



## 2018 Organic Heirloom Spring Wheat Variety Trial



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University of Vermont Extension began its heirloom spring wheat trials in 2007 to determine whether heirloom varieties developed before 1950 could thrive in Vermont's current climate. Many consumers are interested in heirloom wheat for flavor, perceived health benefits or its history, while many farmers are interested in heirloom wheat because it may have superior genetics better adapted to the challenging growing conditions in the Northeast. Production of heirloom wheat may also provide a farmer with a value added market with increased returns. This variety trial was established to determine heirloom spring wheat varieties that are suitable for production in Vermont's growing conditions.

### MATERIALS AND METHODS

In April 2018, an heirloom spring wheat variety trial was established at Borderview Research Farm in Alburgh, Vermont. The experimental design was a randomized block design with three replications. The seedbed was prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 1). The previous crop was soybeans. The field was disked and spike tooth harrowed prior to planting. Plots were seeded with a Great Plains Cone Seeder on 24-Apr at a seeding rate of 350 live seeds m<sup>-2</sup>. The eighteen varieties of heirloom spring wheat, their origin, pedigree, and release date are listed in Table 2.

**Table 1. General plot management of the heirloom spring wheat variety trial, 2018.**

<b>Location</b>	<b>Alburgh, VT Borderview Research Farm</b>
<b>Soil type</b>	Benson rocky silt loam
<b>Previous crop</b>	Soybeans
<b>Seeding rate (seeds m<sup>-2</sup>)</b>	350
<b>Replicates</b>	4
<b>Planting date</b>	24-Apr
<b>Harvest date</b>	1-Aug
<b>Harvest area (ft)</b>	5 x 20
<b>Tillage operations</b>	Fall plow, spring disk & spike tooth harrow

**Table 2. Varietal information of the heirloom spring wheat, 2018.**

Variety	Developed in	Pedigree	Release date
AC Barrie	Sask. Canada	Neepawa/Columbus//BW90	1996
Ceres 05	North Dakota	Marquis/Kota	1926
Champlain	Vermont	Black Sea/Golden Drop	1870
Defiance	Vermont	Golden Drop/White Hamburg	1878
Hope	South Dakota	Yaroslav emmer/Marquis	1927
Komar	North Dakota	Marquis/Kota; Sister selection of Ceres	1930
Ladoga	Leningrad, Rus.	-	1916
Marquis	Ont. Canada	Hard Red Calcutta/Red Fife	1910
Mida 05	North Dakota	Mercury//Ceres/Double Cross	1944
Mida 06	North Dakota	Mercury//Ceres/Double Cross	1944
Red Bobs	Sask. Canada	Selection from fields of Bobs	1926
Red Fife	Canada	-	1860
Reliance	Oregon	Kanred/Marquis	1926
Scarlett	Washington	Too many to list	1998
Spinkcota	Washington	Preston sel./red durum//Preston sel.	1944
Supreme	Sask. Canada	Selection from Red Bobs	1922
Surprise	Vermont	Chile Club/Michigan Club	1909
Thatcher	Minnesota	Marquis/Ilumillo//Marquis/Kanred	1934

Heights and lodging were measured on 31-Jul. Plots were harvested with an Almaco SPC50 small plot combine on 1-Aug. The harvest area was 5' x 20'. Grain moisture, test weight, and yield were determined at harvest. The per acre yields were calculated and normalized to 13.5% so varieties could be compared. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN) and a subsample was collected to determine quality characteristics. Samples were ground using the Perten LM3100 Laboratory Mill. Flour was analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Crude protein was adjusted to 12% and 14% moisture content for comparison between varieties with different flour moisture. Most commercial mills target 12-15% protein content. Falling number was measured (AACC Method 56-81B, AACC Intl., 2000) on the Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage in the grain. It is determined by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of a test-tube. Falling numbers greater than 350 indicate low enzymatic activity and sound quality wheat. A falling number lower than 200 indicates high enzymatic activity and poor quality wheat. Deoxynivalenol (DON), a vomitoxin, was analyzed using Veratox DON 5/5 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.

All data were analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate seeding rate 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 the 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*
<b>LSD</b>	<b>889</b>

## RESULTS

Seasonal precipitation and temperatures were recorded with a Davis Instruments Vantage Pro2 with Weatherlink data logger on site in Alburgh, VT (Table 3). Over the 2018 growing season, there was 1.57 inches less rain than in an average year. The temperature was slightly cooler but only by 0.35 degrees. From April to July there was an accumulation of 3403 Growing Degree Days (GDDs) in Alburgh, VT, 50 GDDs more than the 30-year average.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2017.**

Alburgh, VT	Apr	May	Jun	Jul
Average Temperature (F)	39.2	59.5	64.4	74.1
Departure from Normal	-5.58	3.10	-1.38	3.51
Precipitation (inches)	4.4	1.9	3.7	2.4
Departure from Normal	1.61	-1.51	0.05	-1.72
Growing Degree Days (base 32)	272	853	973	1305
Departure from Normal	-112	97	-42	107

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

### Wheat Yield and Quality

Plant heights were measured on 31-Jul. Three plants in each plot were measured. The average height was 118 cm (Table 4). Taller plants are generally desired for their ability to shade out competing weeds. However, tall wheat may be more prone to lodging depending on many factors such as stalk strength and over-fertilization. A visual estimation of lodging (%) was performed on 31-Jul. Lodging is defined as the collapse of top heavy plants, particularly grain crops because of excess growth or beating by rain. If

lodging was present, its severity was recorded based on a 0 to 5 scale with 0 indicating the entire plot could be harvested with the plot combine and 5 signifying that none of the plot could be harvested.

