NORTHWEST CROPS & SOILS PROGRAM

2013 Organic Winter Wheat Variety Trial Report

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2013 ORGANIC WINTER WHEAT VARIETY TRIAL

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In 2013, the University of Vermont Extension, in collaboration with the University of Maine, began the fourth year of extensive organic variety trials evaluating hard red winter wheat in order to determine which varieties thrive in the Northeast. 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 a randomized complete block with four replications. Wheat varieties evaluated are listed in Table 1.

Table 1. 2013 Winter wheat varieties planted in Alburgh, VT and Willsboro, NY

Winter Wheat Varieties	Type†	Origin and Year of Release‡	Seed Source
Appal. Wht.	HW	NC, 2009	USDA-ARS, NC
Arapahoe	HR	NE, 1998	Albert Lea Seed House, MN
Borden	MHR	Canada, 1983	UVM, VT
Camelot	HR	NE, 2008	USDA-ARS, NE
Expedition	HR	SD, 2002	Albert Lea Seed House, MN
Harvard	HR	Canada	UVM, VT
Ideal	HR	SD, Pending	North Dakota State Univ., ND
Jerry	HR	ND, 2001	North Dakota State Univ., ND
Maxine	HR	Canada, 2001	Matt Williams, ME
Millennium	HR	NE, 1999	USDA-ARS, NE
Morley (AC)	HR	Canada	Bramhill Seeds, Canada
NEO5425	HR	NE, Experimental	UNL, NE
NEO6469	HR	NE, Experimental	UNL, NE
NEO6545(Freeman)	HR	NE, 2013	UNL, NE
NEO6607	HR	NE, Experimental	UNL, NE
NEO7409	HR	NE, Experimental	UNL, NE
NuEast	HR	NC, 2009	USDA-ARS, NC
NWO3666	HW	NE, Experimental	UNL, NE
Overland	HR	NE, 2006	Albert Lea Seed House, MN
Redeemer	HR	Canada	Bramhill Seeds, Canada
Robidoux	HR	NE, 2011	USDA-ARS, NE
Sherman	SW	OR, 1928	UVM, VT
Warthog	HR	Canada	Seedway, VT
Zorro	HR	Canada	UVM, VT

† 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. The field was fall plowed, disked and spike tooth harrowed to prepare for planting. The plots in Alburgh were seeded with a Kincaid Cone Seeder on 21-Sep 2012.

At the Willsboro location, planting of the winter wheat followed a three year crop of alfalfa/timothy hay. The field was moldboard plowed, disked, and dragged with a spring tooth harrow prior to seeding. The plots were seeded on 27-Sep 2012 with a custom made eight-row cone planter.

Populations were measured on 26-Oct 2012 in Alburgh and 16-Nov 2012 in Willsboro. Populations were determined by taking three, 0.3 meter counts per plot. Winter survival of the plots was measured at the Alburgh site on 19-Apr 2013 and in Willsboro on 8-May 2013. Winter survival was based on a visual rating with a 0 – 5 scale, where 5 represents excellent stand density, and 0 represents no stand.

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. At the Alburgh location, plant leaf disease incidence and the percent of plant infected was evaluated on 20-May 2013. Leaf disease was based on a visual rating with a 0-10 scale, where 0 indicates no infection, and 10 indicates severe infection. The percent of plant infection indicates the severity of the grain leaf diseases on the whole plant, and was determined visually where 10% indicates minimal disease coverage and 100% means the entire plant was infected. In Willsboro, the presence of plant leaf disease was assessed on 14-Jun 2013. Throughout the growing season, other pertinent observations on wheat development were recorded.

Image 1. Winter wheat trial harvest in Alburgh, VT.

Grain plots were harvested at the Alburgh site with an Almaco SPC50 plot combine on 17 and 19-Jul 2013, the harvest area was 5’ x 20’ (Image 1). In Willsboro, plots were harvested on 20-Jul 2013 with a Hege plot combine; the plot area harvested was 4’ x 13’. At the time of harvest plant heights were measured, excluding awns, and the severity of lodging was recorded based on a visual rating with a 0 – 5 scale, where 0 indicates no lodging and 5 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 (A.T. Ferrell, Bluffton, IN). 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 12-15% 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 Least Significant Difference (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 2. General plot management of the 2013 winter wheat trials.

Trial Information	Winter wheat variety trial	
Location	Alburgh, VT Borderview Research 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	21-Sep 2012	27-Sep 2012
Harvest date	17 and 19-Jul 2013	20-Jul 2013
Harvest area (ft)	5 x 20	4 x 13
Tillage operations	Fall plow, disk & spike tooth harrow	Fall plow, disk & spring tooth harrow

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 2012 and 2013 sites are shown in Table 3. The growing season this year was marked by lower than normal temperatures in April and June and higher than normal rainfall in the months of May and June. In Alburgh, there was an accumulation of 5035 Growing Degree Days (GDD), which is 5 GDDs below the 30 year average. Willsboro, with 5129 accumulated GDDs, had 89 more GDDs than the long-term average.

Table 3. Temperature and precipitation summary for Alburgh, VT and Willsboro, NY, 2012 and 2013.

