2019

Winter Canola Variety Trial

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THE UNIVERSITY OF VERMONT EXTENSION

2019 WINTER CANOLA VARIETY TRIAL

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Winter canola is a relatively new crop to the Northeast. The majority of the canola grown in North America is grown in the Midwestern U.S. and Canada for both culinary oil as well as biodiesel production. Winter canola is planted in the late summer where it grows through the fall before entering a period of dormancy for the winter. The following spring, the plants resume growth and seed is harvested during the summer months. Winter canola could potentially be a useful crop to growers in the Northeast for diversifying rotations, farm products and markets, and producing fuel on farm. However, for winter canola to be a viable crop in our region, we must identify the varieties that can survive the winter months. To do this, the Northwest Crops and Soils Program conducted a variety trial in 2018-2019, which was part of the National Winter Canola Variety Trial.

MATERIALS AND METHODS

A variety trial was conducted during 2018-2019 at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized block with four replicates and fourteen varieties as treatments (Table 1).

Table 1. Winter canola variety information, 2018-2019.

Variety	Source	Type*	Trait
Surefire	Kansas State University	OP	SU
Riley	Kansas State University	OP	
Torrington	Ohlde Seed Farms	OP	
Quartz	KWS-MOMONT	OP	
HAMOUR	KWS-MOMONT	H	
Advocat	Limagrain	H	
Architect	Limagrain	H	
MONSD1	Monsanto	H	RR
MONSD2	Monsanto	H	RR
MONSD3	Monsanto	H	RR
MONSD4	Monsanto	H	RR
Phoenix CL	Rubisco Seeds	H	Clearfield®
Plurax CL	Rubisco Seeds	H	Clearfield®
Popular	Rubisco Seeds	H	

*H = hybrid; OP = open pollinated.
Clearfield® = tolerant of Beyond® ammonium salt of imazamox herbicide.
SU = sulfonylurea herbicide carryover tolerant.
RR = Roundup Ready®

Plots were 5’ x 20’ and were seeded on 31-Aug 2018 with a Great Plains grain drill (5’ wide) at a rate of 500,000 and 300,000 live seeds ac^{-1} for open pollinated and hybrid varieties, respectively (Table 2). Row spacing was 6 inches. The soil was a Benson rocky silt loam over shaly limestone with 8-15% slopes and the previous crop was spring barley. A pre-planting fertilizer of liquid dairy manure was applied on 21-Aug 2018 at a rate of 6,000 gal ac^{-1}. Plots were assessed visually for fall stand and vigor on 5-Nov 2018. Stand

was ranked on a scale 1-10 where 1 was poor emergence and 10 indicated excellent emergence. Vigor was ranked on a scale 1-5 where 1 indicated low vigor and 5 indicated very vigorous plants. Winter survival was visually assessed as a percentage on 1-May 2019. Plots were fertilized with 200 lbs ac^{-1} N supplied through urea (46-0-0) on 6-May 2019. Bloom dates were recorded when 50% or more of the plot had bloomed, and were reported as days after 1-Jan 2019. The trial was covered with bird netting from 1-Jul 2019 until 29-Jul 2019.

Table 2. Trial information and agronomic information 2018-2019.

Location	Borderview Research Farm - Alburgh, VT
Soil type	Benson rocky silt loam, 8-15% slopes
Previous crop	Spring barley
Plot size (ft)	5 x 20
Seeding rate (live seeds ac^{-1})	500,000 for open pollinated varieties 300,000 for hybrid varieties
Replicates	4
Planting date	31-Aug 2018
Fertilizer application	200 lbs ac^{-1} 46-0-0 6-May 2019
Harvest date	30-Jul 2019
Pressing date	26-Nov 2019
Tillage operations	Fall chisel plow, disk and spring-toothed harrow

On 29-Jul 2019, just prior to harvest, average plant height was determined by taking three measurements of plants in centimeters in each plot, and lodging was recorded on a 0-9 scale, then converted to a percentage for reporting to the National Winter Canola Variety Trial. Percent shatter was recorded as a whole number visual estimate. Canola seed was harvested using an Almaco SPC50 plot combine on 30-Jul 2019. At harvest, yields were recorded and moisture and test weight were determined using a DICKEY-john Mini-GAC Plus moisture and test weight meter. Oil was extruded from the seeds with an AgOil M70 oil press on 26-Nov 2019, and the amount of oil captured was measured to determine oil content.

