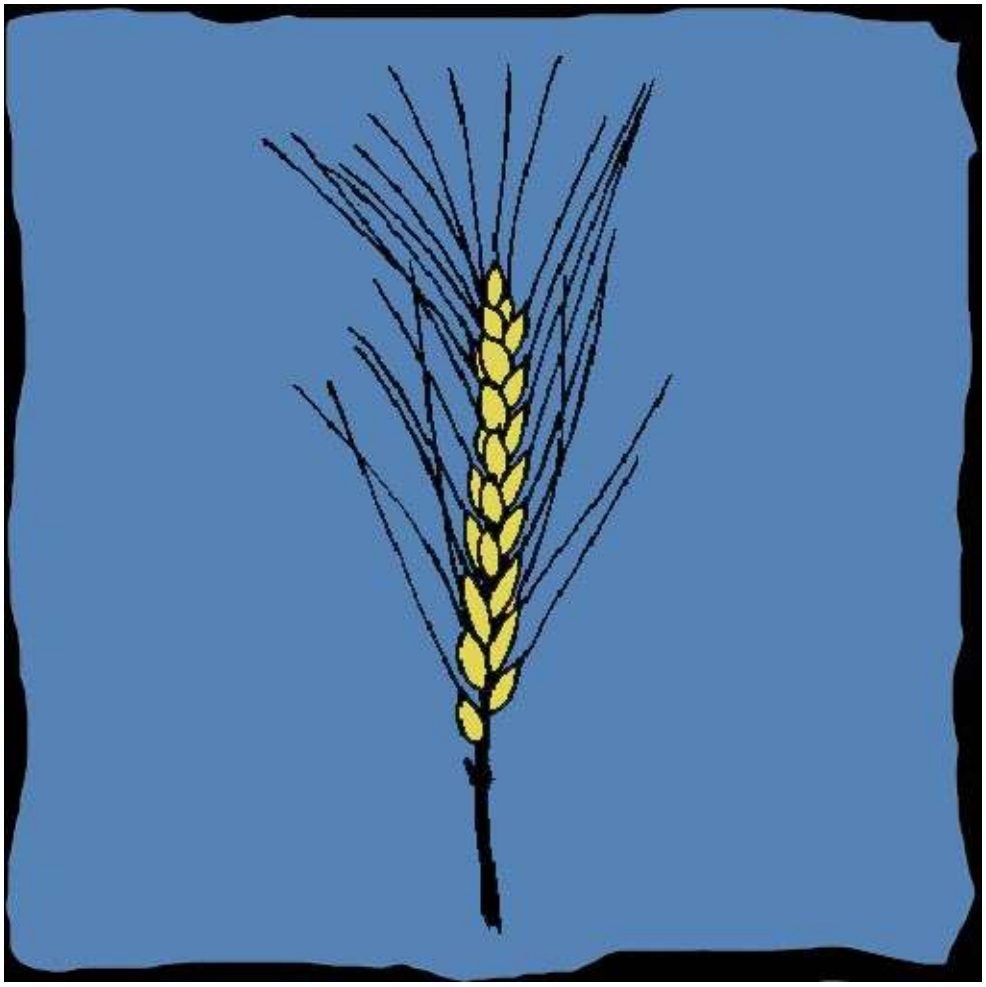
NW CROPS & SOILS PROGRAM

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2010
Spring Wheat Variety Trial



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2010 VERMONT SPRING WHEAT VARIETY PERFORMANCE TRIALS

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In 2010, the University of Vermont Extension in collaboration with the University of Maine began an extensive evaluation of hard red spring wheat varieties grown under organic production in order to determine which varieties thrive in our northern climate. The trials were established at Borderview Research Farm in Alburgh, Vermont and at the Cornell Willsboro Research Farm in Willsboro, New York. The results for the Alburgh location are reported below; the Willsboro data will be added as soon as quality analyses are completed. This trial is one of several in a USDA Organic Research Education Initiative grant focused on the production of high quality organic bread wheat in New England.

SPRING WHEAT VARIETY TRIALS

The experimental plot design was randomized complete block with four replications. Wheat varieties evaluated and their sources are listed in Table 1.

Table 1. Winter wheat varieties planted in Alburgh, VT and Willsboro, NY.

