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CULTIVATING HEALTHY COMMUNITIES

2010 Barley Variety Trial Report

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The UNIVERSITY of VERMONT EXTENSION

2010 VERMONT BARLEY VARIETY TRIAL

INTRODUCTION

There has been increasing interest in growing barley (*Hordeum vulgare* L.) for malting in Vermont and throughout New England to provide local grains for craft breweries and distilleries. Malting barley must meet specific quality characteristics such as high germination and low protein content. Both two-row and six-row barley can be used for malting, depending on the brewer's preferences. The goal of this project was to evaluate yield and quality of publicly available malting barley varieties.

METHODS

Barley varieties trials were planted at Borderview Research Farm in Alburgh, VT on April 13, 2010. The experimental plot design was a randomized complete block with four replications. Barley varieties evaluated are listed in Table 1.

Table 1: spring malting barley varieties planted in Alburgh, VT.

Barley Varieties	Type	Seed Source
AC Newport	2 row	SemiCan
Conlon	2 row	North Dakota State University
Famosa	2 row	La Coop fédérée
Newdale	2 row	SemiCan
Pinnacle	2 row	North Dakota State University
Rasmussen	6 row	Albert Lea Seed House

CULTURAL PRACTICES

The seedbed in Alburgh was prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The plots were seeded with a John Deere 750 grain drill and harvested with an Almaco SP50 small plot combine.

This trial evaluated barley quality based on standard testing parameters used by commercial mills. Yield, moisture, and test weight (a measure of grain density) were recorded at the time of harvest. Samples were ground into flour using a Perten LM3100 Laboratory Mill (Springfield, IL). Protein content was determined using a Perten Inframatic 8600 Flour Analyzer. Falling Number was determined with a Perten NF 1500 Falling Number Machine (AACC Method 56-81B, AACC Intl., 2000). Deoxynivalenol (DON) analysis was done using Veratox DON 5/5 Quantitaive test from the NEOGEN Corp. (Lansing, MI). This test has a detection range of 0.5 to 5 ppm. DON values greater than 1 ppm are considered unsuitable for human consumption (FDA, 1993). Each variety was evaluated for percentage of seed germination by incubating 100 seeds in 4.0 mL of water for 72 hours.

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 ($P< 0.10$).

Table 2: General plot management for trial.

Location	Borderview Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Grass sod
Row spacing (in.)	6
Seeding rate	125 lbs./acre
Replicates	4
Planting date	4/13/10
Harvest date	7/27/10
Harvest area (ft.)	5x10
Tillage operations	Fall plow, disc, & spike-toothed harrow

WEATHER

Seasonal precipitation and temperature recorded at a weather station in close proximity Alburgh are shown in Table 3. The 2010 growing season was ideal for growing barley. Due to early season warmth, barley grew quickly in the spring. From planting to harvest, there was an accumulation of 3,699 Growing Degree Days (GDD), 367 GDDs higher than the 30-year average.

Table 3: Temperature and precipitation summary for Alburgh, VT, 2010.

South Hero (Alburgh)	April	May	June	July
Average Temperature (F)	49.3	59.6	66.0	74.1
Departure from Normal	5.8	3.0	0.2	3.0
Precipitation (inches)	2.76	0.92	4.61	4.30
Departure from Normal	0.25	-2.01	1.40	0.89
Growing Degree Days (base 32)	521	854	1019	1305
Departure from Normal	176	91.5	4.50	94.6

*Based on National Weather Service data from cooperative observer stations in close proximity to field trials. Historical averages are for 30 years of data (1971-2000).

LEAST SIGNIFICANT DIFFERENCE (LSD)

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 Difference (LSD) 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. Barley varieties that were not significantly lower in performance than the highest variety in a particular column are indicated with an asterisk. In the example below 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

Birds ate and damaged approximately 50% of one replication of the barley trials in Alburgh in 2010. However, most of the trial was left undamaged and harvest data is presented in Table 4. All varieties were harvested at less than 13.5% moisture and therefore, were acceptable for grain storage. AC Newport was the only variety to reach the standard test weight for barley, 48 lbs. per bushel. Pinnacle and Rasmussen were the highest yielding varieties, averaging over 2440 lbs per acre (Table 4).

Table 4: Harvest data for barley varieties.

Barley Variety	Harvest moisture	Test weight	Yield @13.5% moisture
	%	lbs/bu	lbs/ac
AC Newport	12.1	**48.0***	2229
Conlon	13.2	46.0	1989
Famosa	10.0*	46.1	1881
Newdale	**8.7***	45.4	2058
Pinnacle	9.7*	43.4	**2617***
Rasmussen	8.7*	44.8	2440*
Trial Mean	10.4	45.6	2202
LSD (0.10)	1.55	1.21	361

*Results that are not significantly different than the top performer in a particular column are indicated with an asterisk.

