2020 Winter Canola Variety Trial

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THE UNIVERSITY OF VERMONT EXTENSION

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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 2019-2020, which was part of the National Winter Canola Variety Trial (https://www.agronomy.k-state.edu/services/crop-performance-tests/canola-and-cotton.html).

MATERIALS AND METHODS

A variety trial was conducted during 2019-2020 at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized block with fifteen varieties replicated 4 times (Table 1).

Table 1. Winter canola variety information, 2019-2020.

Variety	Source	Type†	Trait‡
KS4662	Kansas State University	OP	
KS4719	Kansas State University	OP	
Surefire	Kansas State University	OP	SU
Riley	Kansas State University	OP	
Torrington	Ohlde Seed Farms	OP	
MH 16JD085	KWS-Momont	H	
MH 16JC076	KWS-Momont	H	
MH 15HT227	KWS-Momont	H	
MH 16HIC231	KWS-Momont	H	
CWH190D	Bayer Crop Science	H	
CWH249D	Bayer Crop Science	H	
CWH189D	Bayer Crop Science	H	
CWH317D	Bayer Crop Science	H	
CPX60019	CROPLAN by Winfield	OP	
Plurax CL	Rubisco Seeds	H	Clearfield®

†Type: H = hybrid; OP = open pollinated.
‡Clearfield® = tolerant of Beyond® ammonium salt of imazamox herbicide; SU = sulfonylurea herbicide carryover tolerant.

Plots were 5’ x 20’ and were seeded on 26-Aug 2019 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 Covington silty clay loam with 0-3% slopes and the previous crops were winter rye and corn. Plots were assessed visually for fall stand and vigor on 29-Oct 2019. 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. Two tons lime ac^{-1} was applied on 4-Dec 2019, and 300 lbs ac^{-1} of 19-19-19 fertilizer was applied on 7-Apr 2020. Winter survival was visually assessed as a percentage on 23-Apr 2020. Bloom dates were recorded when 50% or more of the plot had bloomed and were reported as days after 1-Jan 2020. The trial was covered with bird netting from 23-Jun to 14-Jul 2020.

Table 2. Trial information and agronomic information 2019-2020.

Location	**Borderview Research Farm - Alburgh, VT**
Soil type	Covington silty clay loam with 0-3% slopes
Previous crop	Winter rye and silage corn
Plot size (ft)	5 x 20
Seeding rate (live seeds ac^{-1})	500,000 for OP varieties; 300,000 for hybrid varieties
Replicates	4
Planting date	26-Aug 2019
Fertilizer application	300 lbs ac^{-1} 19-19-19, 2 tons ac^{-1} lime
Harvest date	14-Jul 2020
Tillage operations	Fall chisel plow, disk and spring-toothed harrow

On 14-Jul 2020, 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 14-Jul 2020. 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 7-Jan 2021, 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, 2008). 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 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. In the example to the right, treatment C was significantly different from treatment A, but not from treatment B. The difference between C and B is 1.5, which is less than the LSD value of 2.0 and so these treatments 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 treatments were significantly different from one another. Treatment B was not significantly lower than the top yielding treatment, indicated in bold. A lack of significant difference is indicated by shared letters.

Treatment	**Yield**
A	6.0^{b}
B	7.5^{ab}
C	**9.0^{a}**
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 2019-2020 growing season (Table 3). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT. August and September 2019 were slightly cooler than average, with average temperatures 0.51° F below normal, and cooler than average weather patterns continued in November, which was 6.76° F colder than average.

In the winter of 2019-2020, conditions were warmer than average in the coldest months of December through February. After a warm March, April was 3.19° F cooler than the 30-year average, followed by a cool and dry May. The cooler spring was followed by record-setting heat in July, which was 4.17° F hotter than the norm. Despite reduced Growing Degree Days (GDDs) in the spring, the unusually hot summer months leading up to harvest led to more GDDs than usual, with July having 1326 GDDs, 132 more than normal. Overall, precipitation across the entire canola growing season was 2.38” below normal.

Table 3. Weather data and GDDs for winter canola in Alburgh, VT, 2019-2020.

	2019					2020						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Average temperature (°F)	68.3	60.0	50.4	31.2	26.0	23.5	21.8	35.0	41.6	56.1	66.9	74.8
Departure from normal	-0.51	-0.51	2.32	-6.76	0.46	4.62	0.41	3.94	-3.19	-0.44	1.08	4.17
Precipitation (inches)	3.50	3.87	6.32	2.38	1.29	2.63	1.19	2.79	2.09	2.35	1.86	3.94
Departure from normal	-0.41	0.21	2.76	-0.74	-1.06	0.63	-0.53	0.57	-0.72	-1.04	-1.77	-0.28
Growing Degree Days (base 32°F-95°F)	1125	840	571	128	67	37	48	193	315	746	1046	1326
Departure from normal	-15	-15	58	-122	-13	-12	-8	27	-99	-13	35	132

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 with good vigor, despite the cooler than average conditions in August, September, and November (Table 4). This may have been due to the unusually warm October, which saw 58 more GDDs than normal. Fall stand, winter survival, and bloom date did not vary significantly by variety. All varieties ranked at 5.25 or higher for stand on a 1-10 scale. MH 15HT227 and MH 16JD085 had the highest average stand rating at 8 out of 10. The trial average for winter survival was 46.5%, and the average bloom date 25-May. Winter survival was higher than 2019, but similar to other years. MH 16JD085 was the top performer for vigor, with an average rating of 4.75 on a 1-5 scale. MH 16JD085 was statistically similar to MH 16HIC231, Torrington, Plurax CL, Riley, MH 16JC076, MH 15HT227, and CWH317D.

