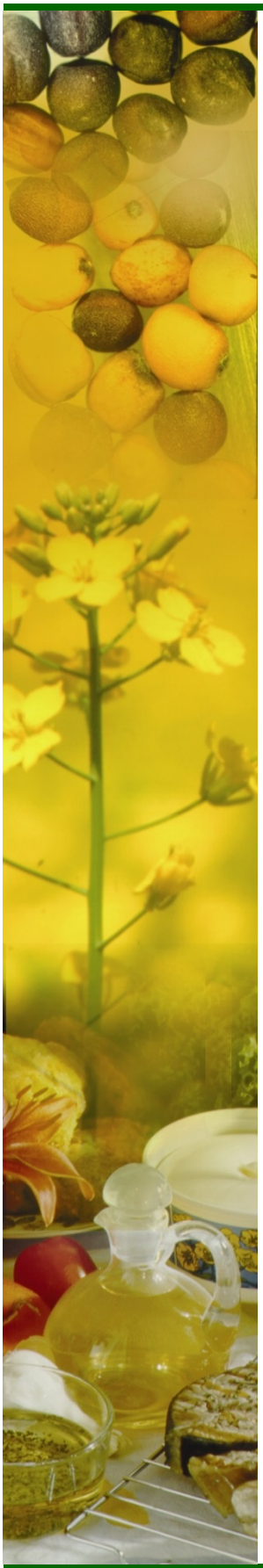

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Quality of western Canadian Canola 2019

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Canada

Quality Service

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Acknowledgments

The Grain Research Laboratory acknowledges the cooperation of the canola producers, grain handling offices, and oilseed crushing plants in western Canada for supplying the samples of newly harvested canola. The assistance of the Industry Services Division of the Canadian Grain Commission in grading producer samples is also acknowledged. The technical assistance of the Oilseeds staff, Grain Research Laboratory is recognized. Thanks to Multi-media services for their assistance in drawing the new map to reflect the new production reporting areas.

Note: Samples for the Canadian Grain Commission's canola harvest sample program were collected from producers, crushing plants and grain handling offices across western Canada. The samples were cleaned to remove dockage prior to grading and testing. Industry Services grain inspectors assigned grade level based on the Official Grain Grading Guide for Canola and Rapeseed (Chapter 10) which can be found at http://www.grainscanada.gc.ca/oggg-gocg/ggg-gcg-eng.htm . Individual harvest samples were analyzed for oil, protein, chlorophyll and total glucosinolates using a NIRSystems 6500 scanning near-infrared spectrometer. This report is based on the analyses by references methods of composite samples made of same grade samples per crop district and province. Composites were prepared by combining Canola, No. 1 Canada samples by provincial crop district; Canola, No. 2 by province, and Canola, No. 3 Canola and Canola Sample Canada samples by western Canada.

Seed oil, protein and glucosinolates contents are reported on an 8.5% moisture basis. Meal protein content is reported on a 12% moisture basis whereas meal glucosinolates content is reported on dry basis.

Crop district canola quality data for Manitoba and Alberta and census area quality data for Saskatchewan can be found on the Canadian Grain Commission Website under in the research and data webpage: https://grainscanada.gc.ca/en/grain-research/export-quality/oilseeds/canola/.

Canola variety data are also published yearly and can be found under the same directory: https://grainscanada.gc.ca/en/grain-research/export-quality/oilseeds/canola/.

Introduction

This report presents quality data and information based on the Canadian Grain Commission's 2019 harvest sample program of western Canadian canola. Quality parameters included are oil, protein, chlorophyll, glucosinolates, free fatty acids and the fatty acid composition of harvest samples. Quality data are from analyses of canola samples submitted to the Canadian Grain Commission throughout the harvest period by producers, grain companies and oilseed crushing companies. The map (Figure 1) shows traditional growing areas for canola in western Canada with 2017 and 2018 production data. Samples received from the Peace River area of British Columbia were combined with Alberta crop district No. 7 samples. Averages of these samples will be referred to as Alberta-Peace River.

In 2018, Statistics Canada changed the production reporting data, they used Census Agricultural Regions (CAR) instead of Small Area Data (SAD) corresponding the Crop Districts for the 2017 Canadian canola production. In Saskatchewan, the new CARs do not correspond to the Crop Districts, while all our historic data are based on Crop Districts. This year report reflects Statistics Canada changes.

