2011 WINTER WHEAT VARIETY TRIAL

In 2011, the University of Vermont Extension in collaboration with the University of Maine began the second year of extensive organic variety trials evaluating hard red winter wheat in order to determine which varieties thrive in our northern climate. The trials were established at the Borderview Research Farm in Alburgh, Vermont and at Cornell University's Willsboro Research Farm in Willsboro, New York. 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.

MATERIALS AND METHODS

The experimental plot design at both locations was randomized complete block with four replications. Wheat varieties evaluated are listed in Table 1.

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

Winter Wheat Varieties	Type†	Origin and Year of Release‡	Seed Source
AC Morley	HR	Canada	Bramhill Seeds, Canada
Alice	HW	SD, 2006	USDA-ARS, SD
Alliance	HR	NE, 1993	USDA-ARS, NE
Anton	HW	NE, 2008	USDA-ARS, NE
Appalachian White	HW	NC, 2009	USDA-ARS, NC
Arapahoe	HR	NE, 1998	Albert Lea Seed House, MN
Borden	MHR	Canada, 1983	Semican, Canada
Camelot	HR	NE, 2008	USDA-ARS, NE
Expedition	HR	SD, 2002	Albert Lea Seed House, MN
Harvard	HR	Canada	Agri-Culver Seeds, NY
Jerry	HR	ND, 2001	North Dakota State Univ.
LP3	HR	WA	Washington State Univ.
Mace	HR	NE, 2008	USDA-ARS, NE
Maxine	HR	Canada, 2001	C&M Seed, Canada
MDM	HW	WA, 2005	Washington State Univ.
Millenium	HR	NE, 1999	USDA-ARS, NE
NE01643	HR	WA	Washington State Univ.
NuEast	HR	NC, 2009	USDA-ARS, NC
Overland	HR	NE, 2006	USDA-ARS, NE
Redeemer	HR	Canada	C&M Seed, Canada
Roughrider	HR	ND, 1975	North Dakota State Univ.
Sherman	SW	OR, 1928	Washington State Univ.
Wahoo	HR	NE, 2000	USDA-ARS, NE
Warthog	HR	Canada	Semican, Canada
Wesley	HR	NE, SD, WY, 2000	USDA-ARS, NE
Zorro	HR	Canada	C&M Seed, Canada

† HR = hard red, MHR = medium hard red, HW = hard white, SW = soft white.

‡ Year of release was not always available.

The seedbeds 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 2). The previous crop planted at the Alburgh site was spring wheat. Prior to that, the site had been perennial forages (reed canary and alfalfa) for the previous 10 years. In August 2010, 2 tons $ac^{-1}$of Giroux's composted poultry manure (2-3-2) was applied the area. The field was then disked and spike tooth harrowed to prepare for planting. The plots in Alburgh were seeded with a Kincaid Cone Seeder on September 23th, 2010.

At the Willsboro location planting of the winter wheat followed a 3 year crop of alfalfa/timothy sod. The sod was plowed in August 2009 and fallow prior to planting. The field was dragged twice during the fallow period to knock down out the alfalfa and perennial grasses. The plots were seeded on September 27th, 2010 with a custom made eight-row cone planter.

Population and vigor were measured on October 14, 2010 in Alburgh and October 29, 2011 in Willsboro. Populations were determined by taking three, 0.3 meter counts per plot. Vigor was based on a visual rating with a 0 – 5 scale, where 5 represents excellent stand density, and 0 represents no stand. On April 12, 2011 at the Alburgh site and April 29, 2011 at the Willsboro site, winter survival was measure on a 0 - 5 scale with the same parameters as above. Flowering dates of the wheat were recorded when at least 50% of the spikes were in bloom. At the Willsboro site flowering dates were approximated to the week of flowering because daily observations could not be recorded due to location. On June 28, 2011 in Alburgh and July 6, 2011 in Willsboro, when most of the wheat varieties were in the soft dough stage, plant heights were measured. At the Alburgh location wheat biomass samples were taken on July 5, 2011 and on July 6, 2011 in Willsboro. The sample area was 0.3 m^2, wheat in this area was clipped 0.5 inch above the soil surface, placed in a cloth bag and dried in order to calculate dry matter yield. At the same time weed pressure was assessed by a visual rating with a 0 – 5 scale, where 0 represents no weeds, and 5 represents severe weed pressure. Throughout the growing season other pertinent observations of disease and wheat development were recorded.

Grain plots were harvested at the Alburgh site with an Almaco SP50 plot combine on July 20th, 2011, the harvest area was 5' x 20'. In Willsboro, plots were harvested on July 28th, 2011 with a Hege plot combine; the plot area harvested was 4'x 13'. At the time of harvest the severity of lodging was recorded based on a visual rating with a 1 – 4 scale, where 1 indicates minor plant lodging, wheat could still be combined and 4 indicates severe lodging and a complete crop loss. In addition, grain moisture, test weight, and yield were calculated.

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 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 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.