Table 4. Pre-harvest characteristics for 15 winter canola varieties, 2019-2020.

Variety	Fall stand	Fall vigor	Winter survival	Bloom date
	1-10 rating§	1-5 rating§	%	Days after 1-Jan, 2020
CPX60019	5.50	3.5[cde†]	46.3	146
CWH189D	6.00	3.0[e]	60.0	146
CWH190D	5.25	3.25[de]	23.8	145
CWH249D	7.25	3.50[cde]	52.5	145
CWH317D	6.25	4.00[abcd]	66.3	143
KS4662	6.75	3.50[cde]	43.8	146
KS4719	6.50	3.75[bcde]	45.0	145
MH 15HT227	8.00	4.00[abcd]	47.5	146
MH 16HIC231	7.25	4.50[ab]	52.5	144
MH 16JC076	7.00	4.00[abcd]	43.8	146
MH 16JD085	8.00	4.75[a]	35.0	145
Plurax CL	6.75	4.25[abc]	45.0	144
Riley	6.75	4.25[abc]	38.8	144
Surefire	6.75	3.75[bcde]	52.5	146
Torrington	6.75	4.50[ab]	45.0	146
LSD (p= 0.10)‡	NS¥	0.867	NS	NS
Trial mean	6.72	3.90	46.5	145

†Treatments within a column with the same letter are statistically similar.

‡LSD- Least significant difference.

¥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: percent pod shatter and moisture (Table 5). Across all varieties, the average plant height was 117 cm and the average lodging was 1.27%, which is low in comparison to previous years. The varieties CWH317D, MH 16JC076, MH 16HIC231, MH 15HT227, Riley, KS4662, and MH 16JD085 all had no shattering at harvest. All varieties had 5% or less shattering within the plots except for CWH249D, which was significantly greater at 10% shattering. This variety did not bloom earlier than average. There was more bird damage on the tops of plants where birds had eaten seed pods where they could pull through the top of the bird netting. The average seed moisture content was 19.8%, and all varieties had to be dried down prior to storage. CWH249D had the lowest moisture content (15.4%) and was significantly lower than MH 15HT227 (29.1%) and CPX60019 (27.3%), but was similar to all other varieties.

The average yield for the trial at 8% moisture was 1256 lbs ac^{-1} (Table 5, Figure 1). In general, canola yields in this region range from 1000-2000 lbs ac^{-1}. CWH317D was the top performer, yielding 1892 lbs ac^{-1}, and was not statistically different than the other varieties. Test weights also did not vary statistically by variety. KS4662 produced seed with the highest test weight was at 49.7 lbs bu^{-1}. The trial average was 47.8 lbs bu^{-1} and all varieties performed below the industry standards of 50 lbs bu^{-1}. This may be due to the dry conditions during seed fill in June and July 2020. Oil content by variety ranged from 23.2% to 38%, with a trial average of 30.5% oil content, and was not statistically different between the varieties trialed. At 7.5% moisture, the average oil yield was 389 lbs ac^{-1} or 51.0 gal ac^{-1}.

Table 5. Harvest characteristics for 15 winter canola varieties, 2020.

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}
CPX60019	128	3.75	5.00^{b}	27.3^{b}†	881	47.4	27.2	259	33.9
CWH189D	119	0.25	5.00^{b}	16.3^{a}	1416	48.7	33.7	494	64.8
CWH190D	126	3.00	5.00^{b}	22.7^{ab}	1123	48.5	30.9	370	48.5
CWH249D	113	0.25	10.00^{c}	15.4^{a}	1703	49.1	32.2	550	72.1
CWH317D	119	1.50	0.00^{a}	21.8^{ab}	1892	48.4	28.3	536	70.2
KS4662	113	1.25	0.00^{a}	18.0^{a}	1205	49.7	28.3	418	54.7
KS4719	121	2.75	2.50^{b}	18.9^{a}	1326	48.0	28.0	368	48.1
MH 15HT227	113	1.75	0.00^{a}	29.1^{b}	1007	45.8	31.6	349	45.7
MH 16HIC231	118	0.00	0.00^{a}	18.7^{a}	1247	47.9	34.0	419	54.9
MH 16JC076	120	0.25	0.00^{a}	22.1^{ab}	1013	45.9	30.0	302	39.6
MH 16JD085	111	0.50	0.00^{a}	17.4^{a}	787	46.6	38.0	294	38.5
Plurax CL	110	1.50	5.00^{b}	19.0^{a}	1343	48.2	35.5	425	55.7
Riley	110	1.25	0.00^{a}	16.7^{a}	1232	45.9	23.2	328	42.9
Surefire	110	0.75	5.00^{b}	17.0^{a}	1239	47.7	25.5	284	37.2
Torrington	121	0.25	5.00^{b}	16.0^{a}	1430	48.8	30.8	442	57.9
LSD (p= 0.10) ‡	NS¥	NS	4.63	7.41	NS	NS	NS	NS	NS
Trial mean	117	1.27	2.83	19.8	1256	47.8	30.5	389	51.0