Alburgh, VT	Sep-12	Oct-12	Mar-13	Apr-13	May-13	Jun-13	Jul-13
Average temperature (°F)	60.8	52.4	32.1	43.6	59.1	64.0	71.7
Departure from normal	0.20	4.20	1.00	-1.20	2.70	-1.80	1.10
Precipitation (inches)	5.36	4.13	1.04	2.12	4.79	9.23 ǂ	1.89
Departure from normal	1.72	0.53	-1.17	-0.70	1.34	5.54	-2.26
Growing Degree Days (base 32°F)	896	652	88.5	348	848	967	1235
Departure from normal	38.0	150	88.5	-35.5	91.4	-47.0	36.8

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.
ǂ June 2013 precipitation data based on National Weather Service data from cooperative stations in South Hero, VT. (http://www.nrcc.cornell.edu/page_summaries.html)

Willsboro, NY	Sep-12	Oct-12	Mar-13	Apr-13	May-13	Jun-13	Jul-13
Average temperature (°F)	61.9	52.9	32.8	44.8	60.7	66.5	73.8
Departure from normal	1.30	4.70	1.70	0.00	4.30	0.70	3.20
Precipitation (inches)	5.36	5.04	2.05	2.05	8.74	9.86	4.49
Departure from normal	1.72	1.44	-0.16	-0.77	5.29	6.17	0.34
Growing Degree Days (base 32°F)	896	648	24.8	383	890	1034	1253
Departure from normal	37.5	146	24.8	-1.50	133	19.5	54.3

Based on National Weather Service data from cooperative observation stations in Burlington, VT. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Winter Wheat Growth and Development:

During the 2013 growing season, several observations and measurements were recorded on wheat development. Several foliar diseases were observed during wheat development at both trial locations including; Powdery Mildew (*Erysiphe graminis f. sp. Tritici*), Ascochyta Leaf Spot (*Didymella exitialis*), Leaf Rust (*Puccinia recondite*), and Stripe Rust (*Puccinia striiformi*) (Image 2 and 3). This was the first confirmed record of Stripe Rust on grains in Vermont. Foliar diseases reduce photosynthetic leaf area, use nutrients, and increase respiration and transpiration within colonized host tissues. A diseased plant typically exhibits reduced vigor, growth and seed fill. The earlier occurrence, the greater degree of host susceptibility, and the longer duration of conditions favorable for disease development will increase yield loss. At the Alburgh location, all of the 25 winter wheat varieties trialed had some degree of leaf disease (Table 4, Figure 1). The variety Expedition had the most severe leaf disease (8.75) with over 77.5% of the plant infected. The variety with the lowest infection severity was Borden (3.25) with only 30% of plant infection. Other varieties with low disease severity included; Appalachian White, Warthog, Overland, Zorro, Ideal, Maxine, Millennium, Harvard, and NuEast.

Image 2. Winter wheat infected with Stripe Rust, Alburgh, VT

Image 3. Winter wheat leaf infected with Stripe Rust, Alburgh, VT

Table 4. Assessment of foliar disease of the 25 winter wheat varieties in Alburgh, VT

Variety	Leaf Disease Severity	Plant Infection
	1-10	%
Appal. Wht.	4.00*	40.0*
Arapahoe	7.50	62.5
Borden	**3.25***	**30.0***
Camelot	6.00	50.0*
Expedition	8.75	77.5
Harvard	5.25*	42.5*
Ideal	5.00*	47.5*
Jerry	6.75	50.0*
Maxine	5.00*	46.3*
Millennium	5.00*	37.5*
Morley (AC)	5.75	47.5*
NEO5425	7.00	67.5
NEO6469	7.25	67.5
NEO6545 (Freeman)	5.50	50.0*
NEO6607	7.50	60.0
NEO7409	8.25	80.0
NuEast	5.25*	47.5*
NWO3666	5.75	47.5*
Overland	4.50*	35.0*
Redeemer	5.75	60.0
Robidoux	7.50	62.5
Roughrider	6.50	52.5
Sherman	5.50	45.0*
Warthog	4.25*	40.0*
Zorro	4.50*	35.0*
LSD (0.10)	2.09	21.4
Trial Mean	5.89	51.3

Values shown in **bold** are of the highest value or top performing.

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

The flowering date was recorded when approximately 50% of the plot was in bloom for each of the varieties (Table 5). In Alburgh, most varieties were in full bloom by 3-Jun, and in Willsboro, the majority of the varieties bloomed the second week of June. In general, bird damage was minimal at both trial locations. 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.