Species		Seed Source
Spring Wheat Varieties	**Type**	
AC Barrie	Hard Red	McCardle Bros
AC McKenzie	Hard Red	Semican
AC Roblin	Hard Red	Wood Prairie Farm
AC Superb	Hard Red	Seedway
AC Walton	Hard Red	McCardle Bros
Ada	Hard Red	University of Minnesota
Batiscan	Hard Red	Semican
Cabernet	Hard Red	Tristate Seeds
Faller	Hard Red	Albert Lea Seed
FBC Dylan	Hard Red	North Dakota State University
Glenn	Hard Red	Albert Lea Seed
Helios	Hard Red	La Coop de Federee
Howard	Hard Red	North Dakota State University
HRS10181J	Hard Red	JGL, Inc
HRS10182J	Hard Red	JGL, Inc
HRS7001J	Hard Red	Grand Falls Milling
Kaffé	Soft White	Semican
Kelse	Hard Red	Washington State University
Kinsey	Hard Red	Semican
Magog	Hard Red	Semican
Melbec	Hard Red	Tristate Seeds
Nick	Hard Red	Tristate Seeds
Oklee	Hard Red	University of Minnesota
RB07	Hard Red	University of Minnesota
Red Fife	Hard Red	Butterworks Farm
Sabin	Hard Red	University of Minnesota
SD7006J	Durum	Grand Falls Milling
Steele	Hard Red	Albert Lea Seed House
Tom	Hard Red	University of Minnesota
Ulen	Hard Red	University of Minnesota

WEATHER DATA

Seasonal precipitation and temperature recorded at weather stations in close proximity to the 2010 sites are shown in Table 2. This growing season's weather was ideal for growing wheat. Due to the warm spring the wheat got off to an early start and continued to be at least a week early in reaching major developmental stages. From planting to harvest in Alburgh there was an accumulation of 4890 Growing Degree Days (GDD), 411 GDDs higher than the 30 year average.

Table 2. Temperature and precipitation summary for Alburgh, VT and Willsboro, NY, 2010.

South Hero (Alburgh)	April	May	June	July	August
Average Temperature (F)	49.3	59.6	66.0	74.1	70.4
Departure from Normal	5.80	3.00	0.20	3.00	1.40
Precipitation (inches)	2.76	0.92	4.61	4.30	5.48
Departure from Normal	0.25	-2.01	1.40	0.89	1.63
Growing Degree Days (base 32)	521	854	1019	1305	1192
Departure from Normal	176	91.5	4.50	94.6	45.0

*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)

CULTURAL PRACTICES

The seedbed at both the Alburgh and Willsboro locations were prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 3). The Alburgh site had been perennial forages (reed canary and alfalfa) for the previous 10 years. In the fall of 2009 the area was moldboard plowed and in the spring of 2010 disked and spike-toothed harrowed to prepare for the planting. The plots in Alburgh were seeded with a Kincaid Cone Seeder on April 21st, 2010. Grain plots were harvested with an Almaco SP50 plot combine on July 30th, 2010.

Following harvest, seed was cleaned with a small Clipper cleaner. An approximate one pound subsample was collected to determine quality. Quality measurements included standard testing parameters used by commercial mills. Test weight was measured by the weighing of a known volume of grain. Generally the heavier the wheat is per bushel, the higher baking quality. The acceptable test weight for bread wheat is 56-60 lbs per bushel. Once test weight was determined, the samples were then ground into flour using the Perten LM3100 Laboratory Mill. At this time flour was evaluated for its protein content, falling number, and mycotoxin levels. Grains were analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Grain protein affects gluten strength and loaf volume. Most commercial mills target 14-15% protein. The determination of falling number (AACC Method 56-81B, AACC Intl., 2000) was measured on the Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain. It is measured by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of the 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) analysis was analyzed using Veratox DON 5/5 Quantitaive 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 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 ($P< 0.10$). There were significant differences among the two locations for most parameters and therefore data from each location is reported independently.

Table 3. General plot management of the wheat trials.

Trial Information	Winter wheat variety trial
Location	Alburgh, VT Borderview Farm
Soil type	Benson rocky silt loam
Previous crop	Sod
Row spacing (in)	6
Seeding rate (lbs ac^{-1})	150
Replicates	4
Planting date	4-21-10
Harvest date	7-30-10
Harvest area (ft)	5x20
Tillage operations	Fall plow, spring disc & spike-toothed harrow

Image 1. Planting the Alburgh spring wheat trial

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 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. Wheat 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

Spring Wheat Growth and Development:

During the 2010 growing season several observations and measurements were recorded on wheat development. All varieties emerged by May 1, 2010. The relative flowering date was recorded for each of the varieties at the Alburgh site (Table 4). The majority of varieties flowered during the fourth week of June. Bird deterrents, squawk boxes and owl decoys, were place in and around the plot area which appeared to help reduce bird presence in the plots. Minimal bird damage was recorded. Lodging amongst the varieties trialed, in general was minimal.

