.5
Polaris	816,571	29.9	11.7abc	2685	43.0ab	10.4ab	11.08f	85.0
Rasmussen	995,819	30.8	11.3abc	**2847**	43.6ab	9.69ab	10.80ef	94.0
Robust	826,530	**33.5**	12.9ab	2342	43.8ab	11.1ab	8.78def	94.5
Scarlett	707,031	30.2	**9.30bc**	1692	41.0bc	11.2ab	**2.27a**	**98.0**
Probability Level	NS	NS	*	NS	**	*	**	NA
Trial Mean	873,831	30.0	11.5	2141	43.4	10.05	6.28	92.0

Within a column, means followed by the same letter are not significantly different ($P < 0.1$).
*, **, coefficients significant at the 0.1 and 0.0001 probability levels, respectively.
NS - no significant coefficients ($P < 0.1$).
NA - was not statistically tested.

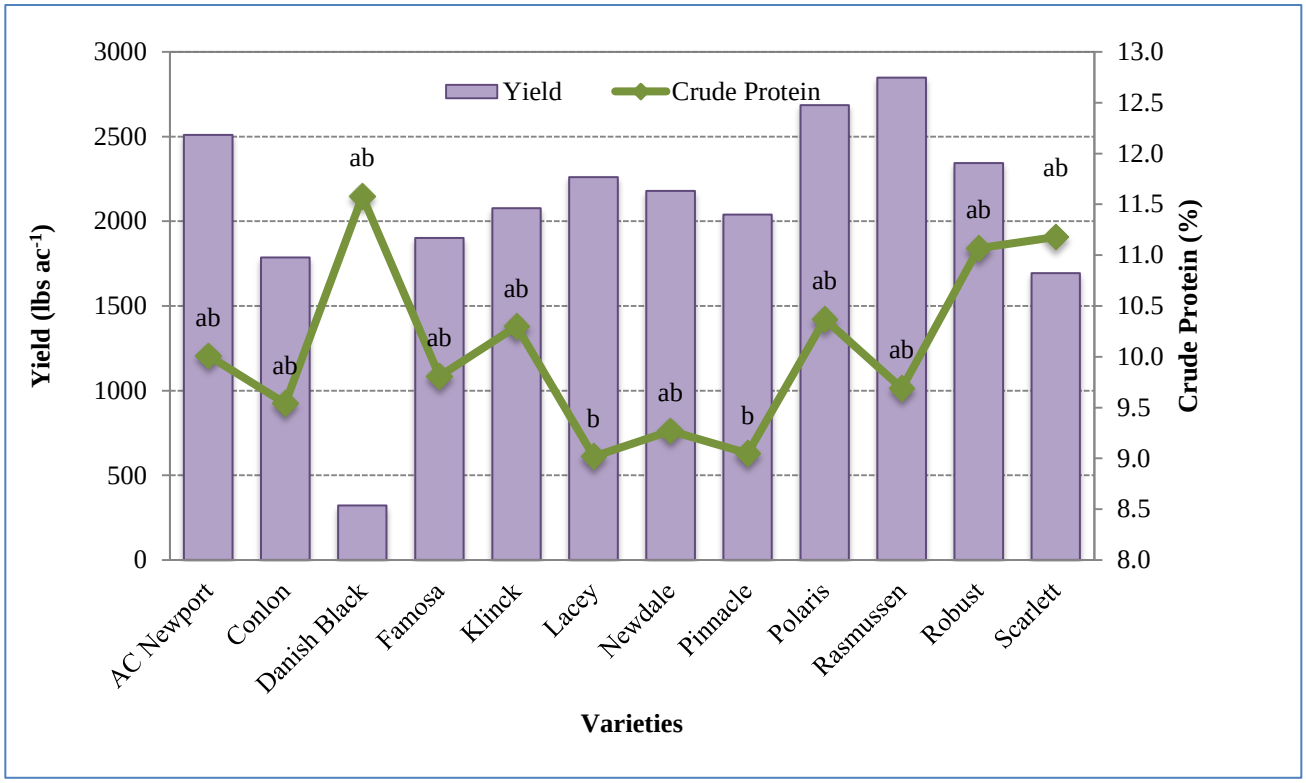

Figure 1. Yield and crude protein for spring barley varieties trialed in Alburgh, VT.

DISCUSSION

Test weight, a measure of grain plumpness, is also an indicator used to determine malt quality. Poor weather conditions during June may have caused lower test weights as all varieties except for AC Newport had below the ideal malting test weight of 48 lbs per bushel. Danish black showed the highest protein content of 11.6%, however, it only differed statistically from Lacey and Pinnacle which had moistures of 9.02% and 9.05% respectively. 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%. All varieties in this trial met the malting standard for protein content, although Lacey, Newdale, and Pinnacle were all below 9.5% which is on the low end of the ideal range for malting barley. Lower crude protein is desirable from a malting/brewing perspective as high protein levels can make beer hazy. Higher protein levels are also often 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. High germination levels, preferably over 95% (three-day test), are essential for a good malting barley. Germination levels in the spring barley were lower than preferred by the industry; only the varieties Formosa, Newdale, and Scarlett were above 95%. Germination was not statistically tested as measurments were not taken for all plots but only one plot for each variety. 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. All spring barley varieties were above this optimal level indicating minimal sprout damage.

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