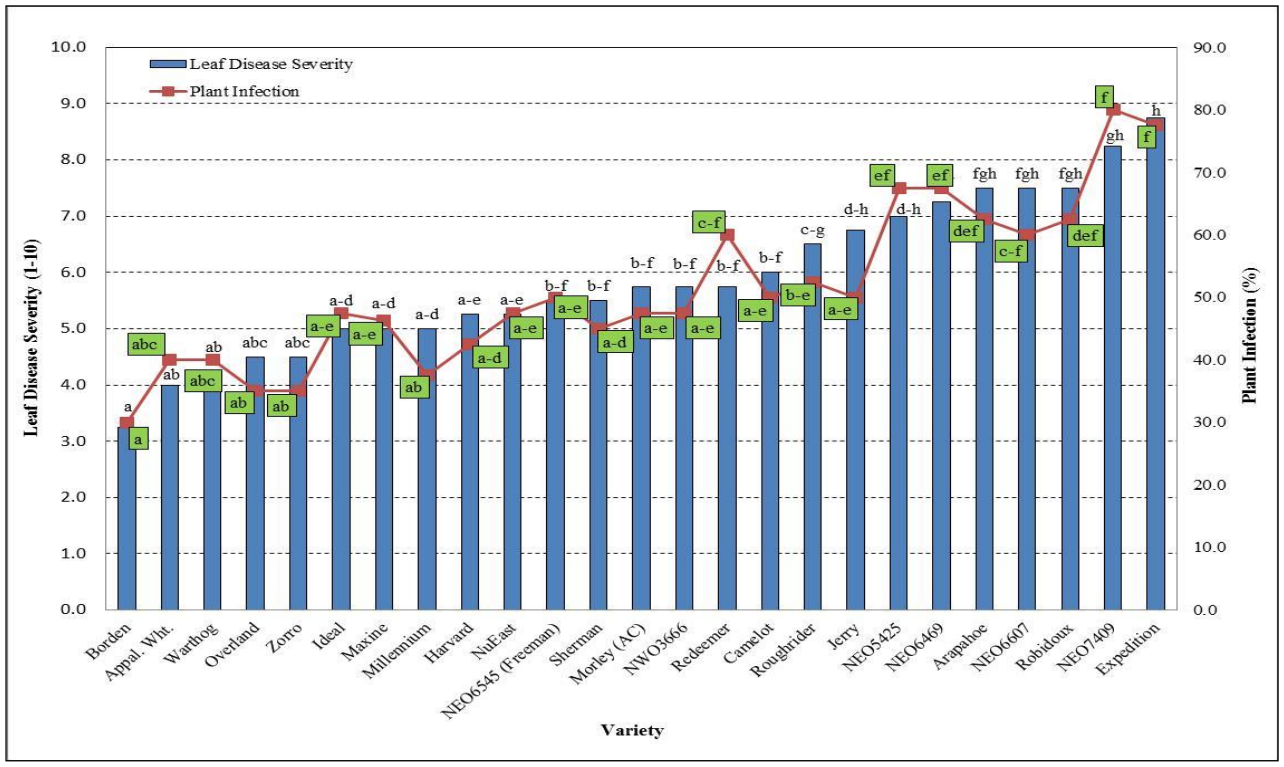


Figure 1. Leaf disease severity and the percent of plant infection of the 25 winter wheat varieties in Alburgh, VT
*Varieties with the same letter did not differ significantly leaf disease severity or plant infection.

Several varieties in both locations were observed to have lodged to varying degrees. At both trial locations, three varieties, Sherman, Roughrider, and Borden had lodging severe enough to impact harvest ability. Three additional varieties, NWO3666, NEO6607, and Jerry lodged severely at the Willsboro location.

Prior to harvest, plant heights were measured (Table 6). Sherman (45.9 inches) and Borden (45.4 inches) were the tallest varieties in Alburgh and Zorro was the tallest variety in Willsboro measuring 42.7 inches. In general, it was observed that the shorter and less vigorous varieties had higher weed pressures. The taller, or earlier developing, varieties overall had less weed presure. Overall, there was minimal weed pressure at the Alburgh trial site, conversely the weed pressure at the Willsboro site was relatively high.

Table 5. The approximate winter wheat flowering dates in Alburgh, VT and Willsboro, NY.

Variety	Alburgh, VT Flowering Date	Willsboro, NY Flowering Date
Appalachian Wht.	3-Jun	14-Jun
Arapahoe	3-Jun	14-Jun
Borden	5-Jun	14-Jun
Camelot	10-Jun	16-Jun
Expedition	3-Jun	16-Jun
Harvard	3-Jun	14-Jun
Ideal	10-Jun	14-Jun
Jerry	5-Jun	14-Jun
Maxine	5-Jun	14-Jun
Millennium	10-Jun	14-Jun
Morley (AC)	5-Jun	14-Jun
NEO5425	3-Jun	18-Jun
NEO6469	3-Jun	14-Jun
NEO6545 (Freeman)	3-Jun	18-Jun
NEO6607	3-Jun	14-Jun
NEO7409	3-Jun	16-Jun
NuEast	3-Jun	14-Jun
NWO3666	3-Jun	14-Jun
Overland	5-Jun	14-Jun
Redeemer	5-Jun	14-Jun
Robidoux	3-Jun	18-Jun
Roughrider	5-Jun	14-Jun
Sherman	10-Jun	14-Jun
Warthog	5-Jun	14-Jun
Zorro	10-Jun	14-Jun

Table 6. Plant heights in Alburgh, VT and Willsboro, NY.

Variety	Alburgh, VT Plant height	Willsboro, NY Plant height
	inches	inches
Appalachian Wht.	32.7	29.1
Arapahoe	39.1	35.3
Borden	45.4*	36.5
Camelot	35.4	31.4
Expedition	36.1	31.1
Harvard	36.8	34.3
Ideal	37.2	31.3
Jerry	38.3	30.0
Maxine	34.9	33.0
Millennium	37.3	34.9
Morley (AC)	40.2	38.2
NEO5425	35.3	31.9
NEO6469	34.6	31.4
NEO6545 (Freeman)	35.0	32.0
NEO6607	35.5	29.1
NEO7409	34.1	30.9
NuEast	35.1	32.4
NWO3666	36.1	33.4
Overland	38.2	33.8
Redeemer	38.9	34.8
Robidoux	36.4	33.9
Roughrider	41.2	31.8
Sherman	**45.9***	28.5
Warthog	36.1	36.4
Zorro	44.2*	**42.7***
LSD (0.10)	2.86	4.25
Trial Mean	37.6	33.1

Values shown in **bold** are of the highest value or top performing.
* Wheat that did not perform significantly lower than the top performing variety in a particular column is indicated with an asterisk.