Table 4. Relative flowering date of spring wheat, Alburgh.

Variety	Early	Mid	Late
	3rd Wk June	4th Wk June	1st Wk July
AC Barrie		**X**	
AC McKenzie			**X**
AC Roblin		**X**	
AC Superb		**X**	
AC Walton			**X**
Ada		**X**	
Batiscan		**X**	
Cabernet		**X**	
Faller		**X**	
FBC Dylan	**X**		
Glenn		**X**	
Helios		**X**	
Howard		**X**	
HRS10181J		**X**	
HRS10182J		**X**	
HRS7001J			**X**
Kaffe		**X**	
Kelse		**X**	
Kinsey			**X**
Magog		**X**	
Melbec	**X**		
Nick	**X**		
Oklee		**X**	
RB07		**X**	
Red Fife			**X**
Sabin		**X**	
SD7006J		**X**	
Steele		**X**	
Tom		**X**	
Ulen		**X**	

Image 2. Loose smut infected wheat

Loose smut caused by the fungus, *Ustilago tritici*, was observed at both locations. At the Alburgh location, six varieties; Steele, Sabin, Red Fife, AC Roblin, Glenn, and FBC Dylan infected plants were observed. The loose smut fungus is carried as dormant mycelium within healthy-looking seed and is spread by planting infected seed. A smut-infected seed or plant cannot be distinguished from an uninfected one until the head starts to emerge. The disease is most obvious just after the time of heading by the characteristic dusty black appearance of diseased heads (Image 2). The spores are dispersed by the wind during wheat flowering and can infect healthy plants.

After the wheat reached physiological maturity, plant heights were measured. Plant heights and weed biomass are reported in Table 5. Plant hieghts were significantly different. Red Fife was the tallest variety at 44.7 inches. The shortest vairety was SD7006J, a durum wheat , 21.3 inches in hieght. Cabernet was also amoungst the shortest varietys at 22.1 inches and had the highest weed biomass at 3048 dry matter lbs ac^{-1}. There was considerable variation in the amount of weed biomass in plots. This was mostly likely related to varying weed seed banks across the test area. Due to this variation we did not observe significant differences among treatments. The weed pressure at this location was severe and uneven pressure across the field. There was no correlation between weed biomass and wheat height. We had predicted that taller wheat would be better able to suppress weed growth. However, we observed that some of shorter wheat varieties had the lowest weed biomass. Early season vigor may be another factor that has influence over weed biomass in our fields.

Image 3. Alburgh trial harvest

Table 5. Plant heights & weed biomass, Alburgh, VT

Alburgh		
Variety	**Plant height**	**Weed biomass**
	inches	lbs ac^{-1}
AC Barrie	36.2	1788
AC McKenzie	37.0	1350
AC Roblin	32.4	2744
AC Superb	31.1	2164
AC Walton	37.1	1208
Ada	28.1	1524
Batiscan	39.4	1187
Cabernet	22.1	**3048**
Faller	32.4	1154
FBC Dylan	31.8	923
Glenn	32.4	1306
Helios	33.4	2523
Howard	27.0	1700
HRS10181J	30.8	1733
HRS10182J	28.9	2668
HRS7001J	37.0	1620
Kaffe	39.9	1570
Kelse	29.4	1378
Kinsey	41.1	1410
Magog	38.7	1353
Melbec	25.3	1844
Nick	25.7	1495
Oklee	30.6	2165
RB07	27.2	567
Red Fife	**44.7***	1140
Sabin	29.6	2883
SD7006J	21.3	2009
Steele	30.3	1319
Tom	30.0	2812
Ulen	30.0	1008
Trial Mean	32.0	1720
LSD (0.10)	2.80	NS

* Wheat varieties that are not significantly different than the top performing variety in a column are indicated with an asterisk.
NS - None of the varieties were significantly different from one another.

Spring Wheat Yield:

The highest yielding variety in Alburgh, 2078 lbs ac^{-1} was HRS7001J (Table 6 and Figure 1). Other top yielding varieties included Kaffe, Kinsey and Batiscan. The lowest yielding variety was SD7006J, a durum wheat, 271 lbs ac^{-1}. Other low yielding varieties included Cabernet, AC Barrie, Howard, and Nick. Weed issues at this location severely impacted grain yields.