Data were analyzed using a general linear model procedure of SAS (SAS Institute, 1999). Replications were treated as random effects, and treatments were treated as fixed. 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 varieties within a column is equal to or greater to the LSD value for the column, there is a real difference between the varieties 90% of the time. Varieties that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk.

In the example to the right, variety C was significantly different from variety A, but not from variety B. The difference between C and B is 1.5, which is less than the LSD value of 2.0 and so these varieties were not significantly different in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. 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, indicated in bold.

Variety	Yield
A	6.0
B	7.5*
C	**9.0**
LSD	2.0

RESULTS

Weather data were collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2018-2019 growing season (Table 3). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT. In the fall and winter of 2018, conditions were colder than normal. Temperatures remained below normal through the spring, until July 2019, when the average temperature was 2.87° F above the 30-year normal. A colder and wetter spring than normal this year reduced the number of Growing Degree Days (GDDs) to 38 GDDs behind the average in April, 96 behind average in May, and 44 behind average in June. Despite the below normal GDDs in the spring, GDDs occurred in December through March, when there are typically no GDDs in this region. Overall, precipitation across the entire canola growing season was 0.8" below normal. Warm conditions provided a total of 6274 growing degree days across the whole season, which is 237 more than normal.

Table 3. Weather data and GDDs for winter canola in Alburgh, VT, 2018-2019.

	2018					2019						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Average temperature (°F)	72.8	63.4	45.8	32.2	25.4	15.0	18.9	28.3	42.7	53.3	64.3	73.5
Departure from normal	3.96	2.76	-2.36	-5.99	-0.55	-3.77	-2.58	-2.79	-2.11	-3.11	-1.46	2.87
Precipitation (inches)	2.96	3.48	3.53	4.50	2.96	1.53	1.70	1.36	3.65	4.90	3.06	2.34
Departure from normal	-0.95	-0.16	-0.07	1.38	0.59	-0.52	-0.06	-0.85	0.83	1.45	-0.63	-1.81
Growing Degree Days (base 32°F)	1260	941	435	136	72	23	38	108	346	660	970	1285
Departure from normal	121	83	-67	-50	72	23	38	108	-38	-96	-44	87

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.

The varieties were able to emerge and establish in the fall adequately, though stands and vigor were not as robust as previous years, likely due to the colder conditions in the October and November (Table 4). All varieties ranked at 7 or higher for stand on a 1-10 scale. Winter survival assessment was documented on 1-May. Winter survival did not vary significantly by variety and the trial average was 14.1%. Overall, winter survival was low in comparison to other years. It is possible that winter survival assessments were taken to early given the cool spring and delayed growth and development of plants.

Table 4. Pre-harvest characteristics for 14 winter canola varieties.

Variety	Fall stand	Fall vigor	Winter survival	Bloom date
	1-10	1-5	%	Days after 1-Jan 2019
Advocat	7.50	3.25	5.50	142
Architect	7.25	3.00	18.0	142
Hamour	8.00	3.50	11.0	141
MONSD1	**9.00**	**4.00**	10.3	141
MONSD2	7.75	3.75	14.8	142
MONSD3	8.25	3.25	**26.3**	141
MONSD4	8.75	**4.00**	23.8	143
Phoenix CL	7.00	2.75	17.8	141
Plurax CL	7.75	3.50	10.3	**144**
Popular	8.50	3.50	13.0	141
Quartz	7.75	3.25	9.00	142
Riley	7.75	3.75	4.50	143
Surefire	7.75	3.50	16.8	142
Torrington	7.25	3.00	16.8	141
LSD (p= 0.10)	NS	NS	NS	NS
Trial mean	7.88	3.43	14.1	142

*Values followed by an asterisk performed statistically similarly to the top performer in **bold.**
NS- Not significant. Stand emergence rating- 1 indicates low emergence and 10 indicates high emergence.
Vigor rating- 1 indicates low vigor and 5 indicates very high vigor.