Winter Wheat Yield and Quality:

The yields at both locations were significantly different. The mean yield in Alburgh (2787 lbs ac^{-1}) was 1500 lbs lower than the mean yield in 2012 and at Willsboro (3142 lbs ac^{-1}) the yield was about 1000 lbs lower than in 2012. The highest yielding variety at the Alburgh site was NEO6545 (Freeman) (3916 lbs ac^{-1}), and NEO6607 (3959 lbs ac^{-1}) was the highest yielding in Willsboro (Tables 7, 8 and Figures 2, 3). Other high yielding varieties in Alburgh include Borden, Harvard, Overland, and Zorro. The varieties NEO5425, Expedition, Zorro, NEO6545 (Freeman), Appalachian White, and NuEast, yielded well at the Willsboro location. The lowest yielding varieties at both locations were Sherman and Roughrider.

The variety with the lowest moisture at the time of harvest was NWO3666 (10.3%) in Alburgh. Several varieties at the Alburgh site had to be dried down to below 14% moisture, necessary for optimal grain storability. The lowest moisture at the Willsboro trial site was Borden (8.18 %). All of the Willsboro varieties except for Expedition (15.7%) had moistures below 14%. 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 Alburgh, NuEast had the highest test weight of 60.8 lbs bu^{-1}. Ten of the 25 winter wheat varieties trial in Alburgh did not attain the optimal 56 to 60 lb bu^{-1} test weight for wheat. The highest test weight in Willsboro was Appalachian White (53.6 lbs bu_{-1}). None of the 25 winter wheat varieties in Willsboro had optimal test weights.

Table 7. Harvest results of 25 winter wheat varieties, Alburgh, VT.

Variety	Harvest moisture	Test weight	Yield @13.5% moisture
	%	lbs bu^{-1}	lbs ac^{-1}
Appalachian Wht.	13.4	59.3*	2898
Arapahoe	14.4	56.1	2536
Borden	13.4	54.3	3453*
Camelot	12.0	57.4*	2594
Expedition	12.6	59.3*	2913
Harvard	16.6	54.6	3453*
Ideal	16.5	53.0	3074
Jerry	15.2	55.3	2470
Maxine	10.7	60.3*	3057
Millennium	15.6	55.5	1721
Morley (AC)	14.8	55.5	2975
NEO5425	18.6	54.3	2964
NEO6469	14.1	56.3	2974
NEO6545 (Freeman)	14.2	56.8*	**3916***
NEO6607	11.9	58.5*	2948
NEO7409	15.6	53.0	2094
NuEast	13.0	**60.8***	3055
NWO3666	**10.3**	59.6*	2575
Overland	12.8	57.9*	3331*
Redeemer	16.2	56.3	2927
Robidoux	15.6	52.0	2316
Roughrider	10.4	58.0*	1494
Sherman	13.7	57.3*	1459
Warthog	12.7	58.4*	3229
Zorro	14.5	55.3	3260*
LSD (0.10)	NS	4.19	686
Trial Mean	14.0	56.6	2787

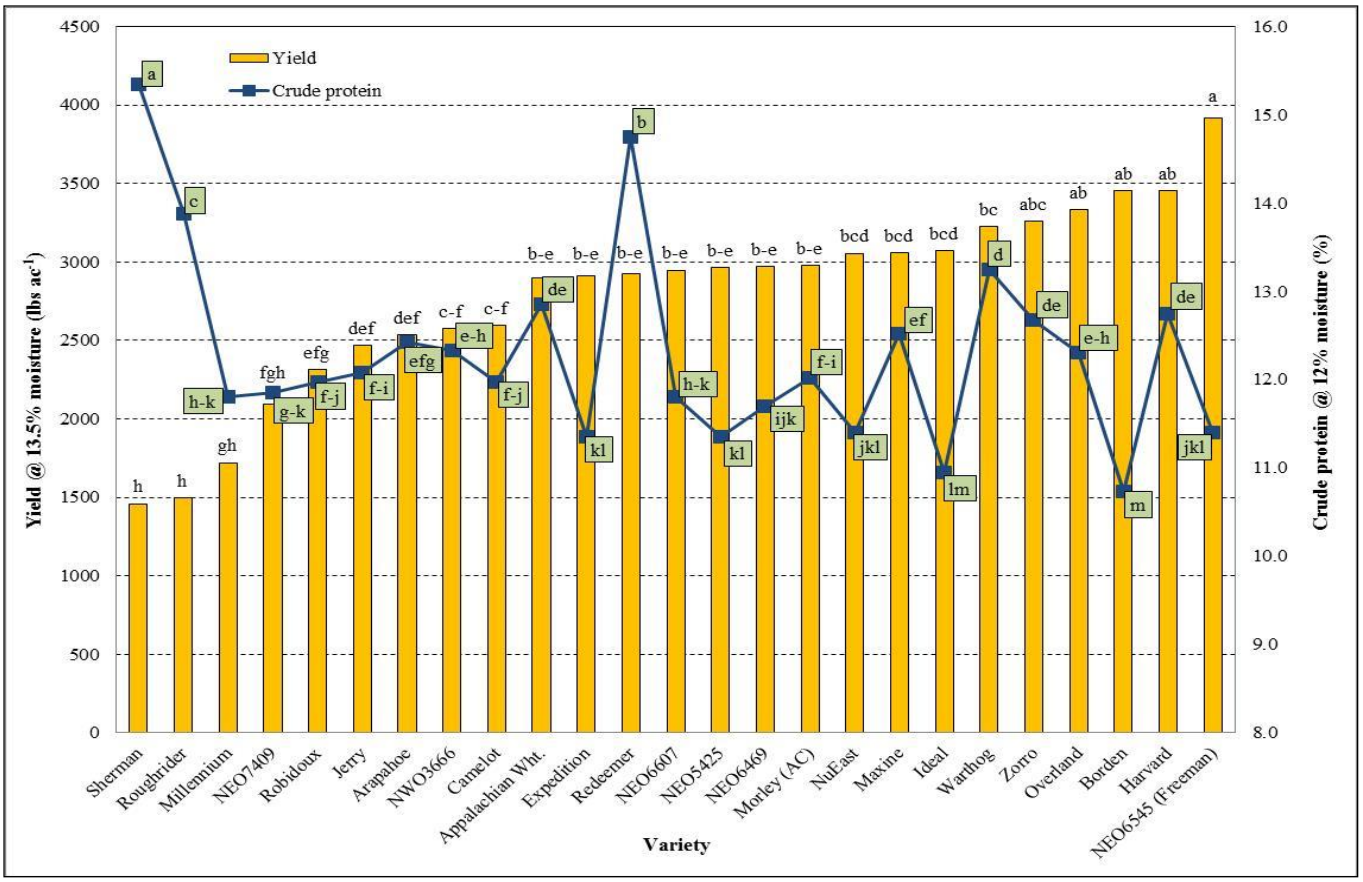
Table 8. Harvest results of 25 winter wheat varieties, Willsboro, NY.

