2019

Organic Spring Wheat Variety Trial

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NORTHWEST CROPS & SOILS PROGRAM

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THE UNIVERSITY OF VERMONT EXTENSION

2019 ORGANIC SPRING WHEAT VARIETY TRIAL

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In 2019, the University of Vermont Extension Northwest Crops and Soils Program evaluated thirty-five hard red spring wheat varieties to determine which would thrive in the Northeast. The trial was established at the Borderview Research Farm in Alburgh, Vermont. Varieties that did not perform well in previous years were eliminated from the 2019 trial and new varieties were added.

MATERIALS AND METHODS

The experimental plot design was a randomized complete block with three replications. Treatments were 35 spring wheat varieties. Spring wheat varieties evaluated and their sources are listed in Table 1.

Table 1. Thirty-five spring wheat varieties trialed in Alburgh, VT, 2019.

Spring wheat varieties	Type	Seed source
AC Scotia	HR†	Semican Atlantic Inc., QC, Canada
AC Walton	HR	2012 Saved trial seed, VT
Alaska	HR	Semican Atlantic Inc., QC, Canada, 2018
Barracuda	HR	Meridian Seeds, ND, 2018
Bolles	HR	Albert Lea Seed, MN
Camaro	HR	2017 Meridian Seeds, ND
Chevello	HR	2014 Meridian Seeds, ND
CMW12638	HR	C&M Seeds, ON, Canada
Forefront	HR	South Dakota State University, SD
Glenn	HR	Albert Lea Seed, MN
Harlaka	HR	Semican Atlantic Inc., QC, Canada
Lang-MN	HR	University of Minnesota, MN, 2017
LCS Albany	HR	Limagrain Cereal Seeds, LLC, CO
LCS Anchor	HR	Limagrain Cereal Seeds, LLC, CO
LCS Breakaway	HR	Limagrain Cereal Seeds, LLC, CO
LCS Iquaca	HR	Limagrain Cereal Seeds, LLC, CO
LCS Nitro	HR	Limagrain Cereal Seeds, LLC, CO
LCS Prime	HR	Limagrain Cereal Seeds, LLC, CO
LCS Pro	HR	Limagrain Cereal Seeds, LLC, CO
LCS Rebel	HR	Limagrain Cereal Seeds, LLC, CO
LCS Trigger	HR	Limagrain Cereal Seeds, LLC, CO
LNR13-0627	HR	Limagrain Cereal Seeds, LLC, CO
Magog	HR	Semican Atlantic Inc., QC, Canada
Major	HR	SynAgri, QC, Canada
Moka	HR	Semican Atlantic Inc., QC, Canada
MS_19SW1	HR	Meridian Seeds, ND
MS_19SW2	HR	Meridian Seeds ND
ND Vitpro	HR	North Dakota State University, ND, 2017

Pokona	HR	Semican Atlantic Inc., QC, Canada, 2018
Prevail	HR	South Dakota State University, SD
Prosper	HR	Albert Lea Seed, MN
RB07	HR	Minnesota Foundation Seed, MN
Rocket	HR	Semican Atlantic Inc., QC, Canada
Scotia	HR	Semican Atlantic Inc., QC, Canada
Shelly	HR	Dahlman Seed Co., MN

†HR; hard red wheat.

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 previous crop planted at the site was corn and the soil type was Benson rocky silt loam. On 25-Apr, 57 lbs N ac^{-1}, 57 lbs P ac^{-1}, and 57 lbs K ac^{-1} were applied. The area was then disked and spike tooth harrowed to prepare for planting. The plots were seeded with a Great Plains NT60 Cone Seeder on 29-Apr at a seeding rate of 350 live seeds m^2, except for the varieties Harlaka, Scotia, Alaska, and some plots of Pokona, which were seeded on 6-May. Plot size was 7' x 20' with 5' buffers and the seeded area was 5' x 20'.

Table 2. General plot management of the organic spring wheat trial, 2019.

Location	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam, 3-8% slopes.
Previous crop	Corn
Row spacing (in)	6
Seeding rate (live seeds m^2)	350 live seeds m^2
Replicates	3
Planting date	29-Apr, 6-May
Harvest date	5-Aug
Harvest area (ft)	5 x 20
Tillage operations	Fall plow, spring disk & spike tooth harrow
Fertility (lbs ac^{-1})	57 lbs N, 57 lbs P, 57 lbs K

Grain plots were harvested with an Almaco SPC50 plot combine on 5-Aug (Image 1). Grain moisture, test weight, and yield were measured at harvest. Moisture and test weight were determined with a DICKEY-John MINI GAC Plus meter. The acceptable test weight for bread wheat is 56-60 lbs per bushel. An approximate one-pound subsample was collected to determine quality, and samples were then ground into flour using the Perten LM3100 Laboratory Mill. Quality measurements included standard testing parameters used by commercial mills. Varieties were analyzed for protein content at 12% moisture using a Perten Inframatic 8600 Flour Analyzer. Grain protein content affects gluten strength and loaf volume, and the target value for most commercial mills is 12-15% protein. Falling numbers (AACC Method 56-81B, AACC Intl., 2000) were 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 a sound quality wheat. A falling number lower than 200 indicates high enzymatic activity and poor quality wheat. Deoxynivalenol (DON) analysis was analyzed on one replicate using the Veratox DON 2/3 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.