A characteristic of quality malting barley is low to moderate protein levels, generally between 9.0 - 11.2% crude protein at 14% moisture. The highest protein varieties in this trial fall within that range (Table 5). Newdale, Rassmussen, Famosa, and AC Newport were all just slightly above 9.0% crude protein. Malting barley yield and protein concentrations are presented in Figure 1.

Table 5: Quality data for barley varieties.

Barley Variety	Crude protein @14% moisture	Falling number @14% moisture	DON	Germination
	%	seconds	ppm	%
AC Newport	9.16*	416*	0.625	98.5*
Conlon	8.12	340	**0.325***	97.5*
Famosa	9.18*	**432***	0.975	**99.0***
Newdale	**9.74***	314	0.675	95.0
Pinnacle	8.12	355	1.000	93.1
Rasmussen	9.43*	357	0.750	97.0*
Trial Mean	8.96	369	0.725	96.7
LSD (0.10)	0.59	53.1	0.275	2.38

*Results that are not significantly different than the top performer in a particular column are indicated with an asterisk.

To meet malting standards, barley varieties must have a germination rate at or above 95%. Five of the six barley varieties evaluated met this level (Table 5). Famosa had the highest germination rate with 99% of the seeds germinating in 72 hours (Table 5; Figure 2).

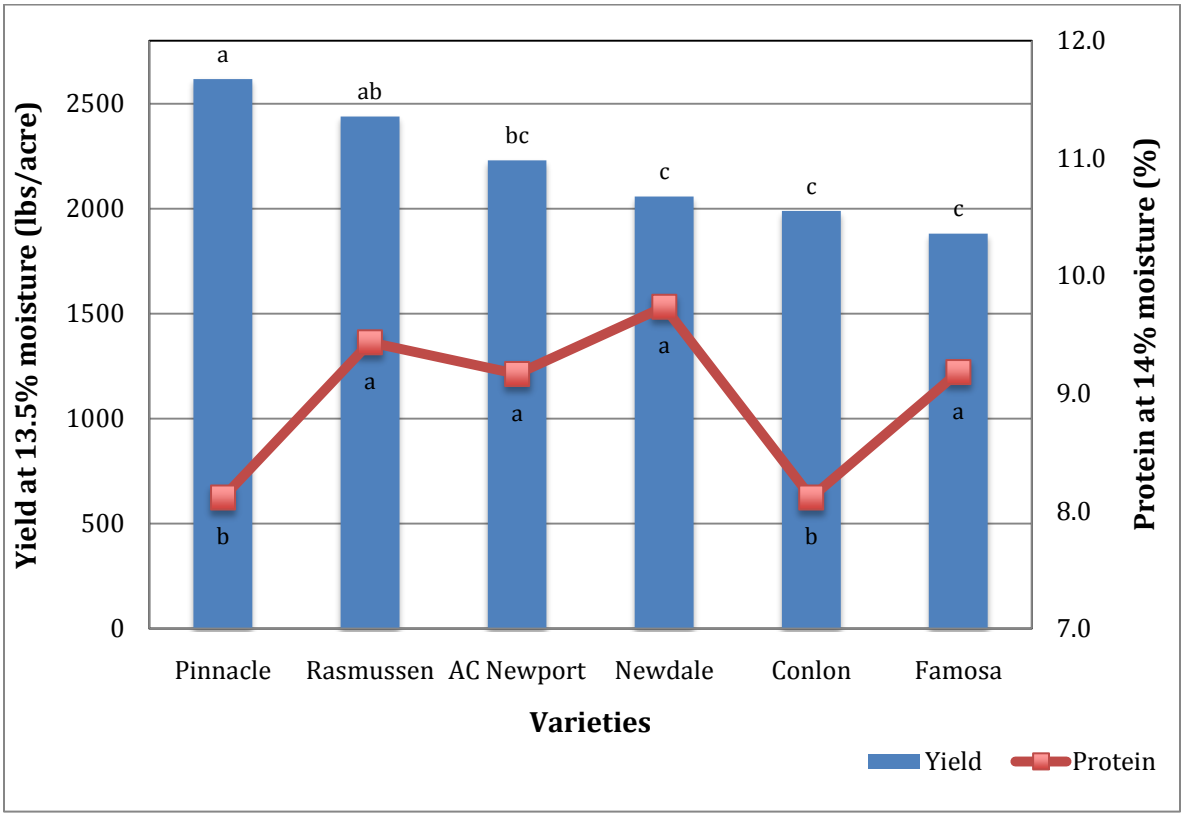

Figure 1: Yield and protein of barley varieties. Protein levels between 9 – 11% are desirable for malting barley. Data points with the same letter are not significantly different from each other (p<0.10).

Falling number is a measure of the level of sprout damage in the grain. Barley seed that has pre-harvest sprouting has a reduced ability to germinate during the malting process. Falling number records the time it takes for a stirrer to fall through a flour and water slurry to the bottom of a test tube. High falling numbers greater than 250 indicate low enzymatic activity and sound quality barley for malting. A falling number lower than 250 indicates high enzymatic activity and poor quality barley. Although differences were seen by variety with Famosa and AC Newport having the highest falling numbers, all results indicated that the varieties met malting standards (Table 5; Figure 2).