Variety	Harvest moisture	Test weight	Yield @13.5% moisture
	%	lbs bu^{-1}	lbs ac^{-1}
Appalachian Wht.	12.8	**53.6***	3614*
Arapahoe	11.6	51.5*	3312
Borden	**8.18***	46.1	3161
Camelot	12.8	51.8*	3115
Expedition	15.7	53.3*	3804*
Harvard	13.4	48.0	2983
Ideal	9.23*	47.1	3440
Jerry	9.98*	46.3	3157
Maxine	11.6	50.0	2731
Millennium	12.4	44.6	2479
Morley (AC)	10.7	48.9	3087
NEO5425	12.5	51.4*	3830*
NEO6469	12.0	49.6	3462
NEO6545 (Freeman)	12.6	50.1	3684*
NEO6607	11.4	51.6*	**3959***
NEO7409	11.4	49.9	2908
NuEast	13.1	53.5*	3563*
NWO3666	12.3	49.5	2996
Overland	12.2	51.1*	3293
Redeemer	11.2	50.0	2898
Robidoux	9.33*	43.5	2864
Roughrider	11.6	44.0	1573
Sherman	10.9	44.0	1614
Warthog	12.4	52.5*	3294
Zorro	11.5	49.4	3721*
LSD (0.10)	1.85	2.96	406
Trial Mean	11.7	49.3	3142

Values shown in **bold** are of the highest value or top performing.

* 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.



.Figure 2. Yield and protein concentration of 25 winter wheat varieties, Alburgh, VT.
Varieties with the same letter did not differ significantly in yield or protein.