Image 1. Almaco SPC50 plot combine, Alburgh, VT.

Data were analyzed using a general linear model procedure of SAS (SAS Institute, 2008). Replications were treated as random effects, and treatments were treated as fixed. DON levels were only evaluated on one replication and therefore were not analyzed for statistical significance. Mean comparisons were made using the Least Significant Difference (LSD) procedure where the F-test was considered significant, at $p<0.10$.

Variations in genetics, soil, weather, and other growing conditions can result in variations in yield and quality. Statistical analysis makes it possible to determine whether a difference between treatments is significant or whether it is due to natural variations in the plant or field. At the bottom of each table, a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. This means that when the difference between two treatments within a column is equal to or greater to the LSD value for the column, there is a real difference between the treatments 90% of the time. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In this 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***
LSD	**889**

RESULTS

Seasonal precipitation and temperature recorded at Borderview Research Farm in Alburgh, VT are displayed in Table 3. Precipitation was above average in April and May during a cool and wet spring, followed by below average precipitation June through August. July was dry, and accumulated 2.34 inches of rainfall, which was 1.81 inches below the 30-year normal. July was also unusually warm, with temperatures 2.87° F above average. The cool and wet spring resulted in fewer Growing Degrees Days (GDDs) than the 30-year normal April through June. July saw 1286 GDDs, 88 above the average. Overall, 4387 GDDs were accumulated from April to August, 104 fewer than normal.

Table 3. Temperature and precipitation summary for Alburgh, VT, 2019.

Alburgh, VT	April	May	June	July	August
Average temperature (°F)	42.7	53.3	64.3	73.5	68.3
Departure from normal	-2.11	-3.11	-1.46	2.87	-0.51
Precipitation (inches)	3.65	4.90	3.06	2.34	3.50
Departure from normal	0.83	1.45	-0.63	-1.81	-0.41
Growing Degree Days (32-95°F)	346	660	970	1286	1125
Departure from normal	-38	-96	-44	88	-14

Weather data was collected from Wunderground.com via the Alburgh weather station. Historical averages are for 30 years of NOAA data (1981-2010) for Enosburg Falls, VT.

Varieties differed significantly in yield, harvest moisture, test weight, protein, and falling number (Table 4). The highest yielding variety was Shelly (3713 lbs ac^{-1}), which was statistically similar to thirteen other varieties. The lowest yielding variety was LCS Prime (2355 lbs ac^{-1}). Yields by variety are also shown in Figure 1. The variety with the lowest moisture at the time of harvest was MS_19SW2 (11.0%), which was significantly similar to twenty-one other varieties. Nine varieties had moistures above the optimal grain storage moisture of 14%, and therefore has to be dried before storage.

Prevail was the top performer in test weight (61.8 lbs bu^{-1}), and twenty-two varieties were statistically similar. The two lowest performing varieties, Major (51.5 lbs bu^{-1}) and MS_19SW1 (55.6 lbs bu^{-1}) were the only varieties that did not meet the minimum industry standard of 56 lbs bu^{-1} for wheat. Harlaka had the highest percentage of crude protein, 20.2%, which was significantly greater than all other varieties in the trial (Table 4, Figure 1). Twenty varieties met or exceeded the industry standard of 12-14% protein. LCS Trigger had the lowest percentage of crude protein; 10.5%. CMW12638 had the highest falling number, 450 seconds, and was similar to six other varieties. The variety that produced the lowest falling number was Pokona at 360 seconds, which was still greater than the industry standard of 350 seconds. These falling number results indicate that all spring wheat varieties had low enzymatic activity and were of sound quality.

In the Northeast, *Fusarium* head blight (FHB) is caused by the species *Fusarium graminearum*. This disease is very destructive and causes yield loss, low test weights, low seed germination, and the 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 greater than 1ppm poses a health risk to both humans and some livestock. While humans should not consume grains with DON concentrations over 1ppm, some livestock can consume grain with up to 10ppm DON. Only one replication of the 2019 trial was tested for DON to see if high levels were present. All spring wheat varieties in 2019 were below the FDA's 1ppm DON limit.