Image 1. Planting the variety trial-Alburgh, VT

Image 2. Winter survival of Redeemer-Alburgh, VT

Table 2. General plot management of the 2011 winter wheat trials.

Trial Information	Winter wheat variety trial	
Location	Alburgh, VT Borderview Farm	Willsboro, NY Willsboro Research Farm
Soil type	Benson rocky silt loam	Kingsbury silt clay loam
Previous crop	Spring wheat	Timothy/Alfalfa Sod
Row spacing (in)	6	6
Seeding rate (live seed/m^2)	350	350
Replicates	4	4
Planting date	9-23-10	9-27-10
Harvest date	7-20-11	7-28-11
Harvest area (ft)	5x20	4x13
Tillage operations	Fall plow, disc, & spike-toothed harrow	Fall plow, disc, & spike-toothed harrow
Fall-applied fertilizer (tons ac^{-1})	2 - Giroux's composted poultry manure(2-3-2)	None

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

Seasonal precipitation and temperature recorded at weather stations in close proximity to the 2011 sites are shown in Table 3. This growing season brought extreme weather conditions. In April and May, both sites received 10 inches above normal rainfall amounts. The increased moisture delayed wheat growth, especially in clay or compacted areas where water pooled and stayed wet for extended amounts of time. The heavy rainfall increased nutrient leaching and in Willsboro, caused erosion issues in several plots (Image 3). From one extreme to the other; in June and July, there were several weeks with very little rain and higher than normal temperatures causing drought like conditions and putting further stress on the wheat. From planting to harvest in Alburgh there was an accumulation of 5506 Growing Degree Days (GDD), 685 GDDs higher than the 30 year average. Willsboro, with 5236 accumulated GDDs had 552 more GDDs than the long term average.

Image 3. Eroded winter wheat plots in Willsboro, NY

Table 3. Temperature and precipitation summary for Alburgh, VT and Willsboro, NY, 2011.

Alburgh, VT	Sept. 2010	Oct. 2010	Nov. 2010	April	May	June	July
Average Temperature (F)	64.0	50.6	39.9	46.6	58.7	67.1	74.4
Departure from Normal	3.60	1.80	2.20	3.10	2.10	1.30	3.30
Precipitation (inches)	4.32	6.73	2.93	7.88	8.67	3.52	3.68
Departure from Normal	0.86	3.75	0.00	5.00	5.35	0.09	-0.29
Growing Degree Days (base 32)	991	578	243	465	826	1088	1314
Departure from Normal	139	57.4	63.4	120	63.6	74.1	104

Willsboro, NY	Sept. 2010	Oct. 2010	Nov. 2010	April	May	June	July
Average Temperature (F)	62.3	48.7	38.7	45.7	58.3	66.2	73.0
Departure from Normal	3.40	2.70	3.70	1.80	3.90	0.90	2.90
Precipitation (inches)	2.68	4.10	2.69	6.59	7.81	2.81	1.80
Departure from Normal	-0.43	1.10	-0.71	5.27	4.61	-5.30	-1.58
Growing Degree Days (base 32)	909	518	236	423	809	1064	1277
Departure from Normal	87.0	32.6	56.4	79.7	49.0	55.9	-9.40

*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)

Winter Wheat Growth and Development:

During the 2011 growing season several observations and measurements were recorded on wheat development. Relative flowering date was recorded when at least 50% of the plot was in bloom for each of the varieties (Table 4). In Alburgh most varieties were in full bloom by June 7 (Image 5). The latest blooming variety was MDM, a Washington State University variety, which didn't flower until June 22. At the Willsboro trial site the majority of the varieties bloomed the third week of June. Interestingly, Redeemer and Borden did not reach full bloom until the fourth week of June. In general,

lodging and bird damage was minimal at both locations. Sherman, at the Alburgh location, partially lodged but not so severely that it couldn't be harvested. Loose smut caused by the fungus, *Ustilago tritici*, was observed at both locations. 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. The spores are dispersed by the wind during wheat flowering and can infect healthy plants. This year's wet spring created the ideal environment for the growth of fungal pathogens including Ascochyta leaf spot (Image 4). At both locations all varieties exhibited signs of this fungus. Redeemer appeared to be particularly susceptible to this fungal pathogen. Ascochyta leaf spot initially appears on lower leaves. The first visual symptoms are chlorotic (yellow) flecks, which turn into distinct oval or round spots (lesions). Overtime these spots spread out over the leaf and the centers turn a gray brown (necrotic). Fungal structures (pycnidia) look like little black dots within the necrotic spots. The spores can overwinter on crop residues or be blown in on the prevailing winds. In general, Ascochyta leaf spot is not usually considered a significant problem in the major wheat producing countries. However, its distribution and impact may be greater than originally thought, because Ascochyta species are found on most cereals and grasses throughout the world. Powdery mildew was observed on several varieties at the Alburgh location in areas where there was poor drainage.

Table 4. Relative flowering date for winter wheat.

