



2021 Organic Spring Wheat Variety Trial



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2020 ORGANIC SPRING WHEAT VARIETY TRIAL

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In 2021, the University of Vermont Extension's Northwest Crops and Soils Program evaluated 35 spring wheat varieties to identify varieties that perform well in production systems in northern Vermont. The trial was established at the Borderview Research Farm in Alburgh, Vermont.

MATERIALS AND METHODS

The spring wheat variety trial was initiated at Borderview Research Farm in Alburgh in April 2021. Plots were managed with practices similar to those used by producers in the surrounding area. Agronomic information is displayed in Table 1. The experimental design was a randomized complete block with four replicates. The previous crops were hemp and mixed vegetables. The field was prepared with a TerraDisc and spike tooth harrow prior to planting. The field was fertilized with a blended organic fertilizer (5-4-3) at a rate of 2000 lb ac⁻¹ prior to seeding. Plots were seeded in 5' x 20' plots with a Great Plains Cone Seeder on 8-Apr at a seeding rate of 350 live seeds m⁻². Thirty-five varieties were planted. Field season data were collected on all varieties. From 7-Jun to 10-Jun, heading dates were recorded. When 50% of heads were emerged in the plot, the plot was determined to be headed out.

Table 1. Trial agronomic information, Alburgh, VT, 2021.

Trial information	Alburgh, VT Borderview Research Farm
Soil type	Covington silty clay loam, 0 to 3 percent slopes
Previous crop	Hemp and mixed vegetables
Seeding rate	350 live seeds m ⁻²
Row spacing (in)	6
Replicates	4
Planting date	8-Apr 2021
Harvest date	3-Aug 2021
Harvest area (ft)	5 x 20
Tillage operations	Pottinger TerraDisc & spike tooth harrow

Table 2. Thirty-five spring wheat varieties information.

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
Bolles	HR	Albert Lea Seed, MN
Boost	HR	South Dakota State University, SD

Camero	HR	2017 Meridian Seeds, ND
Driver	HR	South Dakota State University, SD
Forefront	HR	South Dakota State University, SD
Glenn	HR	Albert Lea Seed, MN
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 Iquaco	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
LNR13-0627	HR	Limagrain Cereal Seeds, LLC, CO
Lang-MN	HR	Albert Lea Seed, MN
MS Barracuda	HR	Saved Trial Seed, VT
Magog	HR	Semican Atlantic Inc., QC, Canada
Major	HR	SynAgri, QC, Canada
Moka	HR	Semican Atlantic Inc., QC, Canada
ND Vitpro	HR	North Dakota State University, ND
Oland	HR	University of Maine, ME
Pokona	HR	Semican Atlantic Inc., QC, Canada
Prevail	HR	South Dakota State University, SD
Prosper	HR	Albert Lea Seed, MN
Red Fife	HR	Cornell University, NY
Rocket	HR	Semican Atlantic Inc., QC, Canada
Sabin	HR	Cornell University, NY
Shelly	HR	Dahlman Seed Co., MN
Tom	HR	Cornell University, NY
Torgy	HR	Albert Lea Seed, MN
Trigger	HR	Saved Trial seed, VT

HR- Hard Red.

Plots were harvested with an Almaco SPC50 small plot combine on 3-Aug. Grain moisture, test weight, and yield were determined at harvest. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN) and a subsample was collected to determine quality characteristics. Grain quality was determined at UVM Extension's E. E. Cummings Crop Testing Laboratory (Burlington, Vermont). Samples were ground using the Perten LM3100 Laboratory Mill. Flour was analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Most commercial mills target 12-15% protein content for bread wheat. Falling number was measured (AACC Method 56-81B, AACC Intl., 2000) on the Perten FN 1500 Falling Number Machine. The falling number indicates the level of enzymatic activity 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. An ideal falling number range is between 300-350, which indicates low enzymatic activity and sound quality wheat. A falling number lower than 200 indicates high enzymatic activity and poor quality wheat, typically as a result of pre-harvest sprouting damage in the grain. Falling number above 400 is suitable but may inhibit fermentation when used for baking.

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. One sample of each variety was run and all tested well below the threshold for human consumption (data not shown).

Stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within the trial were treated as random effects, and treatments were treated as fixed. Treatment mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p < 0.10$).

Variations in project results can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments 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 (LSD's) at the 10% level of probability are shown. Where the difference between two treatments 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 values. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the previous example, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 200, which is less than the LSD value of 300. This means that these treatments did not differ in yield. The difference between A and C is equal to 400, which is greater than the LSD value of 300. This means that the yields of these treatments were significantly different from one another.