In the Northeast, *Fusarium* head blight (FHB) is predominantly caused by the species *Fusarium graminearum*. This disease is very destructive and causes yield loss, low test weights, low seed germination and contamination of grain with mycotoxins. A vomitoxin called deoxynivalenol (DON) is considered the primary mycotoxin associated with FHB. The spores are usually transported by air currents and can infect plants at flowering through grain fill. Consuming contaminated grain (grain with DON levels >1ppm) poses a health risk to humans. All DON levels in this trial were within acceptable levels for human and animal consumption. The variety Conlon had the lowest DON levels, 0.325 ppm (Table 5).

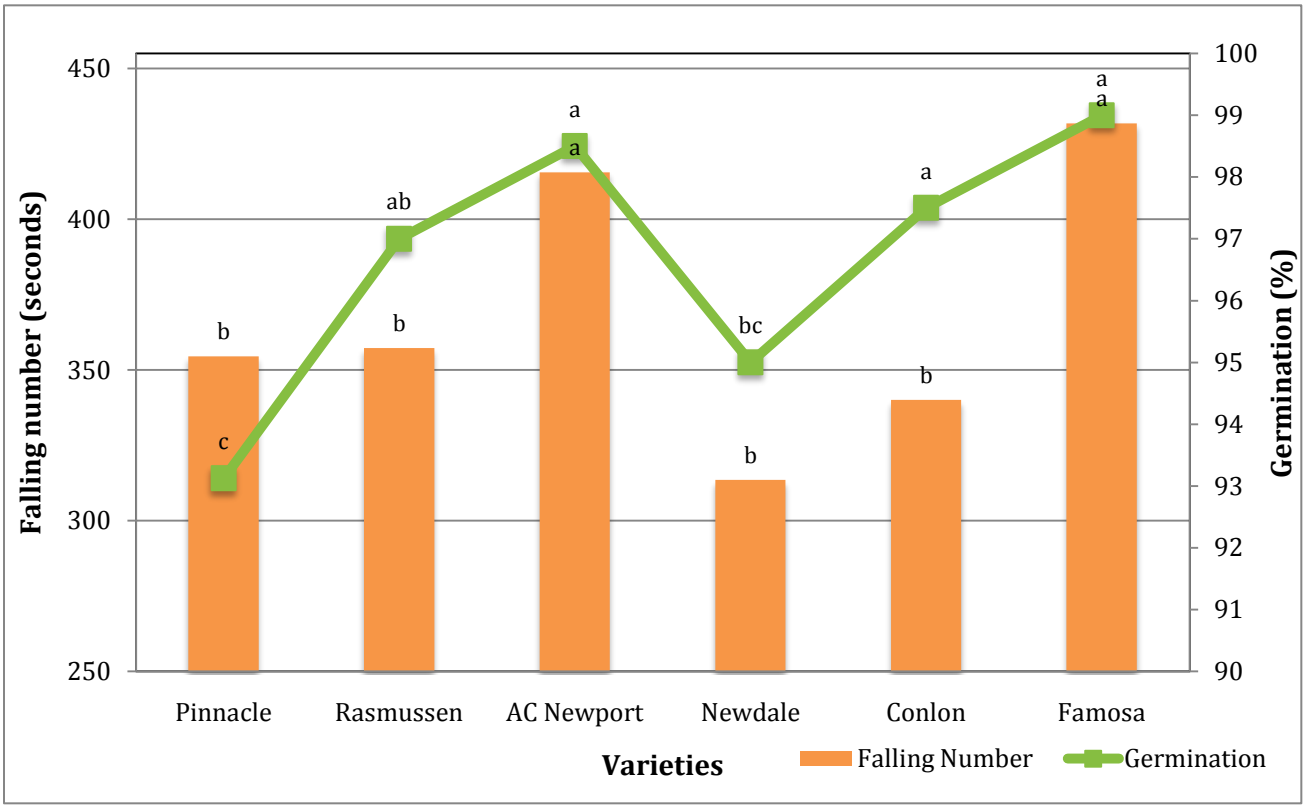

Figure 2: Falling number and germination rates for barley varieties. Falling numbers greater than 250 and germination rates greater than 95% are desirable for malting barley. Data points with the same letter are not significantly different from each other (p<0.10).

DISCUSSION

The malting quality standards require barley to meet an extremely high quality. The weather conditions of the Northeast make it even more difficult to meet these standards. Excessive rain at flowering and during dry-down of the crop can cause significant declines in germination, and falling number and increased levels of DON. This growing season was exceptional for small grain production. The warm and dry spring conditions enabled early planting to maximize yields. There was no precipitation during both the flowering and dry-down stages. This resulted in a high yield and quality crop of barley. All varieties met malting standards in 2010. Continued variety evaluation across a range of growing season conditions will be required to find those most suited for this climate.

The UVM Extension Crops and Soils Team would like to thank Borderview Research Farm for their generous help with the trials.

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