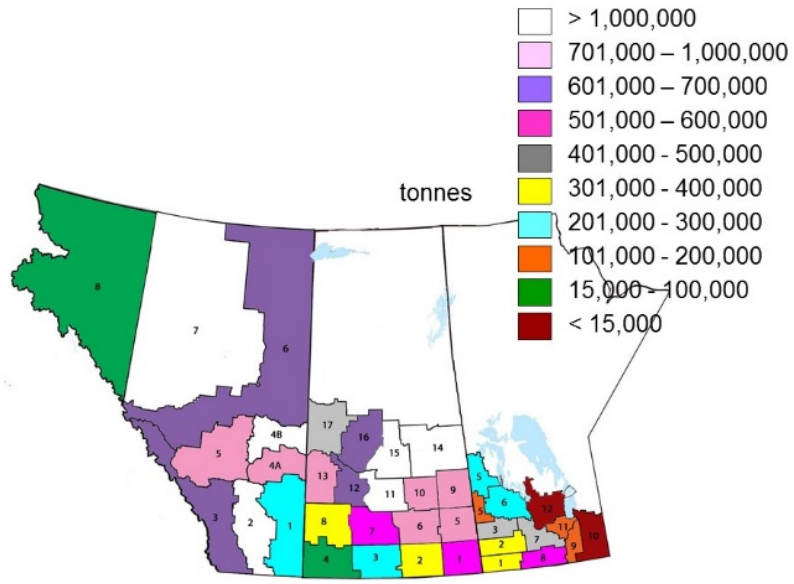
Summary

The 2019 harvest showed a higher percentage of samples graded Canola, No. 1 Canada (85.1%) than the 2018 harvest (74.4%) but lower than the 5-year average (87.3%) (Figure 4). Alberta-Peace River area showed the lowest percent of samples graded Canola, No. 1 Canada (75.6%) when compare to Manitoba (97.0%) and Saskatchewan (88.2%) (Figure 4). The crop district 7 of Alberta-Peace River (northwest section of the province) showed the lowest percent of samples graded Canola, No. 1 Canada (59.2%), slightly lower than what was observed in crop district 3 of Alberta (61.2%).

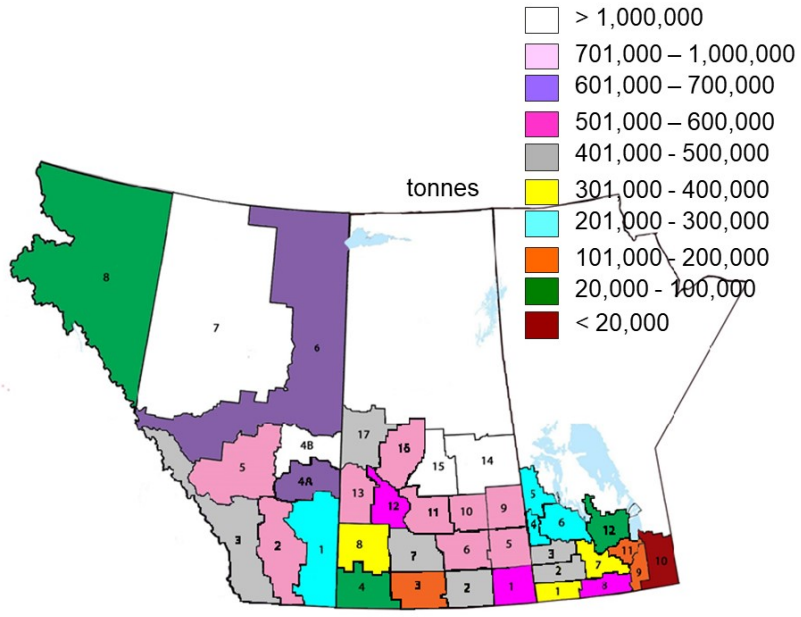
The 2019 western Canadian canola (Canola, No.1 Canada) crop was characterized by an oil content average higher than what was observed for the 2018 crop (44.6% in 2019 versus 44.1% in 2018) and a lower protein content average (20.4% in 2019 versus 21.1% in 2018) for samples graded Canola, No.1 Canada (Table 1). The chlorophyll content average for Canola, No.1 Canada samples was higher in 2019 than in 2018 (12 versus 10 mg/kg, respectively) (Table 1) with some areas in Alberta-Peace River showing averages higher than 20 mg/kg (Table 3). Total seed glucosinolate averages were very similar to last year (9 μmol/g in 2019 versus 10 μmol/g in 2018 and for the 5-year average).

The oleic acid content average of the 2019 canola crop is much lower than what was observed in 2018 (62.43% versus 64.3%) or for the 5 year-average (63.1%). This was accompanied with a sharp increase in α-linolenic acid content (10.0% in 2019 versus 8.7% in 2018) whereas linoleic acid content increased slightly (18.7% in 2019 and 18.3% in 2018) when compared to the 2018 crop. Total saturated fatty acid content for the 2019 canola crop was similar to what was observed in 2018 (6.6% versus 6.7%). This resulted in a very different iodine value for the 2019 canola crop when compared to the 2018 canola crop, 113.7 units in 2019 versus 111.0 units for 2018).

Figure 1 – Maps of western Canada showing 2017 and 2018 canola production per Crop Districts and Agricultural Census Regions



2017 production



2018 production

Note: Since 2017, Saskatchewan canola production data are reported by Agricultural Census Area instead of Crop district, there are now 17 Agricultural Census Area instead of 20 Crop Districts.