Treatment	Yield
A	2100*
B	1900*
C	1700
LSD	300

RESULTS

Seasonal precipitation and temperature recorded at Borderview Research Farm in Alburgh, VT are displayed in Table 3. An early period of mild weather allowed for early planting at the beginning of April. A warmer than average spring and drier summer led to 1637 Growing Degree Days (GDDs) accumulated April to July, which was 34 GDDs above the 30-year average. Precipitation from April to July was 4.99 inches below normal.

Table 3. Seasonal weather data collected in Alburgh, VT, 2021.

	Apr	May	Jun	Jul
Average temperature (°F)	48.1	58.4	70.3	68.1
Departure from normal	2.52	-0.03	2.81	-4.31
Precipitation (inches)	3.52	0.66	3.06	2.92
Departure from normal	0.45	-3.10	-1.20	-1.14
Growing Degree Days (32°-95°F)	145	334	597	561
Departure from normal	62	33	73	-134

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) for Burlington, VT.

Table 4 shows heading date and harvest data for the spring wheat trial. Spring wheat varieties had an average yield of 2777 lbs ac⁻¹ adjusted for 13.5% moisture, which was lower than the previous year. At 3793 lbs ac⁻¹, LCS Pro was the top yielding variety of this year as well as last. Thirty-two of the thirty-five varieties trialed yielded above 2000 lbs ac⁻¹. Most plots reaching heading between 7-Jun and 9-Jun with the exception of Red Fife, which headed out on 10-Jun and produced the smallest yield overall.

Harvest moisture below 14.0% is desirable for grain storage. Wheat above this moisture content must be dried down after harvest, adding time and cost to farmers. This year, all varieties in the trial had moisture above 14.0% and required drying before storage. This may have been a result of cool temperatures around harvest in July. Prevail had the lowest harvest moisture at 14.6%, while LCS Prime was the highest at 17.1%. Test weight is the measure of grain density, which is determined by weighing a known volume of grain. Industry standard for wheat is 60 lbs bu⁻¹. Pokona had the highest test weight at 59.2 lbs bu⁻¹, with Driver, Glenn, LCS Anchor, LCS Breakaway, LCS Pro, Lang-MN, Magog, ND Vitpro, and Sabin testing statistically similarly to the top performer.

Table 4. Spring wheat harvest data, Alburgh, VT, 2021.

Variety	Heading date	Test weight	Moisture	Yield @13.5% moisture
		lbs bu ⁻¹	%	lbs ac ⁻¹
AC Scotia	8-Jun	57.0	15.3	3420*
2128AC Walton	7-Jun	56.5	15.3	2816
Alaska	9-Jun	57.1	14.7	3039*
Bolles	7-Jun	56.0	15.2	2708
Boost	7-Jun	57.0	15.4	2897
Camero	7-Jun	56.8	14.8	1999
Driver	8-Jun	58.7*	15.9	3351*
Forefront	7-Jun	55.8	15.9	2128
Glenn	7-Jun	58.0*	15.1	1585
LCS Albany	8-Jun	55.7	16.0	2822
LCS Anchor	7-Jun	57.9*	14.7	2557
LCS Breakaway	7-Jun	58.4*	15.3	3111*
LCS Iquaco	7-Jun	56.0	16.6*	2791
LCS Nitro	7-Jun	56.5	14.8	2369
LCS Prime	7-Jun	56.9	17.1	2506
LCS Pro	7-Jun	57.5*	15.2	3793
LCS Rebel	7-Jun	56.9	16.0	2276
LNR13-0627	7-Jun	56.3	15.5	2603
Lang-MN	7-Jun	58.3*	15.5	3706*
MS Barracuda	7-Jun	57.0	16.0	3061*
Magog	7-Jun	58.3*	15.2	3137*
Major	9-Jun	57.2	15.5	3184*
Moka	7-Jun	56.8	15.5	2753
ND Vitpro	7-Jun	58.6*	15.4	2520
Oland	9-Jun	55.4	15.2	1524
Pokona	9-Jun	59.2	15.1	3455*

Prevail	7-Jun	57.2	14.6	2450
Prosper	7-Jun	55.8	15.1	3327*
Red Fife	10-Jun	54.1	16.1	1263
Rocket	7-Jun	57.2	15.7	3416*
Sabin	7-Jun	57.4*	15.0	3086*
Shelly	7-Jun	55.8	15.9	2787
Tom	8-Jun	57.2	16.1	2326
Torgy	7-Jun	55.2	15.8	3336*
Trigger	8-Jun	56.8	16.0	3087*
LSD (p=0.10)		1.9	1.0	802
Trial mean	7-Jun	56.9	15.5	2777

† Within a column, values labelled with an asterisk (*) were not statistically different from the top performer in **bold** (p=0.10).