Canola varieties only differed significantly in two harvest characteristics; test weight and oil content (Table 5). Across all varieties, the average plant height was 50.8 cm, lodging was 17.9%, and shatter was 3.18%. There was more bird damage on the tops of plants where birds had eaten seed pods they could pull through the top of the bird netting. Seed moisture content at harvest varied little (trial average = 16.1%) and all varieties had to be dried down prior to storage. In some cases, the full plot area was not harvested due to weeds, in which case the new harvest area was taken into account in calculating yield per acre.

Despite poorer establishment than previous years, yields were exceptionally high, and the trial average for yield at 8% moisture was 2498 lbs ac^{-1} (Table 5, Figure 1). In general, canola yields in this region range from 1000-2000 lbs ac^{-1}. Quartz was the top-performer, yielding 3404 lbs ac^{-1}, and was not statistically different than the other varieties. Quartz was also the top performer in oil yield at 7.5% moisture, yielding 789 lbs ac^{-1}, or 103 gal ac^{-1}. The trial average for oil yield was 554 lbs ac^{-1} or 72.6 gal ac^{-1}. The variety that produced seed with the highest test weight was Phoenix CL (50.3 lbs bu^{-1}), which was statistically similar to MONSD4, MONSD2, MONDSD1, Quartz, Riley, and Popular. Phoenix CL was the only variety to produce seed at or above the industry standard test weight of 50 lbs bu^{-1}. This may be due to the dry conditions during seed fill in June and July 2019. MONDSD4 had the highest oil content, 26.5%, and was similar to Hamour, Phoenix CL, Quartz, Plurax CL, Surefire, Advocat, MONSD1, and Popular (Figure 1).

Table 5. Harvest characteristics for 14 winter canola varieties.

Variety	Plant height	Lodging	Shatter	Harvest moisture	Seed yield at 8% moisture	Test weight	Oil content	Oil yield at 7.5% moisture	
	cm	%	%	%	lbs ac^{-1}	lbs bu^{-1}	%	lbs ac^{-1}	gal ac^{-1}
Advocat	48.1	16.7	2.50	15.5	2414	47.8	24.7*	544	71.3
Architect	50.8	22.2	2.25	17.5	2789	45.6	21.5	537	70.3
Hamour	**54.8**	13.9	3.75	**19.1**	2019	46.2	26.3*	485	63.5
MONSD1	49.2	8.33	2.25	15.8	2588	49.1*	24.4*	570	74.7
MONSD2	54.4	16.7	1.75	15.0	2409	49.4*	23.0	510	66.8
MONSD3	51.9	30.6	3.00	15.3	2514	47.2	23.2	566	74.1
MONSD4	53.6	5.56	1.50	15.2	2296	49.6*	**26.5***	557	73.0
Phoenix CL	47.8	**33.3**	6.25	13.6	2486	**50.3***	25.9*	602	78.8
Plurax CL	47.3	19.4	4.50	18.6	2487	47.7	25.5*	519	68.0
Popular	49.8	8.33	2.25	16.5	2796	48.1*	23.9*	609	79.8
Quartz	52.2	13.9	3.25	15.2	**3404**	49.1*	25.6*	**789**	**103**
Riley	50.9	13.9	2.50	15.7	2290	49.1*	22.5	477	62.5
Surefire	49.1	19.4	**7.00**	16.1	2217	47.7	25.4*	512	67.1
Torrington	50.4	27.8	1.75	16.9	2261	46.4	23.7	480	62.9
LSD (p= 0.10)	NS	NS	NS	NS	NS	2.31	2.67	NS	NS
Trial mean	50.8	17.9	3.18	16.1	2498	48.1	24.4	554	72.6

*Values followed by an asterisk performed statistically similarly to the top performer in **bold.**
NS - Not significant at the p=0.10.