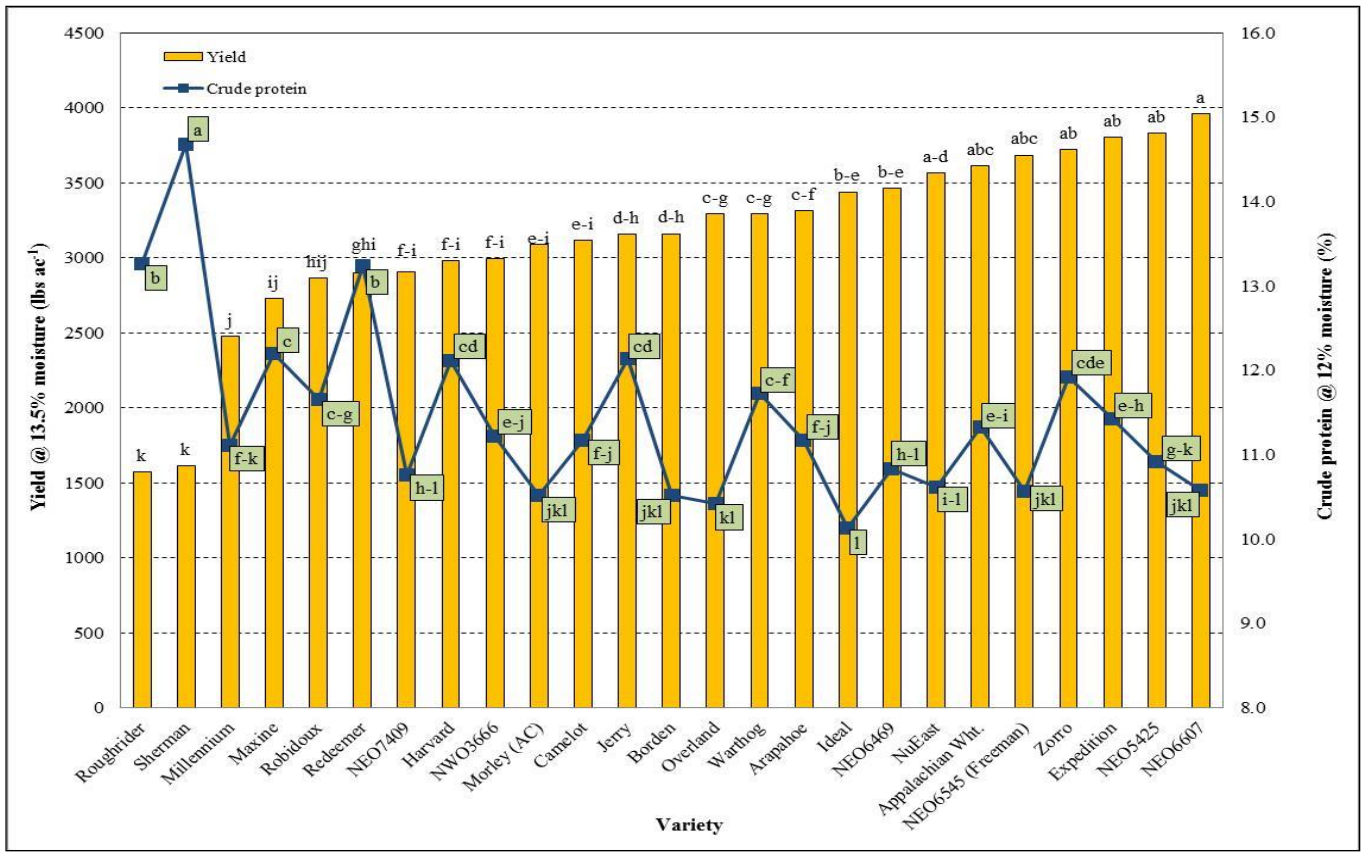


Figure 3. Yield and protein concentration of 25 winter wheat varieties, Willsboro, NY.
Varieties with the same letter did not differ significantly in yield or protein.

The common measures used by commercial mills to evaluate wheat quality are grain protein, falling number, test weight, and mycotoxin (DON) content (Table 9, 10). All of the quality analyses were significantly different. The variety with the highest protein content at both locations was Sherman. Fifteen of the 25 varieties trialed in Alburgh, and six of the 25 in Willsboro, met the 12-15% protein level required by most commerical bakers. Borden had the lowest protein level in Alburgh (10.7%) and in Willsboro it was Ideal (10.1%). All varieites except for NEO5425 at the Willsboro trial site had falling numbers of 300 seconds or above indicating little or no sprout damage.

Table 9. Quality of 25 winter wheat varieties, Alburgh, VT.

Variety	Crude protein @ 12% moisture	Crude protein @ 14% moisture	Falling number @ 14% moisture	DON
	%	%	seconds	ppm
Appalachian Wht.	12.9	11.1	377	8.48
Arapahoe	12.4	10.7	386	6.58
Borden	10.7	9.23	369	9.63
Camelot	12.0	10.3	415*	6.43
Expedition	11.4	9.75	391	4.05*
Harvard	12.8	11.0	362	5.99
Ideal	11.0	9.4	366	10.58
Jerry	12.1	10.4	393	8.20
Maxine	12.5	10.8	392	6.85
Millennium	11.8	10.2	384	8.75
Morley (AC)	12.0	10.4	356	9.15
NEO5425	11.4	9.73	401	3.89*
NEO6469	11.7	10.1	398	5.43
NEO6545 (Freeman)	11.4	9.82	405	3.03*
NEO6607	11.8	10.2	388	**2.13***
NEO7409	11.9	10.2	429*	3.48*
NuEast	11.4	9.80	410*	4.73
NWO3666	12.3	10.6	372	7.30
Overland	12.3	10.6	367	6.53
Redeemer	14.8	12.7*	383	4.00*
Robidoux	12.0	10.3	391	7.88
Roughrider	13.9	11.9	408	7.55
Sherman	**15.4***	**13.2***	386	6.58
Warthog	13.3	11.4	**440***	5.93
Zorro	12.7	10.9	365	8.58
LSD (0.10)	0.59	0.51	30.1	2.47
Trial Mean	12.3	10.6	389	6.47

Table 10. Quality of 25 winter wheat varieties,Willsboro. NY.

Variety	Crude protein @ 12% moisture	Crude protein @ 14% moisture	Falling number @ 14% moisture	DON
	%	%	seconds	ppm
Appalachian Wht.	11.3	11.1	352	7.08*
Arapahoe	11.2	10.9	372	10.2
Borden	10.5	10.3	353	14.2
Camelot	11.2	10.9	403*	12.9
Expedition	11.4	11.2	361	9.08*
Harvard	12.1	11.8	330	12.8
Ideal	10.1	9.90	337	18.1
Jerry	12.1	11.9	300	15.3
Maxine	12.2	11.9	392*	9.03*
Millennium	11.1	10.9	340	14.5
Morley (AC)	10.5	10.3	333	15.6
NEO5425	10.9	10.7	290	10.7
NEO6469	10.8	10.6	328	12.3
NEO6545 (Freeman)	10.6	10.3	368	8.98*
NEO6607	10.6	10.3	377	**6.70***
NEO7409	10.8	10.5	349	8.55*
NuEast	10.6	10.4	391*	8.35*
NWO3666	11.2	11.0	300	13.4
Overland	10.4	10.2	376	8.85*
Redeemer	13.2	12.9	408*	11.2
Robidoux	11.7	11.4	352	16.8
Roughrider	13.3	13.0	308	12.6
Sherman	**14.7***	**14.3***	324	11.0
Warthog	11.7	11.5	**421***	11.0
Zorro	11.9	11.6	354	17.7
LSD (0.10)	0.74	0.73	35.0	2.97
Trial Mean	11.4	11.2	353	11.9

Values shown in **bold** are of the highest value or top performing.
* Wheat that did not perform significantly lower than the top performing variety in a particular column is indicated with an asterisk.