At harvest Red Fife had the highest grain moisture at 19.7%, the lowest, Nick was recorded at 10.9%.

Tom had the highest test weight 58.3 lbs bu^{-1}. It's no surprise that the durum, SD7006J, had the lowest test weight, 39.0 lbs bu^{-1}. In general, most varieties reached the optimal 55 to 60 lb bu^{-1} test weight for wheat.

Table 6. Harvest data of the 30 spring wheat, Alburgh, VT

Variety	Harvest moisture	Test weight	Yield @13.5%moisture
	%	lbs bu^{-1}	lbs ac^{-1}
AC Barrie	16.7	54.5	845
AC McKenzie	13.6	56.0*	1146
AC Roblin	12.0	51.3	1097
AC Superb	16.2	53.1	1297
AC Walton	19.3*	51.6	1222
Ada	12.2	55.9*	1011
Batiscan	16.5	55.3*	1661*
Cabernet	13.9	51.3	517
Faller	16.9	56.4*	1580
FBC Dylan	13.5	55.6*	1286
Glenn	11.1	55.3*	1063
Helios	13.4	55.0*	1148
Howard	16.1	51.0	911
HRS10181J	15.9	50.8	1241
HRS10182J	17.4*	54.5	1345
HRS7001J	15.9	49.3	**2078***
Kaffe	15.0	56.3*	2009*
Kelse	13.2	54.9*	1530
Kinsey	18.7*	53.0	1794*
Magog	15.3	52.6	1281
Melbec	12.6	47.0	1149
Nick	10.9	51.0	981
Oklee	14.2	55.9*	1130
RB07	15.8	57.0*	1113
Red Fife	**19.7***	50.8	1083
Sabin	13.2	55.1*	1247
SD7006J	16.5	39.0	271
Steele	16.3	55.5*	1222
Tom	17.3*	**58.3***	1298
Ulen	12.6	56.6*	1277
Trial Mean	15.1	53.3	1228
LSD (0.10)	2.51	3.38	473

* Wheat varieties that are not significantly different than the top performing variety in a column are indicated with an asterisk.