Table 1 – Canola, No. 1 Canada: Quality data for 2019 and 2018 harvests plus the 5-year means

Quality parameter	2019	2018	2014-18 Mean
Number of received samples	2320	2505	2151
Number of Canola, No. 1 Canada samples	1936	1874	1880
Percent of samples graded Canola, No. 1 Canada	85.1	74.4	87.3
Oil content[1] (%, 8.5% moisture)	44.6	44.1	44.4
Protein content[1] (%, 8.5% moisture)	20.4	21.1	20.4
Oil-free protein of the meal[1] (%, 12% moisture)	38.3	39.1	38.1
Chlorophyll content (mg/kg in seed)	12	10	12
Total seed glucosinolates (μmol/g, 8.5% moisture)	9	10	10
Oil-free total glucosinolates of the meal (μmol/g, 8.5% moisture)	18	22	22
Free fatty acids (%)	0.16	0.15	0.17
Oleic acid (% in oil)	62.4	64.3	63.1
Linoleic acid (% in oil)	18.7	18.3	18.7
α-Linolenic acid (% in oil)	10.0	8.7	9.3
Erucic acid (% in oil)	0.00	0.00	0.01
Total saturated fatty acids[2] (% in oil)	6.6	6.7	6.7
Iodine value	113.7	111.0	112.5
Total mono-unsaturated fatty acids (MUFA)[3] (% in oil)	64.0	65.8	64.7
Total poly-unsaturated fatty acids (PUFA)[4] (% in oil)	28.8	27.0	28.1

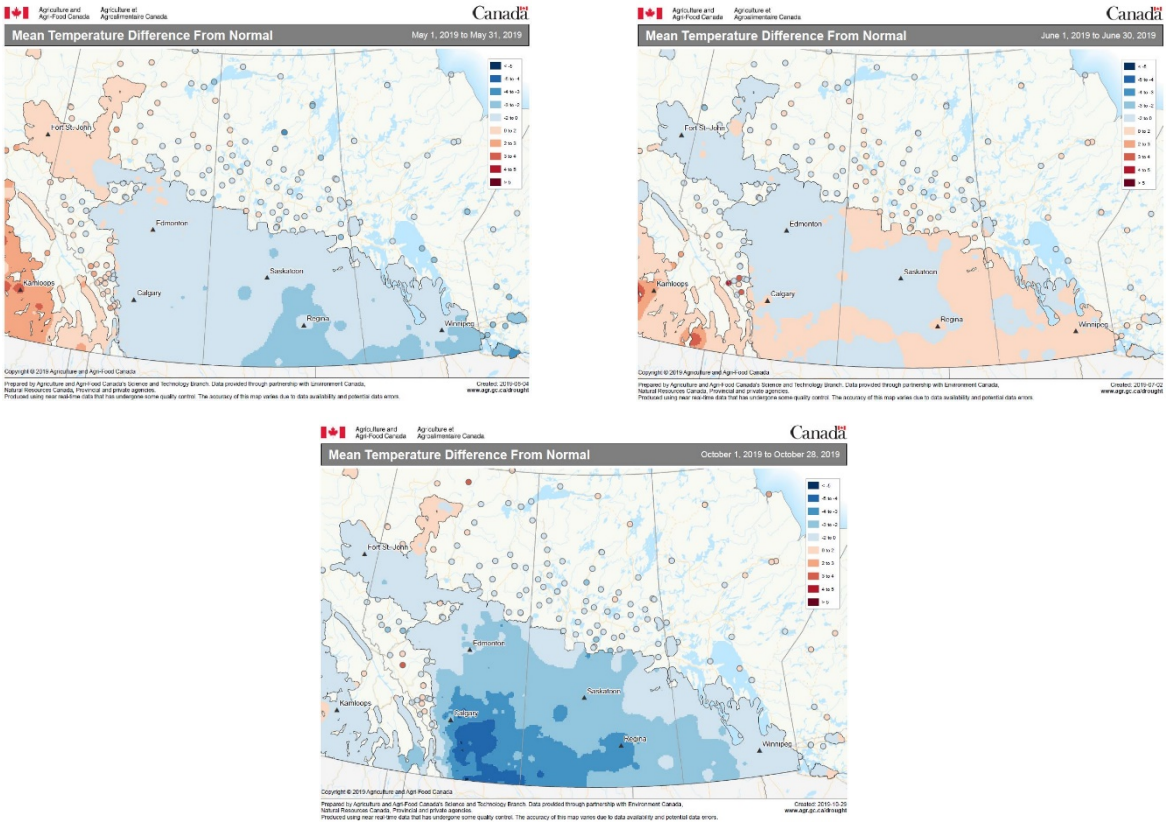
[1] Protein content calculated from nitrogen content using N x 6.25
[2] Total saturated fatty acids are the sum of palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0), and lignoceric (C24:0).
[3] Total mono-unsaturated fatty acids are the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1), and nervonic (C24:1) acids.
[4] Total poly-unsaturated fatty acids are the sum of linoleic (C18:2), linolenic (C18:3) and eicosadienoic (C20:2) acids.

Mean free fatty acids average levels in 2019 Canola (0.16%), No.1 Canada seed was similar to what was observed in 2018 (0.15%) (Table 1), with some Manitoba crop district averages higher than 0.3% due to the wet September harvest (Table 4).

Weather and production review

Weather review and effects on seeding and harvest

Figure 2a – Maps - Monthly mean temperature difference from normal in Canada (Prairies) during the 2019 growing season (May, June and October 2019).