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 (Image 4, 5). Eating contaminated grain greater than 1ppm poses a health risk to both humans and livestock. The DON levels were extremely high in 2013 (Figure 4, 5). All of the 25 winter wheat varieties trialed at both locations were above the FDA's 1ppm limit. The lowest DON level at both trial sites was NEO6607 (Alburgh 2.13 ppm and Willsboro 6.70 ppm). Other varieties with low DON levels in both Willsboro and Alburgh include, NEO7409, NEO6545 (Freeman), and Expedition. Interestingly, the mean DON level at the Alburgh location (6.47 ppm) was 5.43 ppm less than the trial mean at the Willsboro site (11.9 ppm).

Image 4. 2013 Flowering winter wheat, Alburgh, VT

Image 5. The premature bleaching of grain heads, a telltale sign of Fusarium Head Blight infection, Alburgh, VT.

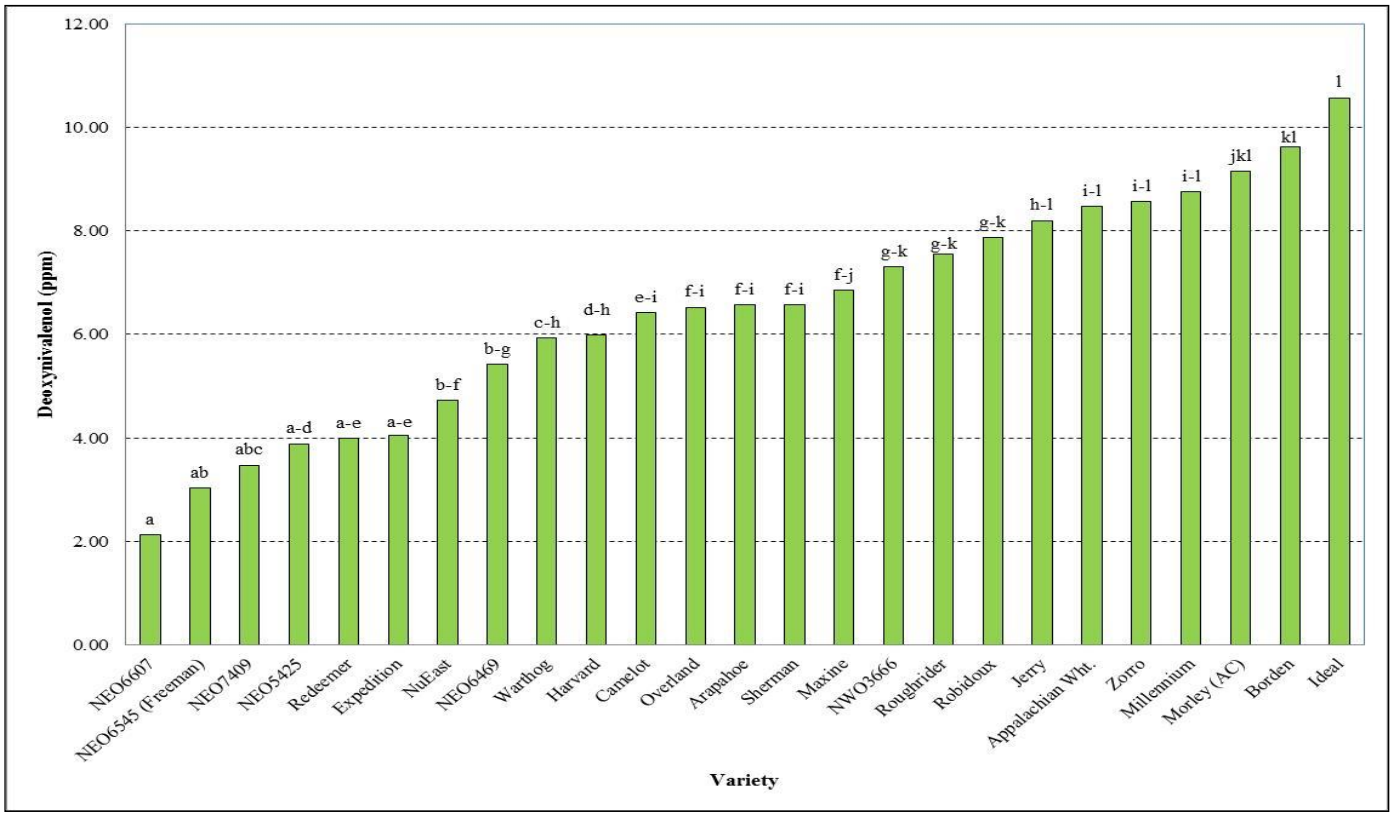


Figure 4. Deoxynivalenol (DON) level of 25 winter wheat varieties, Alburgh, VT.
Varieties with the same letter did not differ significantly in DON levels.