Table 4. Yield and quality results of 35 spring wheat varieties, Alburgh, VT, 2019.

Variety	Yield @13.5% moisture	Harvest moisture	Test weight	Crude protein @ 12% moisture	Falling number
	lbs ac^{-1}	%	lbs bu^{-1}	%	seconds
AC Scotia	3322*	14.5	56.5	12.1	414
AC Walton	2947	13.4	56.8	11.5	400
Alaska	2932	14.2	59.6*	12.7	385
Barracuda	3417*	12.2*	60.8*	13.2	416
Bolles	2426	12.5*	61.2*	12.8	431*
CMW12638	3187*	16.0	58.3	11.3	**450**
Camaro	2753	11.3*	61.7*	13.7	388
Chevello	3315*	11.9*	61.4*	11.1	400
Forefront	3192*	12.2*	61.7*	12.2	391
Glenn	2447	13.0*	61.5*	13.5	370
Harlaka	2376	13.0*	59.3	**20.2**	381
LCS Albany	2817	12.3*	60.8*	11.0	386
LCS Anchor	3198*	11.7*	61.8*	14.5	400
LCS Breakaway	3220*	12.0*	61.2*	13.3	414
LCS Iquaca	2398	13.4	60.4*	11.2	424*
LCS Nitro	2886	12.0*	60.0*	11.7	420
LCS Prime	2355	13.4	58.2	10.6	400
LCS Pro	2844	13.5	60.1*	11.7	393
LCS Rebel	3053*	12.8*	61.5*	11.6	404
LCS Trigger	2604	15.2	57.1	10.5	425*
LNR13-0627	3045	11.9*	59.8*	10.8	409
Lang-MN	3247*	11.5*	61.5*	12.6	428*
MS_19SW1	2945	12.5*	55.6	13.3	394
MS_19SW2	3493*	**11.0**	60.6*	11.2	397
Magog	2739	14.3	57.4	12.1	427*
Major	2405	18.8	51.5	12.4	401
Moka	3179*	12.4*	60.0*	12.1	412
ND Vitpro	2356	12.0*	60.9*	13.8	403
Pokona	2800	16.9	58.1	12.4	360
Prevail	3351*	11.6*	**61.8**	12.7	405
Prosper	3454*	12.4*	60.9*	11.4	392
RB07	2931	11.5*	60.9*	13.0	420
Rocket	3031	14.7	57.6	10.8	380
Scotia	2870	14.2	56.1	12.0	393
Shelly	**3713**	12.5*	61.8*	11.9	436*
LSD (0.10)	662	2.12	2.31	2.85	26.5
Trial Mean	2950	13.1	59.5	12.4	404

*Varieties with an asterisk are not significantly different from the top performer in **bold**.