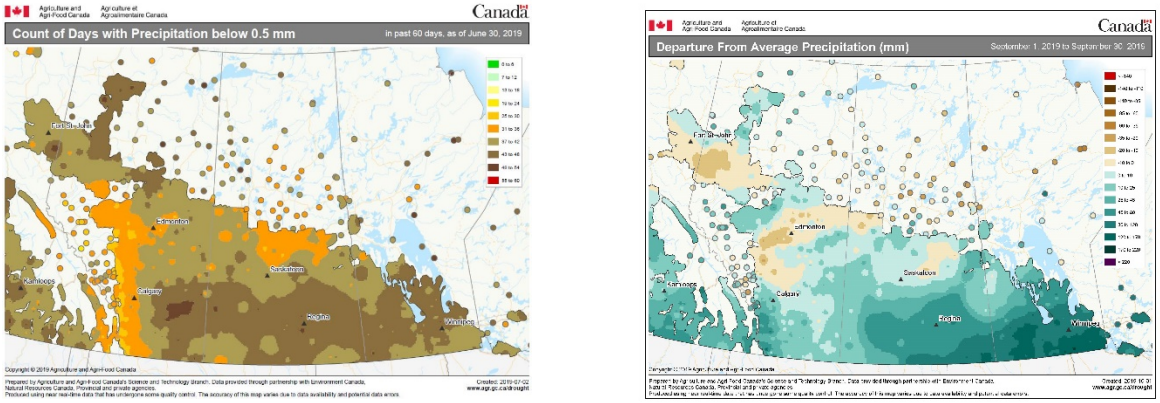


The weather review and weather maps (Figures 2a and 2b) were obtained from Agriculture and Agri-Food Canada (http://www.agr.gc.ca/DW-GS/current-actuelles.jspx?lang=eng&jsEnabled=true) and http://www.agr.gc.ca/atlas/maps_cartes/canadianDroughtMonitor/monthlyAssessments/en/. Seeding and harvest progress for each provinces are presented in Figure 3. These graphs were made using data reported by the provincial reports that could be find at https://www.gov.mb.ca/agriculture/crops/seasonal-reports/crop-report-archive/index.html for Manitoba, http://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/market-and-trade-statistics/crops-statistics/crop-

report/2017-previous-weeks-crop-reports for Saskatchewan and
http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/All/sdd4191 for Alberta.

Seeding conditions: In the prairies, April temperatures were near normal, between 2°C lower and 2°C higher than normal; however, seeding started about one week later than last year in Manitoba and Alberta. In May, the overall temperatures were on average 3 to 4°C colder than normal (Figure 2a). Seeding started early May and progressed steadily, by the end of May and the first week of June, seeding was completed in the three provinces (Figure 3). May and June temperatures were cooler than normal (Figure 2a), and moisture was also an issue with some areas receiving well below normal precipitations (Figure 2b). By the end of May, the Canadian drought conditions showed abnormally dry areas in most of the prairies with non-negligible areas in Saskatchewan and Alberta showing severe drought conditions (Figure 2c). Cooler temperatures and lack of moisture led to a delayed canola seed germination. Finally, some timely rains allowed seeds to germinate, however germination was patchy in lots of fields leading to uneven fields.

Figure 2b – Maps – Precipitation during the 2019 growing season – days with precipitation below 0.5 mm (May to June 2019) and departure from average in September 2019.

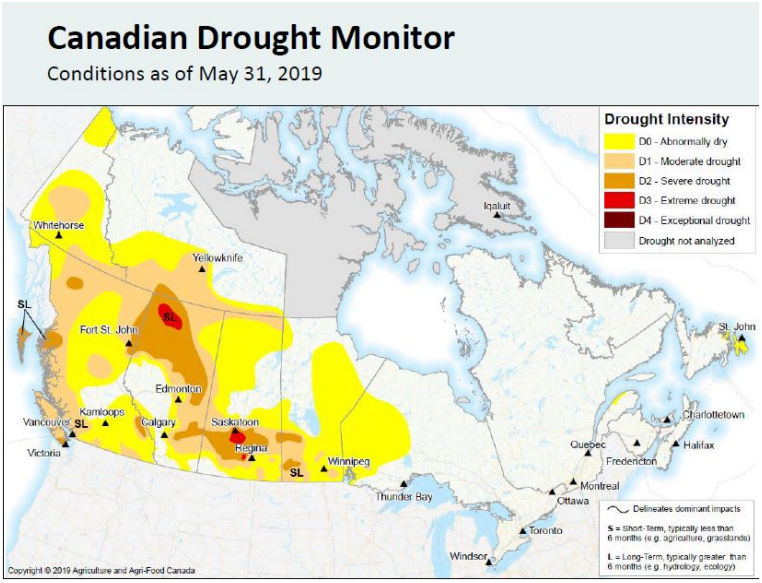


Source: http://www4.agr.gc.ca/DW-GS/historical-historiques.jspx?lang=eng&jsEnabled=true

Growing season Cooler than normal temperatures (average 2 to 3°C lower) persisted during summer for most of the three provinces. In general, crops were one two weeks behind for most growing season due to the delayed germination in the three provinces. In Manitoba, during June the days were quite warm with temperatures reaching over 30°C, however nights were quite cool with overnight low in the single digit range. Above normal precipitations were the norm for the summer months in the prairies (Figure 2b). However, these precipitations were uneven. In Manitoba, rainfalls were generally localized with severe thunderstorms resulting in surface runoff and standing water in some areas. Early August, Manitoba saw some higher than normal temperatures with minimal rainfalls, but that changed drastically by the end of the month. In Saskatchewan, the eastern part of the province experienced high moisture conditions whereas the south and the eastern areas of Alberta were quite

dry with the rest of the province, especially the north and the Peace River areas, had too much moisture. During most of the growing season, the reported main causes of crop damages were either localized flooding due too much moisture or lack of moisture and high winds and hail.