Variety	Alburgh, VT **Flowering Date**	Willsboro, NY **Flowering Date**
AC Morley	8-Jun	< 17-Jun
Alice	7-Jun	< 10-Jun
Alliance	7-Jun	< 17-Jun
Anton	7-Jun	< 17-Jun
Appalachian Wht.	7-Jun	< 17-Jun
Arapahoe	7-Jun	< 17-Jun
Borden	10-Jun	< 23-Jun
Camelot	10-Jun	< 17-Jun
Expedition	7-Jun	< 10-Jun
Harvard	7-Jun	< 17-Jun
Jerry	10-Jun	< 17-Jun
LP3	10-Jun	< 17-Jun
Mace	10-Jun	< 17-Jun
Maxine	7-Jun	< 17-Jun
MDM	22-Jun	< 17-Jun
Millenium	7-Jun	< 17-Jun
NEO1643	7-Jun	< 17-Jun
NuEast	7-Jun	< 17-Jun
Overland	7-Jun	< 17-Jun
Redeemer	7-Jun	< 23-Jun
Roughrider	10-Jun	< 17-Jun
Sherman	10-Jun	< 17-Jun
Wahoo	7-Jun	< 17-Jun
Warthog	7-Jun	< 17-Jun
Wesley	7-Jun	< 17-Jun
Zorro	10-Jun	< 17-Jun

Image 4. Ascochyta leaf spot infected wheat

Image 5. Flowering wheat

Image 6. Plots inundated with Field pennycress– Willsboro, NY

After the wheat reached the soft dough stage, plant heights were measured. Plant height, weed severity, and whole plant wheat biomass are reported in Table 5. Borden, Sherman, AC Morley, and Roughrider were among the tallest varieties for both locations. In general we observed that the shorter and less vigorous varieties had higher weed preassures. The taller, or earlier developing varieties overall had less weed presure and higher wheat biomass. In general, there was low weed pressure in the winter wheat trial at the Alburgh location. An inundation of Field pennycress (*Thaspi arvense* L.) created greater weed pressure for the winter wheat grown at the Willsboro trial site (Image 6).

Table 5. Plant heights, weed rating, & wheat biomass, Alburgh and Willsboro

Alburgh, VT				Willsboro, NY			
Variety	**Plant height**	**Weeds**	**Wheat biomass**	**Variety**	**Plant height**	**Weeds**	**Wheat biomass**
	inches	1-5 scale	DM lbs ac^{-1}		inches	1-5 scale	DM lbs ac^{-1}
AC Morley	45.1	**1.25**	9675	AC Morley	38.8	2.88	**12291***
Alice	33.5	2.50	9313	Alice	27.3	2.38*	6618
Alliance	38.5	2.00	9692	Alliance	30.7	2.75	7223
Anton	33.7	1.75	9106	Anton	28.7	3.25	7462
Appalachian Wht.	35.5	1.75	5951	Appalachian Wht.	30.4	3.00	9081
Arapahoe	40.6	2.00	10120	Arapahoe	34.8	2.38*	10578*
Borden	**49.8**	**1.25**	**14368**	Borden	37.0	2.75	7670
Camelot	36.4	1.50	9287	Camelot	31.1	2.50*	7905
Expedition	37.9	1.75	9072	Expedition	30.9	3.88	6680
Harvard	39.4	**1.25**	10585	Harvard	33.9	3.13	8505
Jerry	41.3	1.75	9905	Jerry	36.2	**1.75***	8108
LP3	28.9	2.25	8928	LP3	25.2	4.00	5509
Mace	31.5	2.00	8336	Mace	26.9	3.50	5907
Maxine	35.2	2.25	8975	Maxine	30.0	4.75	4512
MDM	37.5	-	-	MDM	32.6	-	-
Millenium	37.7	1.75	14100	Millenium	30.7	2.75	7860
NEO1643	38.1	2.25	8483	NEO1643	30.7	3.00	6678
NuEast	36.1	2.00	7564	NuEast	33.1	3.75	8033
Overland	38.3	1.50	7841	Overland	33.9	2.25*	9430
Redeemer	41.2	**1.25**	8564	Redeemer	33.1	3.25	6303
Roughrider	46.9	1.75	12727	Roughrider	37.9	2.50*	7442
Sherman	48.6	**1.25**	9954	Sherman	**42.3***	2.13*	8451
Wahoo	37.8	2.00	8496	Wahoo	30.9	2.75	7373
Warthog	39.6	1.50	9325	Warthog	30.1	3.75	6868
Wesley	33.7	2.00	8120	Wesley	29.0	2.50*	7603
Zorro	45.1	**1.25**	13055	Zorro	39.2	2.38*	9831*
LSD (0.10)	2.31	NS	NS	*LSD (0.10)*	3.12	0.95	2605
Trial Mean	38.8	1.75	9661	*Trial Mean*	32.5	2.96	7757

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

Winter Wheat Yield:

The highest yielding variety at the Alburgh site was AC Morley (5172 lbs ac^{-1}), and Overland (3397 lbs ac^{-1}) in Willsboro (Tables 6, 7 and Figures 1, 2). Varieties that yielded over 2 tons ac^{-1} at the Alburgh site were; Borden Harvard, NEO1643, Redeemer, and Warthog. Harvard, AC Morley, NEO1643 yielded well at both trial locations. Varieties that yielded well at both locations indicate a variety's ability to adapt to various soil and climatic conditions. In Alburgh, the lowest yielding variety was MDM (2138 lbs ac^{-1}) and Warthog (1481 lbs ac^{-1}) was the lowest yielding variety in Willsboro. Interestingly, Warthog was one of the top yielding varieties in Alburgh.