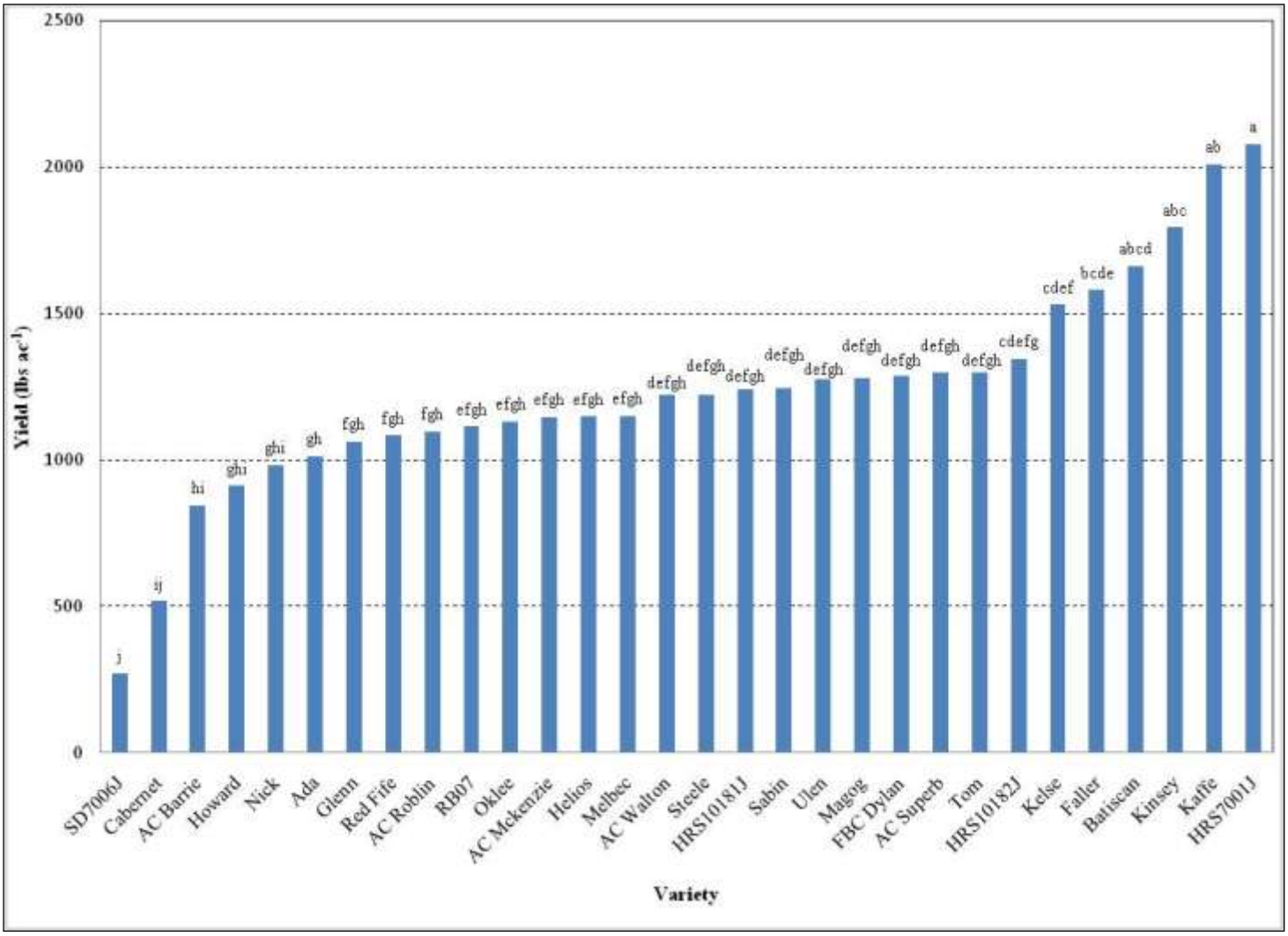

Figure 1. Yields of the 30 spring wheat varieties, Alburgh, VT
*Varieties with the same letter did not differ significantly in protein content.

Spring Wheat Quality:

The common measures used by commerial mills to evaluate wheat quality are: grain protein, falling number, test weight, and mycotoxin (DON) content (Table 7 and Figure 2). The varieties with the highest protein content were SD7006J, 17.5% and Melbec, 16.4%. The lowest protein content was HRS7001J at 12.1%. Interestingly the lowest protein content of the spring wheat was 1.5% higher than the highest protein level of winter wheat trialed. Helios had the highest falling number at 414 seconds. Other varieties with high falling numbers include Ada and FBC Dylan. Almost every variety had acceptable protein and falling number levels based on mill standards. Unfortunately all of the spring wheat trialed had DON levels that exceeded the FDA's 1ppm regulation. The highest DON value was SD7006J, 8.88 ppm. It was a relatively dry season, but there was a rainy period during the time when the spring wheat was flowering. In addition, there was high weed pressure in all of the plots; most likely increasing humidity and creating a ideal environment for fungal growth . In the Northeast, *Fusarium* head blight 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. Eating contaminated grain, >1ppm, poses a health risk to both humans and livestock

Table 7. Quality analyses of the 30 spring wheat vareities, Alburgh, VT

Variety	Crude protein @14% moisture	Falling number @14% moisture	DON
	%	seconds	ppm
AC Barrie	16.4	394*	3.28
AC McKenzie	15.0	377	2.18
AC Roblin	15.6	358	2.33
AC Superb	14.7	345	4.93
AC Walton	15.3	357	2.13
Ada	14.3	404*	3.28
Batiscan	12.5	160	5.48
Cabernet	14.6	328	4.45
Faller	14.1	341	2.33
FBC Dylan	13.5	403*	2.78
Glenn	15.6	334	2.03
Helios	15.6	**414***	2.30
Howard	13.4	318	3.28
HRS10181J	15.0	280	3.33
HRS10182J	14.1	326	3.98
HRS7001J	12.1	302	3.35
Kaffe	13.4	288	4.10
Kelse	15.8	315	4.53
Kinsey	13.8	377	3.65
Magog	15.5	384	3.05
Melbec	16.4*	309	4.03
Nick	12.7	187	6.88
Oklee	15.2	362	3.75
RB07	14.9	344	2.43
Red Fife	15.8	305	2.10
Sabin	16.5*	351	1.63
SD7006J	**17.5***	312	**8.88***
Steele	14.9	319	3.40
Tom	13.3	381	1.68
Ulen	15.0	288	3.10
Trial Mean	14.7	332	3.49
LSD (0.10)	1.41	24.0	1.34

* Wheat that did not perform significantly lower than the top performing variety in a particular column are indicated with an asterisk.