**Table 4. Growth and harvest characteristics of heirloom spring wheat for Alburgh, VT, 2018.**

Variety	Height cm	Lodging 0-5 scale	Yield at 13.5% moisture lbs ac <sup>-1</sup>	Moisture @ harvest %	Test weight lbs bu <sup>-1</sup>	Crude protein @ 12% moisture content %	Falling number seconds
AC Barrie	120	0.00	2470	12.4*	<b>59.4*</b>	16.2	415
Ceres 05	116	1.50*	2346	12.6*	59.3*	16.2	420
Champlain	119	0.50	2372	12.4*	57.2	<b>17.3*</b>	397
Defiance	119	<b>1.75*</b>	2420	12.6*	58.0	17.0*	424
Hope	117	0.25	2613	12.4*	58.8*	15.6	406
Komar	119	0.75	2327	12.4*	58.3	16.4	389
Ladoga	117	0.25	2175	12.5*	57.8	16.3	415
Marquis	119	0.50	2402	<b>12.2*</b>	58.8*	16.6	420
Mida 05	113	0.00	2321	12.3*	58.5	16.4	394
Mida 06	115	0.00	2464	12.5*	58.8*	16.2	400
Red Bobs	113	0.00	2256	12.7	59.0*	15.6	417
Red Fife	121	0.00	2257	13.8	59.1*	15.2	314
Reliance	119	0.50	<b>2625</b>	12.4*	59.0*	16.6	400
Scarlett	121	0.50	2469	12.4*	58.7*	16.4	<b>463*</b>
Spinkcota	118	0.25	2204	12.6*	58.5	16.9*	397
Supreme	120	0.75	2609	12.7	58.2	16.7*	439*
Surprise	115	0.25	2486	12.4*	59.1*	16.1	393
Thatcher	<b>121</b>	0.00	2260	12.9	58.6	16.6	369
LSD	NS	0.83	NS	0.45	0.78	0.60	32.3
Trial mean	118	0.43	2393	12.5	58.6	16.4	404

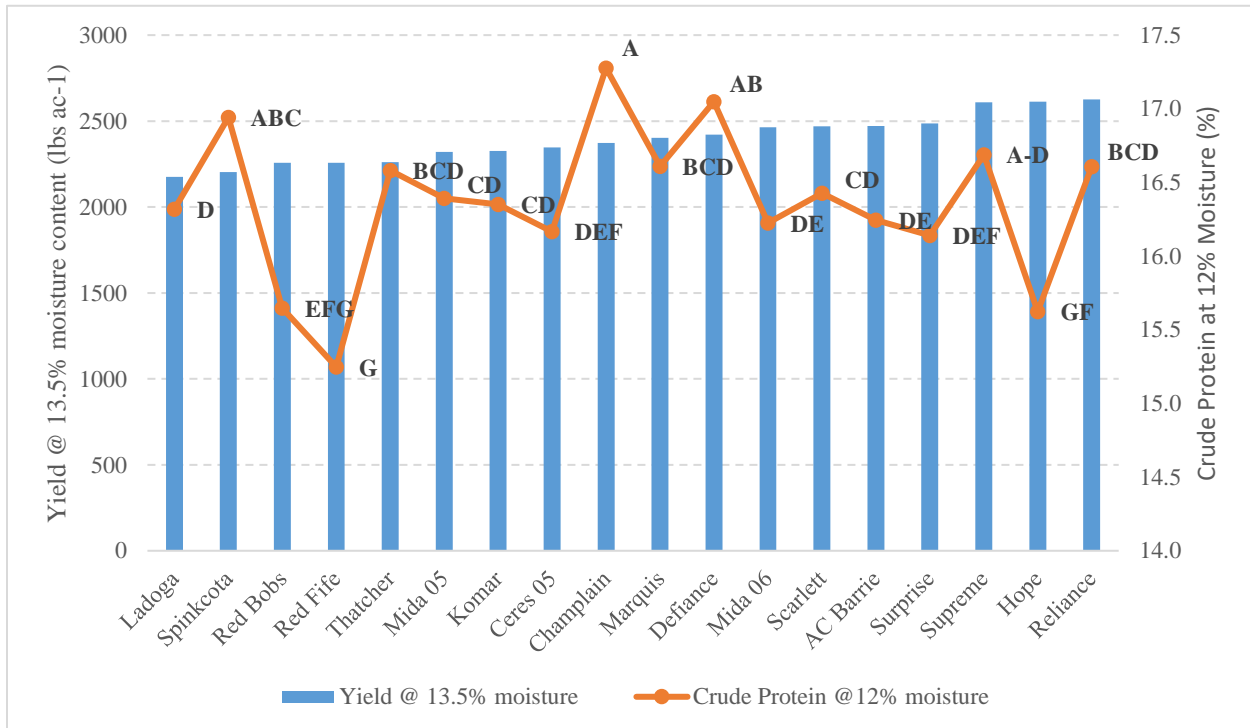
\*Treatments that did not perform significantly lower than the top-performing treatment, shown in **bold**, in a particular column are indicated with an asterisk.