Appalachian White, a hard white winter wheat had the highest test weight in Alburgh (65.8 lbs bu^{-1}). In Willsboro NuEast, a new variety from North Carolina had the highest test weight of 60.4 lbs bu^{-1}. MDM, a Washington State variety, had the lowest test weight at both trial sites. Test weight is the measure of grain density determined by weighing a known volume of grain. Generally, the heavier the wheat is per bushel, the higher baking quality. In general, most varieties reached or exceeded the optimal 56 to 60 lbs bu^{-1} test weight for wheat.

Table 6. Yield results of 26 winter wheat varieties, Alburgh

Variety	Harvest moisture	Test weight	Yield @13.5% moisture
	%	lbs bu^{-1}	lbs ac^{-1}
AC Morley	15.1	65.0*	**5172***
Alice	14.2	63.5*	3159
Alliance	14.7	63.3*	3074
Anton	15.1	63.5*	2481
Appalachian Wht.	13.4	**65.8***	3839
Arapahoe	14.2	65.3*	3028
Borden	14.6	64.8*	4307
Camelot	12.9	63.3*	3687
Expedition	12.9	62.8*	3207
Harvard	14.8	65.0*	4338
Jerry	14.3	63.5*	3609
LP3	14.8	64.3*	3283
Mace	13.5	65.0*	2576
Maxine	14.4	63.3*	3325
MDM	**20.8***	53.5	2138
Millenium	15.1	63.5*	3683
NEO1643	15.2	65.0*	4145
NuEast	13.9	64.3*	3758
Overland	15.4	61.8	3904
Redeemer	13.4	64.8*	4149
Roughrider	14.7	64.0*	3011
Sherman	15.2	65.5*	3227
Wahoo	14.7	65.3*	2623
Warthog	15.4	63.8*	4202
Wesley	11.5	64.5*	3368
Zorro	15.3	62.8*	3933
LSD (0.10)	1.04	3.82	435
Trial Mean	14.6	63.7	3509

Table 7. Yield results of 26 winter wheat varieties, Willsboro

Variety	Harvest moisture	Test weight	Yield @13.5% moisture
	%	lbs bu^{-1}	lbs ac^{-1}
AC Morley	13.0	60.0*	3226*
Alice	10.5	58.0	2501
Alliance	11.8	57.3	2225
Anton	11.8	57.7	1616
Appalachian Wht.	**17.0***	59.0	2501
Arapahoe	12.8	58.4	2653
Borden	9.55	55.0	2331
Camelot	12.3	58.0	2387
Expedition	12.6	59.2*	2436
Harvard	13.4	58.6	3006*
Jerry	11.7	57.8	2862*
LP3	14.4	58.0	1525
Mace	10.6	56.6	1952
Maxine	13.5	58.1	1654
MDM	14.1	53.3	1688
Millenium	12.6	58.7	2501
NEO1643	12.8	58.4	2712*
NuEast	12.9	**60.4***	2913*
Overland	12.3	58.5	**3397***
Redeemer	10.5	58.0	2217
Roughrider	12.8	59.3*	2457
Sherman	15.9*	58.6	2660
Wahoo	13.2	57.8	2390
Warthog	13.0	58.7	1481
Wesley	10.4	57.8	2823*
Zorro	12.7	58.0	2984*
LSD (0.10)	2.23	1.32	690
Trial Mean	12.6	58.0	2427