Figure 2c – Maps – Canadian drought conditions as of May 31st, 2019



<u>Harvesting conditions</u>: Harvest started end of August this year as the 2019 canola crop was one to two weeks behind in development for the time of the year (Figure 3). In September, frequent rainfalls (Figure 2b) and cooler than normal temperatures delayed harvest greatly. By mid-September, barely 10% of the canola crop was harvest compared to over 40% last year at the same time of the year. The first snow fall occurred in Alberta and part of Saskatchewan the last week of September, it was followed by a killer frost couples of days later (Figure 3). Thanksgiving week saw a significant snow fall in Manitoba, stopping all harvest activities. Couples of days of warm weather melted the snow and helped Manitoba producers to get back into the fields where harvest activity resumed at a frantic pace to finish harvest. By the end of October, canola harvest was considered over with about 90% of the 2019 canola crop harvested.

Rain and the cool weather pushed the Saskatchewan canola harvest well in November. The last Saskatchewan crop report (November 18, 2019) indicated that overall 91% of the canola crop was harvested; however 19% of the crop in the east-central region of the province was still in the fields.

The 2019 Alberta canola harvest was slower than the 2018 one until mid-October as too much rain and cool temperatures resulted in multiple harvest stops for Alberta producers. The final Alberta crop

report stated that overall only 84.5% of the 2019 canola crop has been harvested as of December 3rd, 2019; about 34% and 20% of the seeded canola in the Peace River and the North-East areas of the province were still in the fields. Canola seeds were harvest wet or tough by a lot of producers; grains had to be dried before they were binned. This likely will affect the overall quality of the crop as the shipping season progresses.

There are still a lot of canola in the fields at the moment. These fields will have to be harvested in the spring 2020 and a similar situation as spring 2017 might occur with some spring canola seeds grading Canada, No. 1 Canola being commingled with the 2019 autumn harvest and either exported or crushed within Canada.

Production

In 2019, it is estimated that canola producers seeded 8,480.6 thousand hectares of canola, about 8% less than in 2018 (9,232.2 thousand hectares), only about 1.7% less than the 5-year average (Table 2). This year, it is estimated that 161.4 thousand hectares were not harvested compared to 112.5 thousand hectares in 2018. Statistics Canada reported that the 2019 western Canada average yield was 2,242 kg/hec, slightly higher than what was observed in 2018 (2,231 kg/hec) and for the 5-year yield average (2,208 kg/hec). In 2019, the highest yield average was observed in Manitoba at 2,354 kg/hec (2,427 Kg/hec in 2018), followed by British Columbia (2,331 kg/hec in 2019 versus 2,281 kg/hec in 2018) and Alberta (2,259 kg/hec in 2019 versus 2,172 kg/hec in 2018). This year, the lowest yield was found in Saskatchewan at 2,200 kg/hec (2,205 Kg/hec in 2018). As of January 2020, Statistics Canada reported that the estimated 2019 Canadian production was 18.682 million metric tonnes (MT) about 1.7 MT less than last year production and about 2.5 MT less than the record production observed in 2017 (21.328 MT) but similar to the 5-year average production (18.682 MT). In 2019, the provincial production for Manitoba, Saskatchewan, Alberta and British Columbia accounted for 16.4, 54.3, 28.5 and 0.4% (16.3, 53.7, 28.9 and 0.4% in 2018) of the total canola production in Canada, respectively (Table 2).

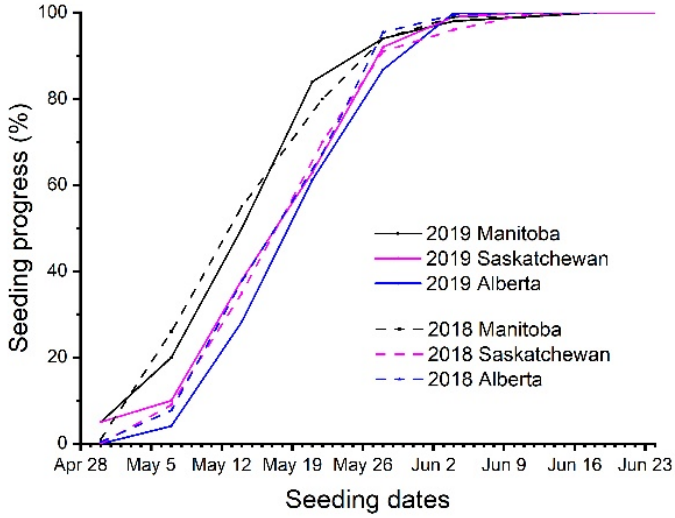
Table 2 - Seeded area and production for western Canadian canola