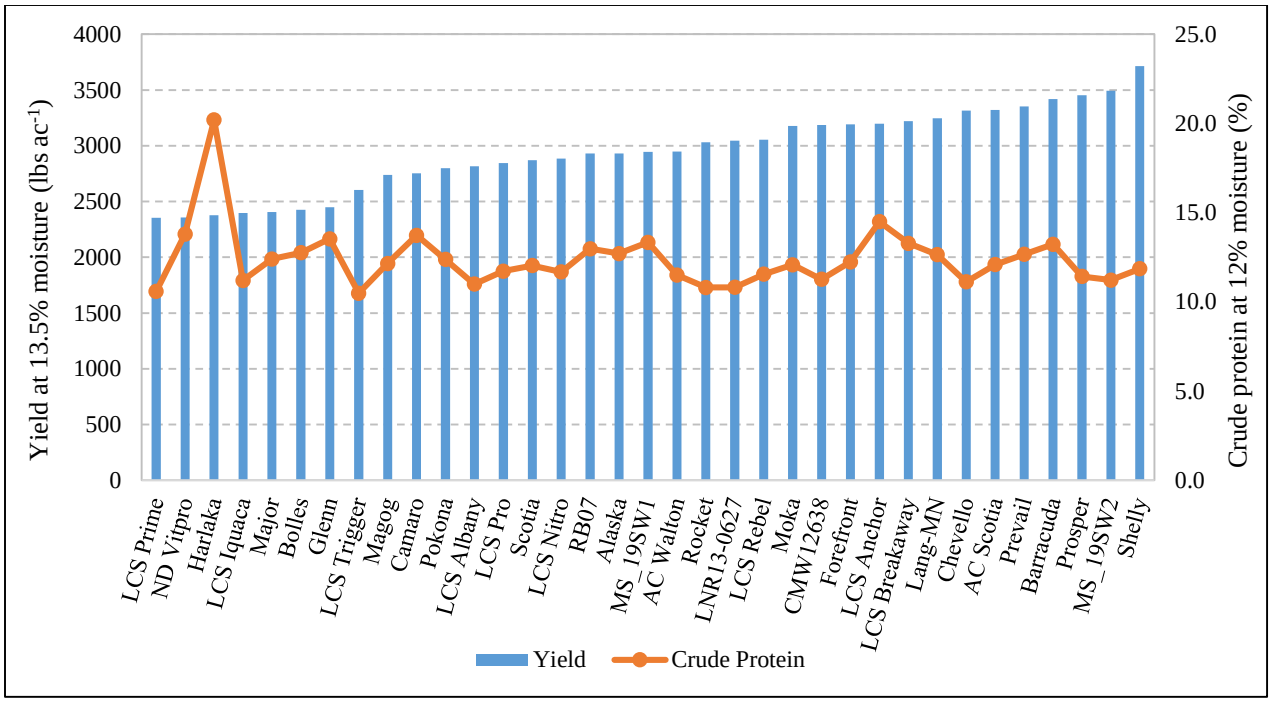

Figure 1. Yield and protein concentrations of thirty-five spring wheat varieties, Alburgh, VT, 2019.

DISCUSSION

It is important to remember that the results only represent one year of data. The early 2019 growing season had lower than average temperatures and higher rainfall, which is ideal for the growth of cereal grains that prefer cooler weather. Wet weather can increase the presence of FHB and DON, however, all DON levels tested were below the FDA standard of 1ppm. July weather was hotter than average and dry, reducing the risk of pathogens. Overall the 2019 varieties yielded an average of 2950 lbs ac^{-1}, the highest trial yield since 2012 (Figure 2).

As you make variety choices on your farm, it is important that you evaluate data from test sites that are as similar to your region as possible.

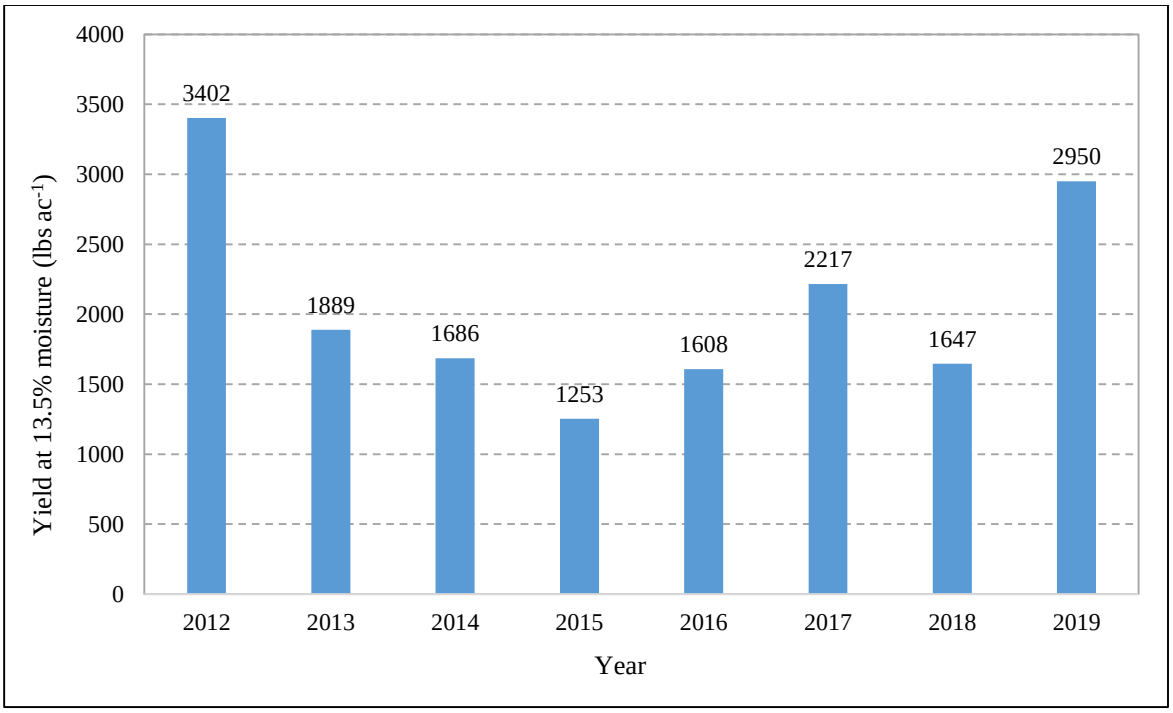

Figure 2. Mean yields from spring wheat variety trials from 2012 to 2019, Alburgh, VT.

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