†Treatments within a column with the same letter are statistically similar.
‡LSD- Least significant difference.
¥NS- Not significant.

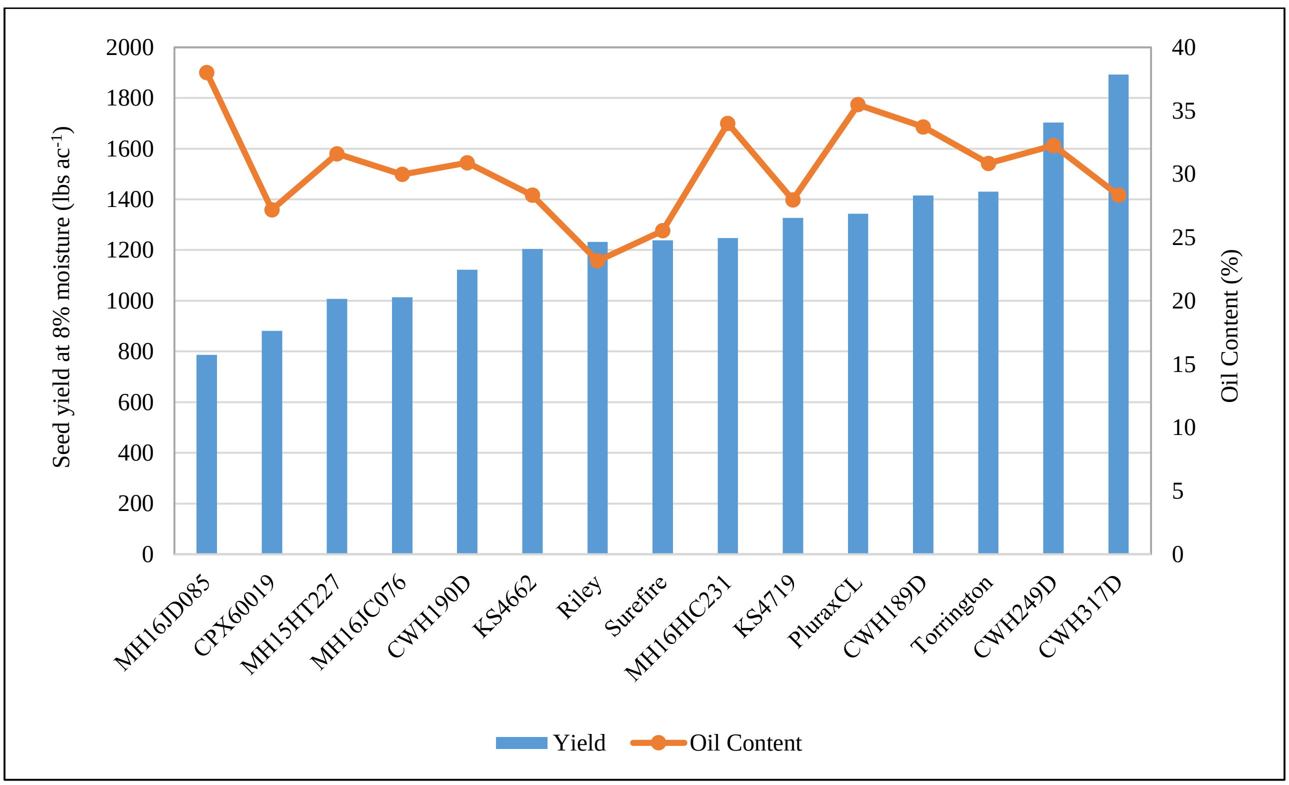

Figure 1. Seed yields at 8% moisture by variety, Alburgh VT, 2020.

DISCUSSION

Despite a range of variations in weather patterns- cooler than average temperatures in much of the fall, a warm winter and 2.38" less precipitation over the season than normal- all canola varieties successfully overwintered and produced seed in the summer of 2020. All varieties except for CPX60019 and MH 16JD085 produced over 1000 lbs ac^{-1} at 8% moisture. While no varieties met the standard test weight of 50 lbs bu^{-1}, many were close with a trial average of 47.8 lbs bu^{-1}. 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. 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. 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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