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

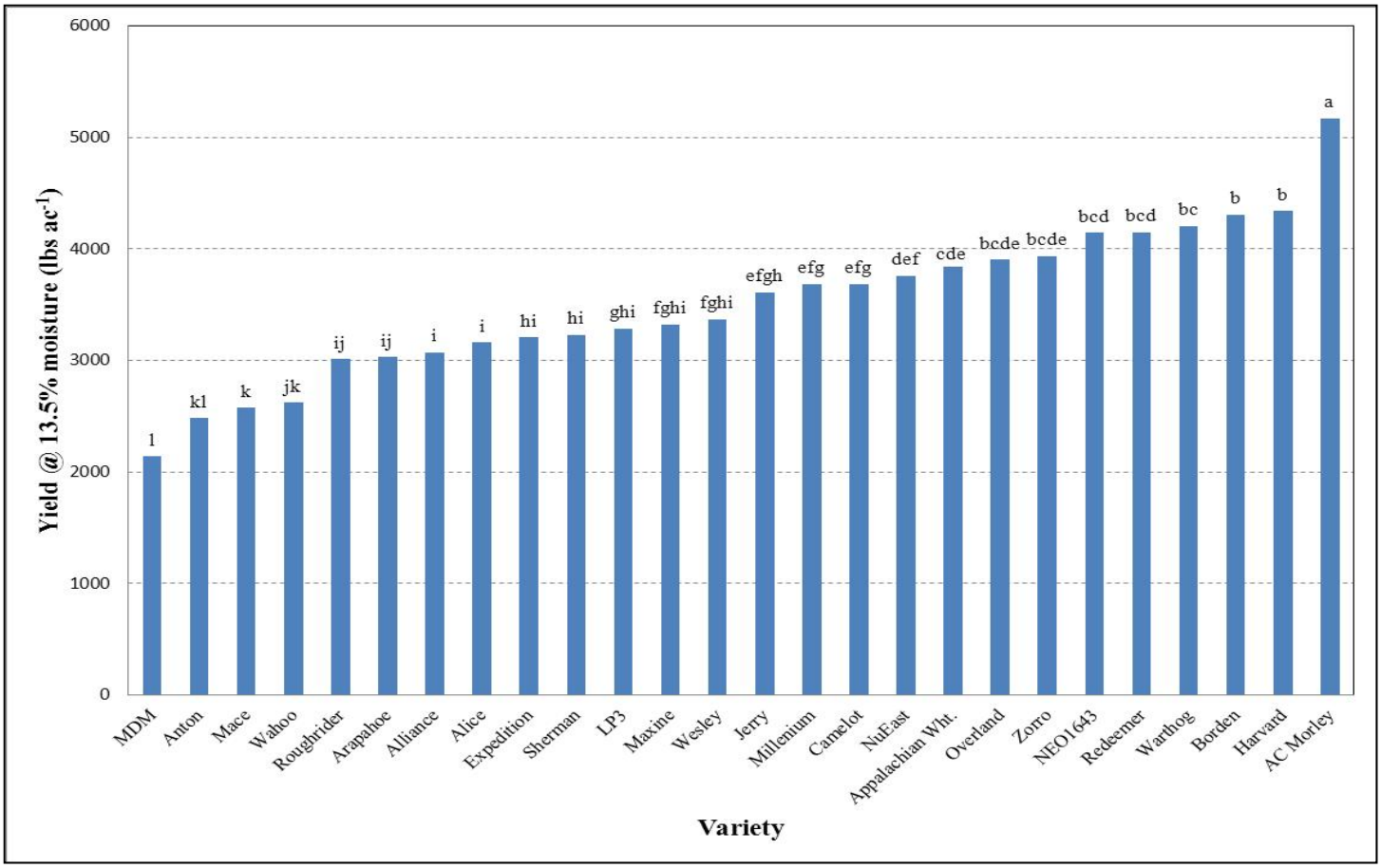

Figure 1. Yield of 26 winter wheat varieties, Alburgh, VT
**Varieties with the same letter did not differ significantly in yield.*