	Seeded area			Harvested area			Production[1]		
	thousand hectares			thousand hectares			thousand tonnes		
	2019	2018	2014-18	2019	2018	2014-18	2019	2018	2014-18
Manitoba	1,338.6	1,382.4	1,308.4	1,298.5	1,367.5	1,292.9	3,056.3	3,318.4	2,888.5
Saskatchewan	4,674.1	4,997.9	4,713.0	4,604.2	4,955.0	4,682.1	10,130.5	10,927.1	10,059.8
Alberta	2,401.2	2,755.9	2668.6	2,355.6	2,703.0	2,634.4	5,320.1	5,870.6	6,100.6
British Columbia	34.7	55.4	53.2	30.9	54.3	41.9	72.0	123.9	87.0

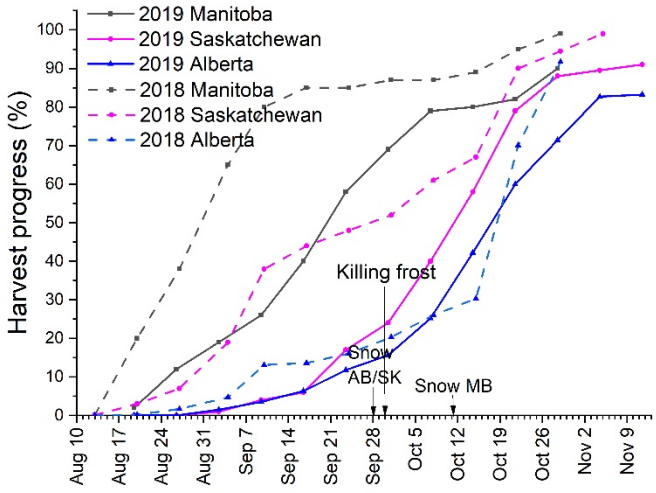
Canada	**8,480.6**	**9,232.2**	**8,628.1**	**8.319.2**	**9,119.7**	**8,534.9**	**18,648.8**	**20,342.5**	**18,682.1**

[1] For all production data please consult Statistics Canada. Table 32-10-0359-01 Estimated areas, yield, production, average farm price and total farm value of principal field crops, in metric and imperial units at:
https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3210035901
DOI: https://doi.org/10.25318/3210035901-eng

Figure 3 – Seeding and harvest progress in Manitoba, Saskatchewan and Alberta for the 2018 and 2019 growing seasons



Seeding progress: 2018 and 2019



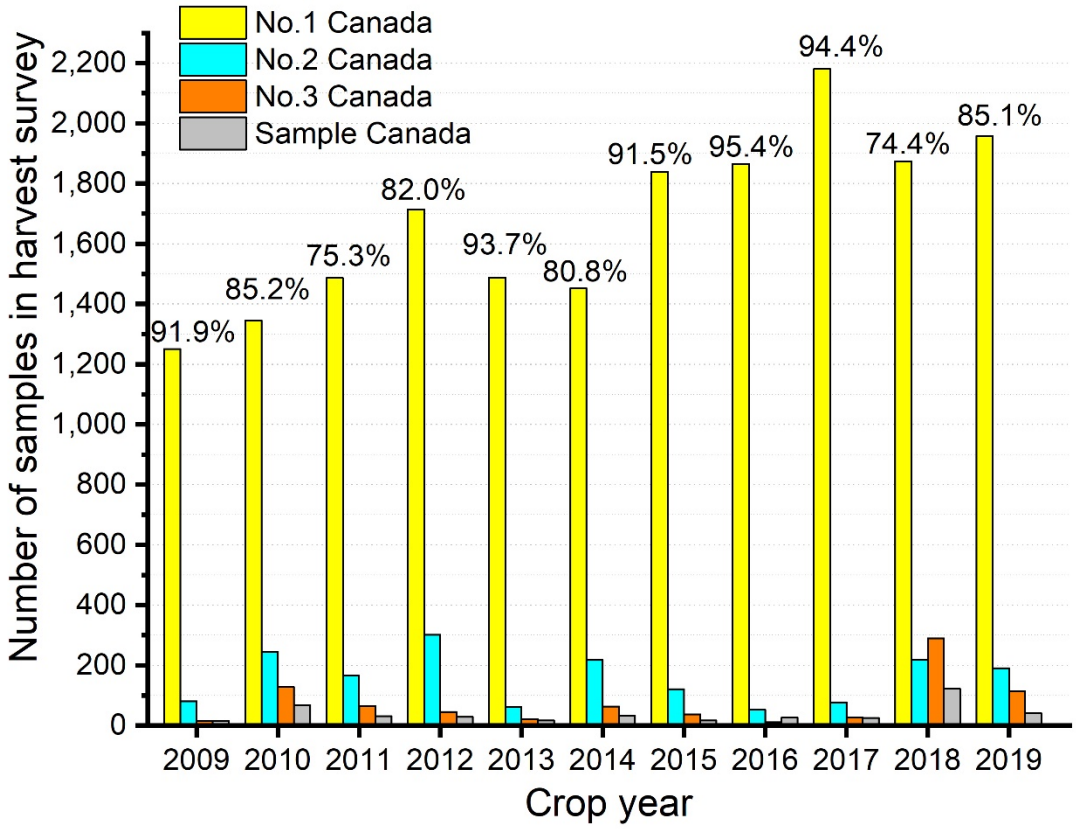
Harvest progress: 2018 and 2019

Harvest sample program samples and grade distribution

This report of quality data for the 2019 harvest is based on analyses of 2,320 individual canola samples. Composites of Canola, No.1 Canada from each crop districts from each province were made using these samples. Specialty oil samples, such as high oleic acid, low linolenic acid, and high erucic acid, were excluded from this report. In 2019, we received about 200 less samples than in 2018 and about 170 more samples than the 5-year average (Table 1). Crop district composites of Canola, No.1 Canada samples were prepared using 1,936 samples.