NS – shows no significant difference.

Though Thatcher was the tallest variety at 121 cm, it was not significantly taller than any other variety grown in the 2018 season. Very few varieties showed signs of lodging. Defiance and Ceres had significantly higher lodging than all other varieties. AC Barrie, Mida 05, Mida 06, Red Bobs, Red Fife, and Thatcher had no signs of lodging, scoring an average of 0 on the lodging scale (Table 4).

The average yield at 13.5% moisture for the trial was 2393 lbs ac<sup>-1</sup>. The highest yielding variety was Reliance, with a yield of 2625 lbs ac<sup>-1</sup> but was not statistically different than any other variety. In the 2018 growing season, the average harvest moisture was 12.5% well below the recommended 14% moisture for storage. Test weight is the measure of grain density. The acceptable test weight for bread wheat is 56-60 lbs per bushel. The average test weight for 2018 fit into the ideal range at 58.6. The variety with the highest test weight was AC Barrie at 59.4 lbs bu<sup>-1</sup>. Nine other varieties were statistically similar to this variety.

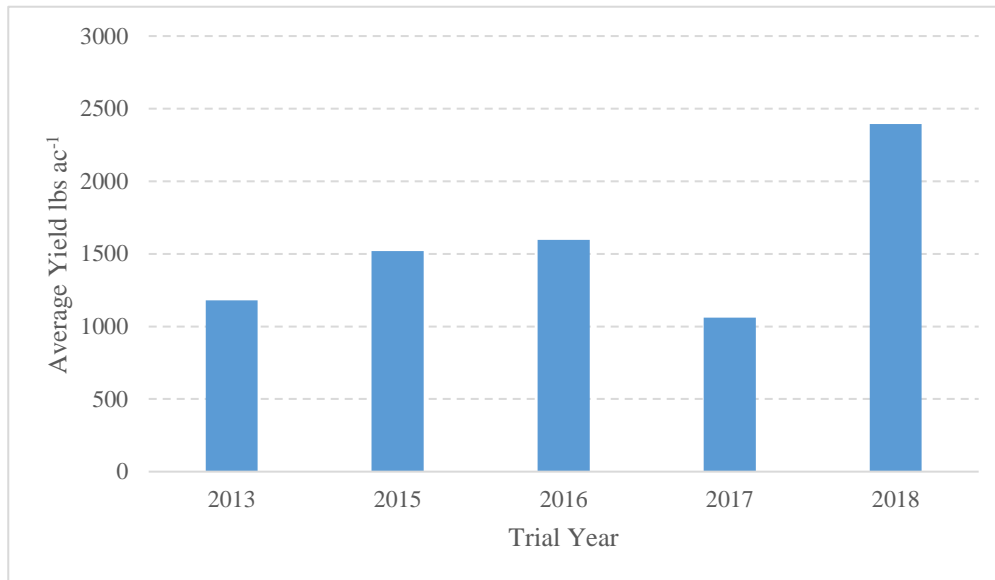
The optimal protein level for wheat is above 12%, in 2018 protein levels ranged from 15.2% to 17.3%. Champlain (17.3%) had the highest crude protein concentrations; Defiance (17.0%), Spinkckota (16.9%), and Supreme (16.7%) were all statistically similar (Figure 1). All of the varieties had falling numbers over 300 seconds, indicating low enzymatic activity and sound quality wheat. The average falling number was 404. The variety with the highest falling number was Scarlett (463 seconds) and Supreme (439 seconds) was the only variety statistically similar. Only one replication of the trial was tested for DON concentrations and all were below the industry standard of 1ppm. Hence, no further analysis was conducted for trial plots.



**Figure 1. Yield and protein of heirloom spring wheat varieties grown in Alburgh, VT, 2018.** Treatments that share a letter did not differ significantly by variety in yield ( $p=0.10$ .)

## DISCUSSION

The 2018 growing season had higher yields than the four previous years (Figure 2). This could be due to a couple of things. There was 50 more GDDs than the average year. There was very little lodging observed, which could make harvest easier and more effective. The 2018 growing season was also cooler and had less rain than other years, which would have affected the yield and quality of the wheat. The weather in 2018 effected the DON levels, and all DON levels were low across all grains trials at Borderview Research Farm in 2018. The low rainfall likely also helped maintain high CP and falling numbers for all varieties in the trial.



**Figure 2. Mean yields from spring wheat variety trials from 2013 to 2018 (2014 missing), Alburgh, VT.**

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