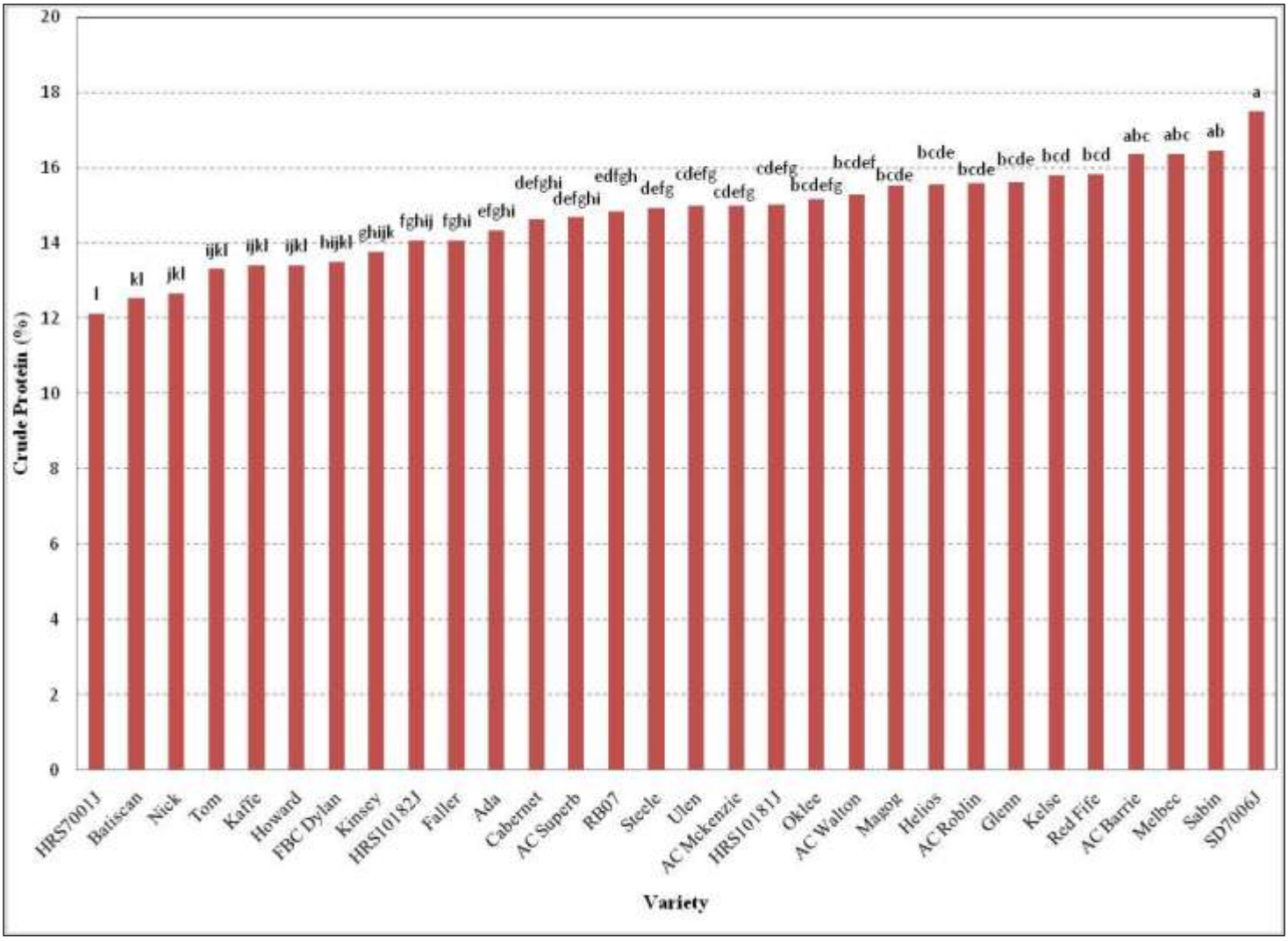

Figure 2. Crude protein of the 30 spring wheat varieties, Alburgh, VT
*Varieties with the same letter did not differ significantly in protein content.

The UVM Extension Crops and Soils Team would like to thank the Borderview Research Farm and the Willsboro Research Farm for their generous help with the trials and acknowledge the USDA OREI grants program for their financial support. Any reference to commercial products, trade names, or brand names is for information only, and no endorsement or approval is intended.

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