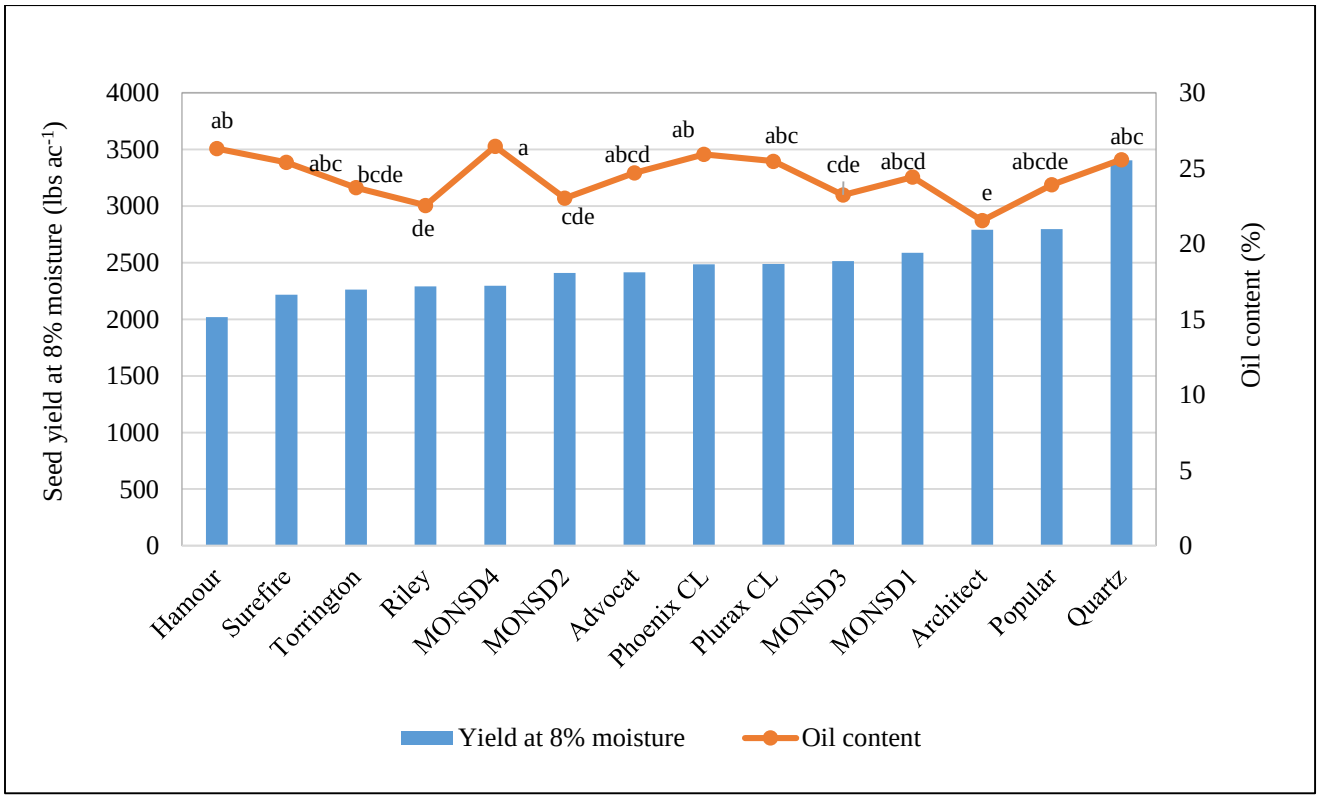

Figure 1. Seed yields at 8% moisture and oil content percentages by variety, Alburgh VT, 2019. Varieties followed by the same letter are statistically similar at p=0.10.

DISCUSSION

Despite colder average winter temperatures and a cool, wet spring that lagged in GDDs, all canola varieties successfully overwintered and were harvestable in the summer of 2019. All varieties produced over 2000 lbs ac^{-1}, the highest yields at this location since 2010, which may be due to the anomalous presence of GDDs during the winter months. However, only Phoenix CL met the standard test weight of 50 lbs bu^{-1}. Furthermore, oil contents for canola are typically expected to be greater than 40%. In our trials, however, we have commonly seen levels of 30-35% and therefore, an average oil content of 24.4% is quite lower than ideal. Low test weight and oil content may be related to poor weather conditions in the spring and summer of 2019. These data indicate that winter canola, when it survives winters in the Northeast, can produce decent yields but may have a lower potential compared to the common canola growing regions of the United States. The top yielding variety this year, Quartz, has been one of the top yielding varieties in the Vermont variety trials for the last four years. By participating in the National Winter Canola Variety Trial, we hope to provide data and encouragement for the development of hardier, high yielding winter canola varieties suitable for this region.

Further research is needed, as this only represents one year of data with exceptional weather patterns. The performance of winter canola will be interesting to monitor in future years if we continue to observe deviations in weather patterns and GDDs as the regional climate fluctuates.

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