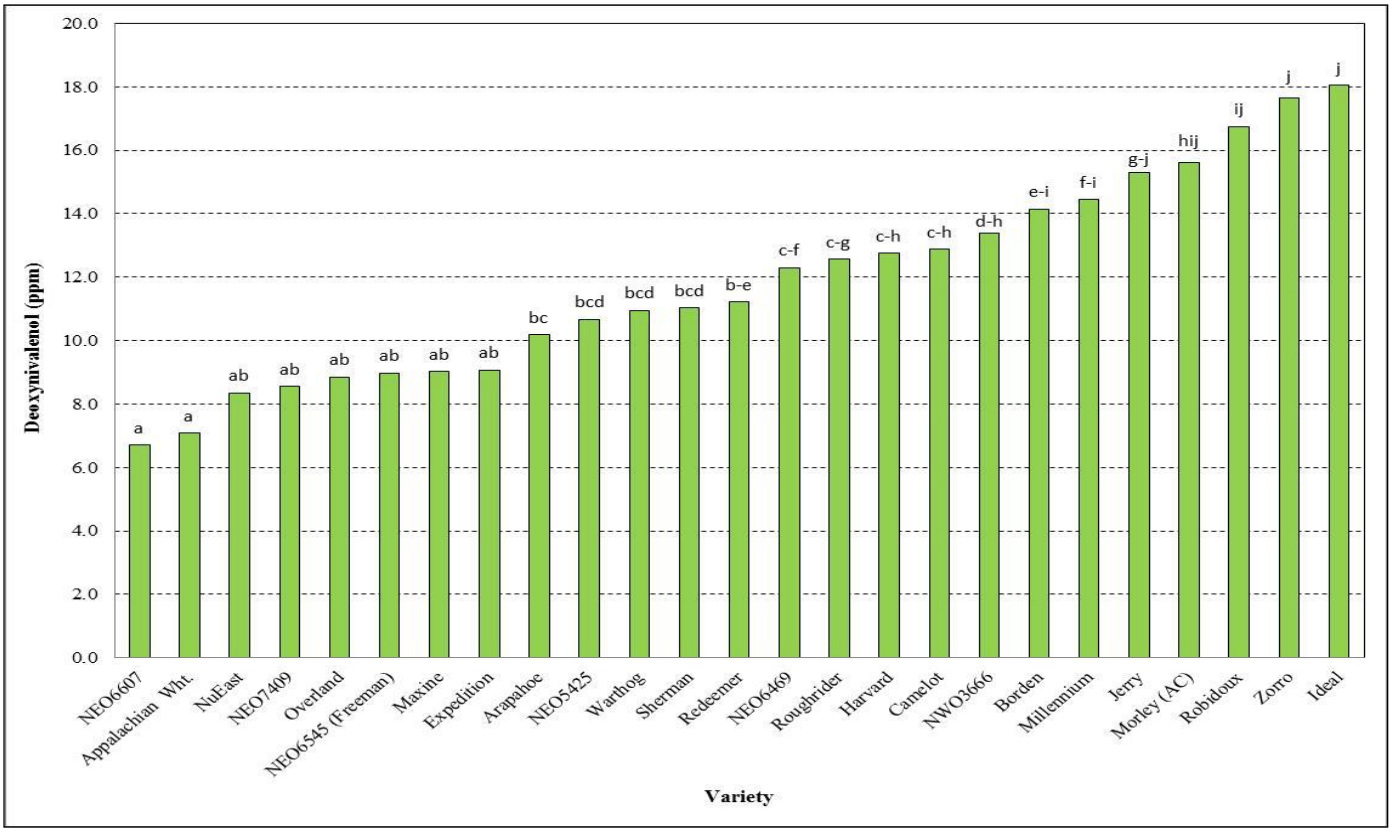


Figure 5. Deoxynivalenol (DON) level of 25 winter wheat varieties, Willsboro, NY.
Varieties with the same letter did not differ significantly in DON levels.

DISCUSSION

It is important to remember that the results only represent one year of data. The 2013 growing season was by far one of the most challenging in recent history due to the excessive rains during key periods of wheat development. The wet weather in May and June brought an excess of 7 inches of rain to Alburgh and approximately 11 inches above the long-term averages in Willsboro. The rains started soon after spring green up which saturated the plots impacting wheat development. This could explain the increase in weed pressure observed at the Willsboro trial location which could have contributed to the reduction in grain yields this season.

There was more lodging observed at both locations this year than in 2012. This could be due to the heavy rains leaching needed plant nutrients away from the plant consequently weakening plant structure. Also, the heavy rains were often accompanied by high winds which may have contributed to the increased lodging.

In addition, the long periods of wetness created the ideal conditions for fungus growth resulting in a plethora of small grain diseases. Plant leaf diseases are not uncommon, but the extent of infection and the number of diseases observed in 2013 were severe enough to have impacted grain yield and quality. However, the most damaging disease this year was Fusarium head blight (FHB) (*Fusarium graminearum*). The continued heavy rains and cool temperatures during flowering provided the perfect conditions for FHB to thrive. A high incidence of premature bleached grain heads and salmon colored spikelets, were observed throughout both trial locations. The infection resulted in some of the highest levels of the mycotoxin deoxynivalenol (DON) seen to date in the Northeast. Interestingly, Alburgh had significantly lower DON levels than the Willsboro trial location which could be attributed to later flowering dates in Willsboro.

Although 2013 was one of the most difficult years for growing wheat, it does provide the opportunity to observe the FHB susceptibility of the different varieties. A variety that can maintain lower levels of FHB infection during such a year

certainly indicates its strength for being grown in the northeast. It is important to note that the variety Ideal had the highest DON levels at both locations and is likely a variety that is risky to grow in this climate.

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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