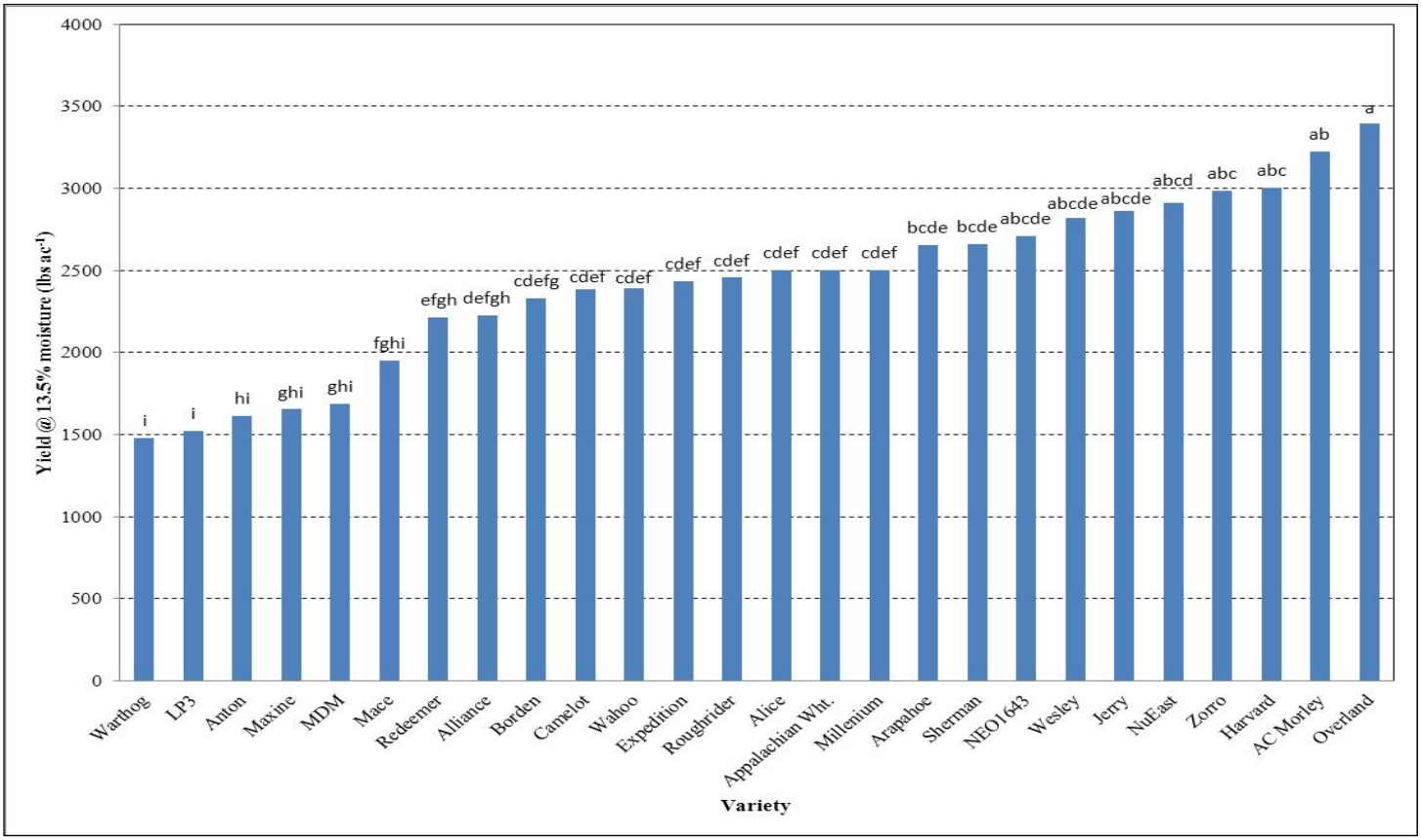

Figure 2. Yield of 26 winter wheat varieties, Willsboro, NY
**Varieties with the same letter did not differ significantly in yield.*

Winter 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 8, 9; Fig. 3, 4). The varieties with the highest protein content at both locations was Redeemer and Sherman. Every variety had acceptable falling number levels based on mill standards. 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. Eating contaminated grain, >1ppm, poses a health risk to both humans and livestock. The erractic weather coniditons during wheat development could have increased FHB growth. At both locations Anton, Appalachian White, Camelot, LP3, and Wesley all had DON concentrations above 1ppm. Most varieties were below the 1 ppm FDA threshold.

Table 8. Quality of 26 winter wheat vareities, Alburgh

Variety	Crude protein @ 12%	Falling number @ 14%	DON
	%	seconds	ppm
AC Morley	9.63	370	**0.38***
Alice	9.78	401	0.95
Alliance	8.84	381	0.75*
Anton	10.4	404	5.26
Appalachian Wht.	9.94	395	2.00
Arapahoe	9.62	**429***	1.25
Borden	9.66	402	0.55*
Camelot	9.24	393	1.78
Expedition	9.38	391	1.28
Harvard	9.72	349	0.60*
Jerry	10.4	416*	0.78*
LP3	10.4	383	3.00
Mace	10.2	410*	1.83
Maxine	10.3	412*	1.03
MDM	10.7	380	2.20
Millenium	9.83	391	1.48
NEO1643	9.37	405	1.03
NuEast	8.61	410*	1.23
Overland	9.69	404	1.6
Redeemer	**12.3***	428*	**0.38***
Roughrider	10.3	412*	0.58*
Sherman	11.8*	410*	0.53*
Wahoo	9.70	392	2.13
Warthog	10.0	413*	0.73*
Wesley	10.5	387	2.73
Zorro	11.0	397	0.93
LSD (0.10)	0.85	22.6	0.41
Trial Mean	10.0	398	1.42

Table 9. Quality of 26 winter wheat varieties,Willsboro

Variety	Crude protein @ 12%	Falling number @ 14%	DON
	%	seconds	ppm
AC Morley	10.6	402	0.63*
Alice	11.3	393	1.25
Alliance	9.89	400	0.83*
Anton	12.1	375	4.80
Appalachian Wht.	11.5	367	2.03
Arapahoe	10.6	420	0.88*
Borden	9.82	408	0.53*
Camelot	11.4	421	1.50
Expedition	10.7	412	1.23
Harvard	11.2	389	1.13
Jerry	11.5	423	0.75*
LP3	12.5	414	2.20
Mace	11.2	427	0.95*
Maxine	12.7	367	1.23
MDM	12.0	393	0.73*
Millenium	10.9	419	1.18
NEO1643	10.5	431	1.15
NuEast	11.1	440*	2.40
Overland	10.8	426	1.28
Redeemer	13.0*	452*	0.65*
Roughrider	11.7	432	**0.30***
Sherman	**13.4***	400	0.58*
Wahoo	10.4	399	0.68*
Warthog	12.0	**466***	0.78*
Wesley	11.8	384	2.98
Zorro	11.3	429	0.45*
LSD (0.10)	0.61	29.6	0.75
Trial Mean	11.4	411	1.27