Exports of commercially cleaned canola exports (from August 2019 to December 2019) contained on average 1.83% dockage, ranging from 0.60 to 2.5%, which affects quality factors such as oil content, chlorophyll and free fatty acid (https://www.grainscanada.gc.ca/canola/export-exportation/ceqd-dqec-eng.htm). Canola exports containing over 2.5% dockage are considered not commercially clean (NCC) and usually have even greater reductions in measured quality components. The composition of samples received in 2019 and 2018 was compared and 5-year average data are presented in the report (Table 1). Comparison with the quality of Canadian canola export shipments is provided in Table 6.

Figure 4 – Canola samples received in harvest sample program and the historical grade distribution, 2009-2019



In 2019, only 85.1% of the samples were graded Canola, No. 1 Canada, compared to 74.4% in 2018 and 87.3% for the 5-year average (Figure 4). Since 2009, this is the 4th lowest percent of samples graded Canola, No. 1 Canada, the worse average was obtained last year (74.4%) followed by the 2011 average (75.3%) and the 2012 average (82.0%). The grade distribution of the 2019 canola crop varied greatly between provinces and between crop districts within a province. This year again, the lowest percent of samples graded Canola, No. 1 Canada was found in Alberta-Peace River where only 75.1% (52.1% in 2018) of the samples were graded Canola, No. 1 Canada, versus 88.2% in Saskatchewan and 97.0% in Manitoba. The area with the most damaged canola samples was the north-west part of Alberta-Peace River, only 59.2% (14.5% in 2018) of the samples from crop district 7 from Alberta-Peace River were graded Canola, No. 1 Canada followed by Alberta crop district 3 (61.2% in 2019 versus 70.7% in 2018). The main damage was distinctly green seed count (DGR) and admixture. Overall, DGR were 0.39% (0.36% in 2018) in Canola, No. 1 Canada, 3.13% (4.04% in 2018) in Canola, No. 2 Canada, 10.23% (12.01% in 2018) in Canola, No. 3 Canada and 8.52% (32.95% in 2018) in Sample.

Quality of western Canadian canola 2019

Tables 3 to 5 show detailed information on the quality of western Canadian canola harvested in 2019 whereas Table 6 compares the quality of the harvest to the quality of recent canola exports. It is important to note that the numbers of samples in each grade or province may not be representative of the total production or grade distribution. However, there were sufficient samples to provide good quality information for each province and each grade. Provincial and western Canadian averages were calculated from results for each crop district, weighted by a combination of production by crop district using a 5-year average production (Statistics Canada production estimate) combined with an estimate of grade distribution per crop district.

All oil and protein content values discussed below are presented using the Canadian Grain Commission's historical 8.5% moisture basis in order to permit annual and regional comparisons. Protein content of the oil-free meal is presented at 12% moisture whereas the glucosinolate content of the oil-free meal is reported on dry basis to reflect meal-trading rules established by the Canadian Oilseed Processors Association (COPA).

Exports of commercially cleaned canola contained up to 2.5% dockage, which will affect quality factors such as oil content, chlorophyll and free fatty acids. Canola exports containing over 2.5% dockage are considered not commercially clean (NCC) and will have even greater reductions in measured quality components.