The ideal range for bread wheat is 12-15% crude protein, though some artisan bread bakers have found success working with wheat in the 10-12% range, depending on the end-product. All varieties tested above 12% protein, adjusted for 12.5% moisture. The trial mean was 14.7% protein, which is within the range for high quality bread flour (Table 5), and 12 varieties tested above 15%.

The falling number trial mean was 332 seconds. Forefront and LCS Albany had the lowest falling numbers at 231 seconds, while Tom tested the highest at 517, both outside of the ideal range for bread baking. As mentioned previously, falling number measures viscosity by recording the time in seconds it takes for a plunger to fall through a slurry to the bottom of a test tube. The viscosity is an indicator of enzymatic (alpha-amylase) activity in the kernel which most often results from pre-harvest sprouting in the grain. Low falling number indicates high enzymatic activity, or more pre-harvest sprouting damage. This is most common if there are rain events as the grain is ripening prior to harvest. The acceptable range for wheat falling numbers is 200-400, however, falling number below 250 has a negative impact on bread quality and might lead to lower prices paid for the wheat or possible rejection at the mill. Thirty-one of the thirty-five varieties tested within this acceptable range, with two varieties testing below 250, and four testing above 400. High falling numbers, over 400 seconds, can potentially lead to slower fermentation, poorer loaf volume, and drier bread texture, depending on the end product.

One replicate per variety was tested for deoxynivalenol (DON) vomitoxin, and all were below the FDA threshold of 1 ppm so no further testing was conducted (data not shown).

Table 5. Spring wheat quality data, Alburgh, VT, 2021.

Variety	Crude protein @ 12.5% moisture	Falling Number
	%	Seconds
AC Scotia	12.9	390
AC Walton	14.2	355
Alaska	15.0	325
Bolles	16.0*†	356
Boost	14.9	298
Camero	16.0*	270
Driver	13.5	363
Forefront	15.8	231
Glenn	17.4	297
LCS Albany	14.2	231
LCS Anchor	15.5	309
LCS Breakaway	15.2	346
LCS Iquaco	14.3	309
LCS Nitro	14.1	300
LCS Prime	13.7	329
LCS Pro	14.4	348
LCS Rebel	15.2	281
LNR13-0627	13.9	277
Lang-MN	13.8	385
MS Barracuda	15.7	381
Magog	12.7	425
Major	14.1	411
Moka	14.4	341
ND Vitpro	16.9*	371
Oland	14.8	278
Pokona	14.2	410
Prevail	15.5	357
Prosper	13.9	337
Red Fife	14.8	265
Rocket	14.5	323
Sabin	14.9	279
Shelly	14.1	312
Tom	17.0*	517
Torgy	15.9	314
Trigger	12.8	301
LSD (p=0.10)	1.4	55
Trial mean	14.7	332

† Within a column, values labelled with an asterisk (*) were not statistically different from the top performer in bold (p=0.10).

DISCUSSION

The 2021 growing season was slightly warmer and significantly drier than the 30-year average. This allowed for early planting in April followed by moderate drought conditions at the Borderview Research Farm. Warm, dry weather during grain dry down is favorable for most cereal grain crops. Spring wheat trial yields were high but did not upstage the 2020 yields that had outperformed each of the prior seven seasons. Protein was in the optimum 12-15% range for every spring wheat variety planted with a few exceeded 15% protein. Falling numbers also fell within the optimum range for baking with the exception of a few varieties over 400 seconds. Differences between the 2021 and the peak performing 2020 spring wheat yields may be attributed to the weather patterns of the two seasons, where 2021 was granted less rain.

It is important to note that this only represents one year of data. The weather this growing season was challenging for many crops at Borderview Research Farm, and across much of Vermont and New England. The drought conditions and untimely temperatures in early spring and midsummer led to stress, disease and pest pressures. Though these trial yields did not match those of the 2020 growing season, the 2021 spring wheat crop still significantly outperformed trial yields from the five years prior to 2020. 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. Wheat is generally considered a specialty crop in the Northeast and it is recommended growers consider quality standards, consider post-harvest handling requirements, and communicate with potential buyers during variety selection and prior to planting large acreage of grain.

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