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

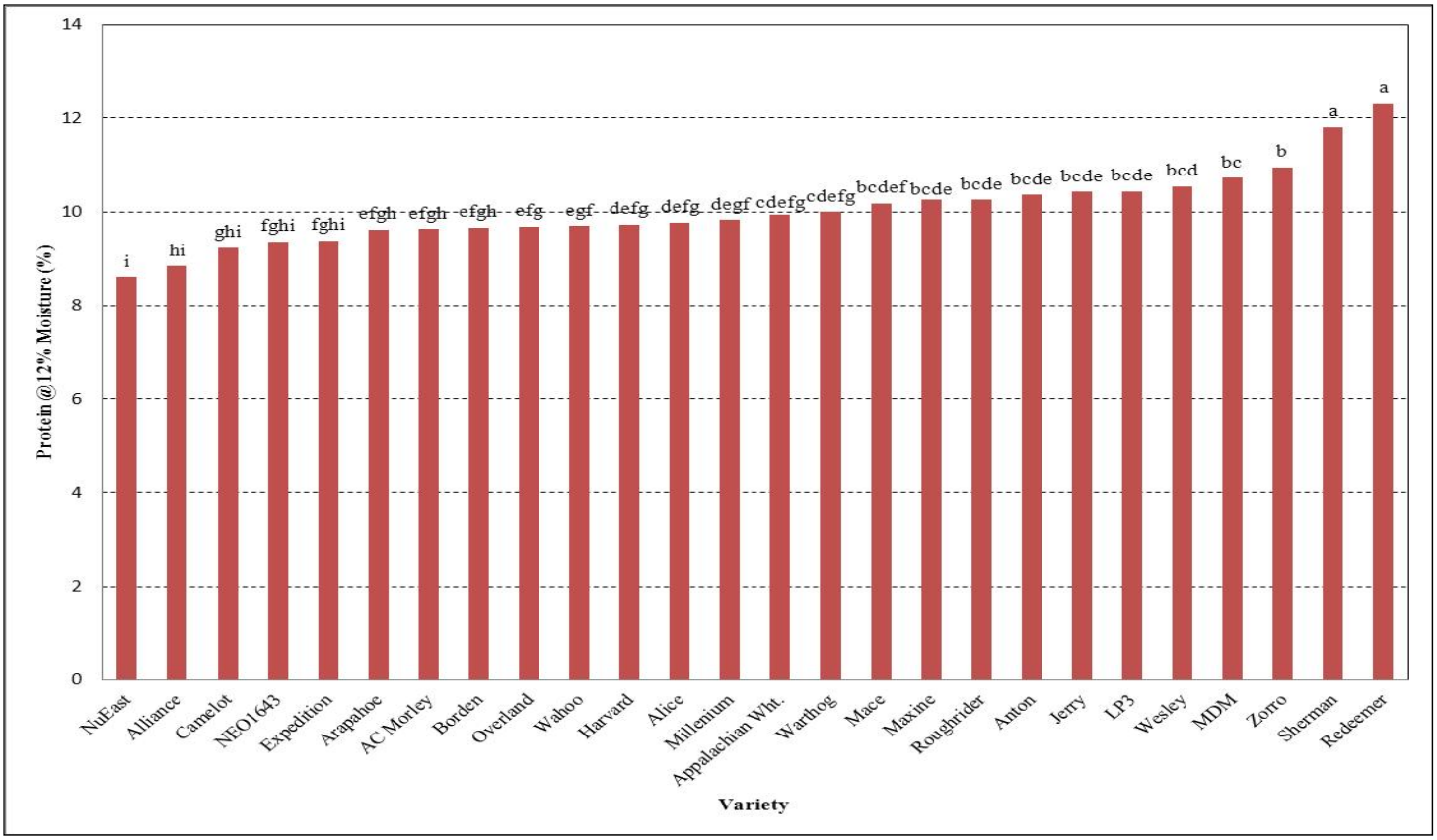

Figure 3. Protein concentration of 26 winter wheat varieties, Alburgh, VT
*Varieties with the same letter did not differ significantly in protein content.

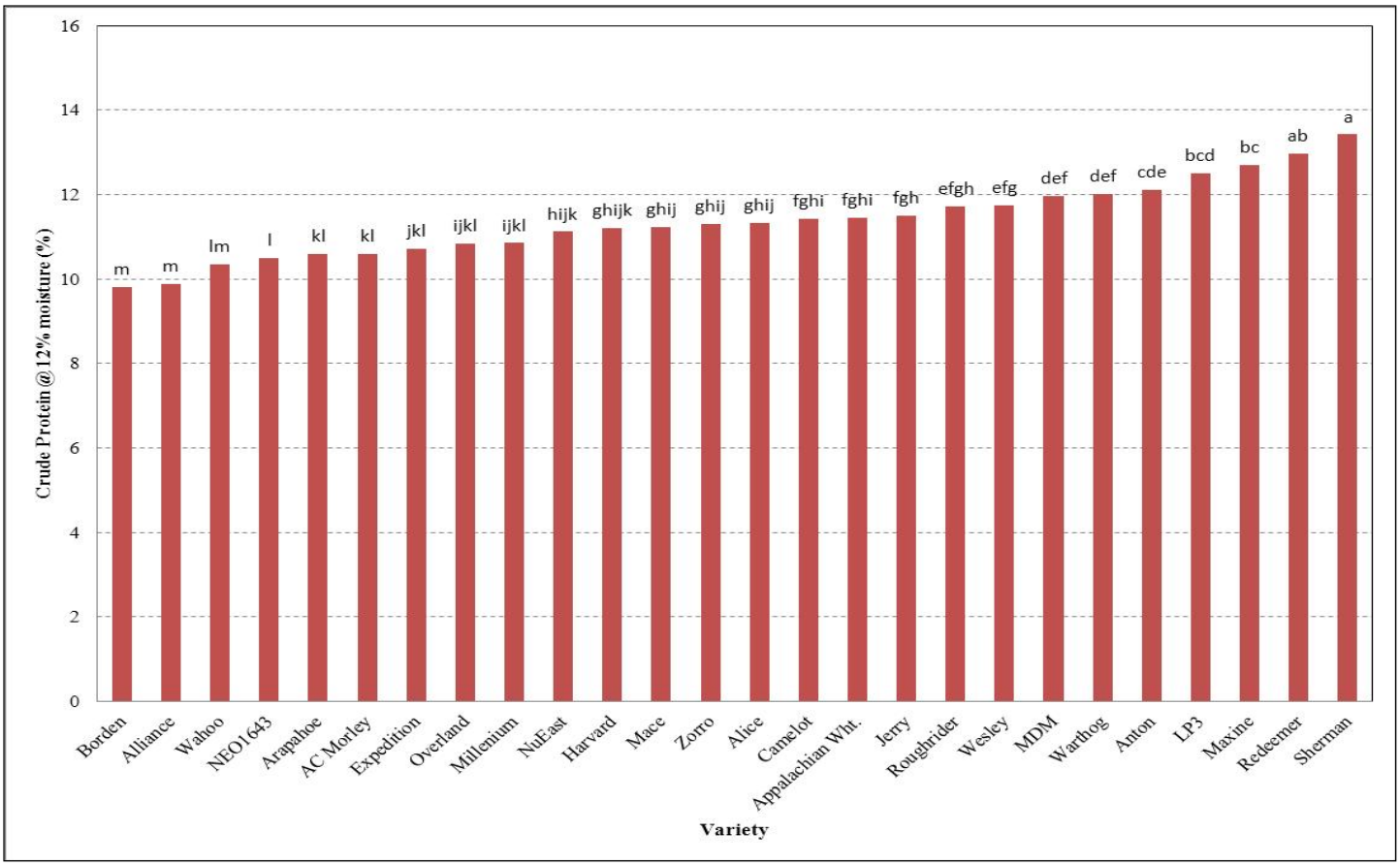

Figure 4. Protein concentration of 26 winter wheat varieties, Willsboro, NY
*Varieties with the same letter did not differ significantly in protein content.

DISCUSSION

It is important to remember that the results only represent one year of data. The extreme weather conditions during the 2011 growing season affected both yield and quality. In general the protein levels were lower than 2010 levels at the Alburgh location possibly do to nitrogen loss from the heavy rains this spring. Interestingly, at the Willsboro site protein levels didn't appear to be impacted as compared to 2010. This could be attributed to the higher level of organic N in the soil from the plow down sod compared to composted poultry manure applied in Alburgh. In Willsboro the heavy rains caused soil erosion and compaction which may have reduced yields. It appears that varieties from Eastern Washington may not be suitable for production in our climate. These varieties especially LP3 and MDM performed well below average in yields and quality. Conditions in these wheat growing regions are much more arid than the temperate climate of the Northeast. Varieties developed in these areas would not be subject to the same diseases and climatic regimes and hence much less adaptable. The variety Redeemer has consistently shown high quality at multiple locations, however yields are variable depending on the site and soil type. This is similar to farmer observations reported for this variety. Local bakers that have baked with Redeemer find it superior to other varieties that we have trialed. However, farmers have reported that Redeemer grows better on well-drained soils than heavy textured soils. This is similar to our observations where Redeemer was a top-yielder at the Alburgh site (silt loam) and was a low yielder at the Willsboro site (clay soil). In areas of heavy textured soils when Redeemer was grown in rotation with wheat or other cereals there was a notable increase in Ascochyta leaf spot infection. It is important, as you make variety choices on your farm, that you evaluate data from test sites that are as similar to your region as possible.

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