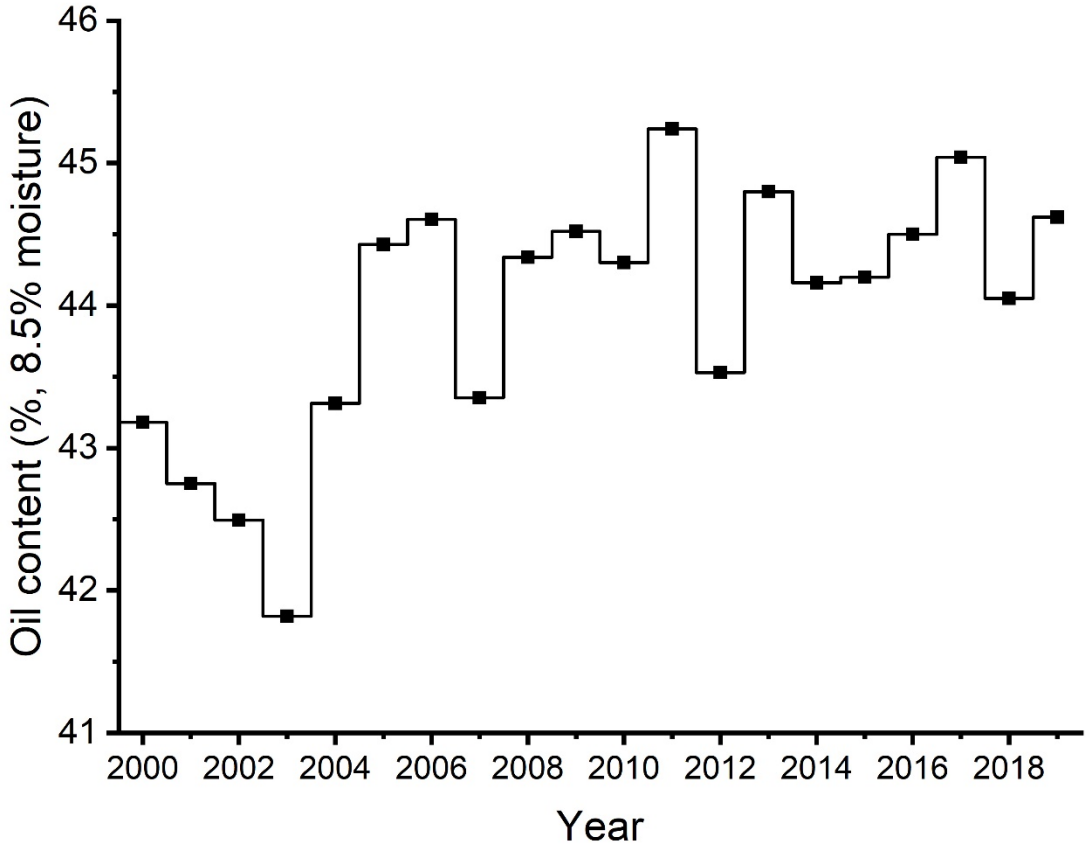
Oil content

For Canola, No.1 Canada, the 2019 oil content was 44.6 %, significantly higher than the 2018 average (44.1%) (Table 1). This 2019 average is slightly higher than the 5-year average (2014-2018) of 44.4% (Table 1, Figure 5).

This year, samples from Saskatchewan graded Canola No. 1, Canada showed the highest oil content average at 45.1%, followed by samples from Alberta-Peace River (44.2%) and Manitoba (43.9%) (Table 3). The oil content of individual Canola, No.1 Canada samples harvested in 2019 by producers across western Canada ranged from 38.3 to 50.8% in Manitoba, 36.0 to 51.0% in Saskatchewan and 37.0 to 51.9% in Alberta-Peace River (Table 3).

Oil content for Canola, No. 2 Canada (44.4%) was slightly lower than for Canola, No. 1 Canada (44.6%). Oil content for Canola, No. 2 Canada samples from western Canada ranged from 38.5 to 50.6% (Table 3). This year the oil content averages for Canola, No. 3 Canada and Sample grade are 44.7% and 43.7%, respectively.

Figure 5 – Canola, No. 1 Canada - harvest samples, 2000–2019
Oil content of the seed (%, at 8.5% moisture)



Oil content is influenced by both genetics and environment. For any known canola variety, hot and dry growing conditions will give canola seed with lower oil content when compared to cool growing conditions. The overall cooler growing conditions in 2019 compared to the very dry and hot conditions observed during the 2018 growing seasons (especially in the southern part of Alberta-Peace River) are responsible this year for the noticeable higher oil content averages observed this year compared to the 2018 averages. This year again, the southern part of Alberta-Peace River showed the lowest oil content averages, 42.1 and 43% in crop districts No.1 and No. 2, respectively. Samples graded Canola, No.1 Canada from crop districts 7 to 11 in Manitoba also showed lower oil content averages than the Canadian average, 41.5 to 43.2%.

The oil content mean of commercially clean canola exports of Canola, No.1 Canada was 43.8% for the December 2019 exports. They averaged 43.7% for the August-November 2019 exports (Table 6). The oil content for last year's shipping season for commercially clean cargoes of canola averaged 43.3% and 43.2% for the non-commercially clean exports.

When compared to oil content of the harvest samples, the commercially clean and the non-commercially clean exports of Canola, No.1 Canada had lower oil content averages due to the dilution from the dockage. Harvest samples are completely cleaned (0.00% dockage) whereas the dockage

averages for the Commercially Clean up to December 2019 exports were 1.83%. Last shipping season, dockage for the commercially clean exports averaged 1.73% (Table 6).

It is expected that the mean oil content of Canadian exports for the 2019-20 shipping season will be higher than for last shipping season, in the 43.5% range.

Protein content

Crude protein content averages were 20.4% for both Canola, No.1 Canada and Canola, No. 2 Canada and 20.5% for Canola, No. 3 Canada. Average protein seed content observed for Canola, No.1 Canada in 2019 was lower than the one observed in 2018 (21.1%). This 2019 average is identical to the 5-year average (20.4%) (Table 1, Figure 6). Protein content of individual producer samples ranged from 14.4 to 27.8% for Canola, No. 1 Canada samples and from 15.8 to 26.8% for Canola, No. 2 Canada samples (Table 3). The protein contents of samples graded Canola, No. 3 Canada and Canola, Sample Canada ranged from 15.7 to 24.5% and 17.0 to 24.6%, averaging 20.5 and 20.10%, respectively.

Seed protein averages of Canola, No. 1 Canada commercially clean exports were 20.5% in December 2019 and 20.7% in the August-November 2019 exports (Table 6). Protein content averages for the actual shipping season are lower than what was observed for last shipping season (21.0% for August-July 2018), reflecting the 2019 harvest canola protein content.

Figure 6 – Canola, No. 1 Canada - harvest samples, 2000–2019
Protein content of the seed (%, at 8.5% moisture)

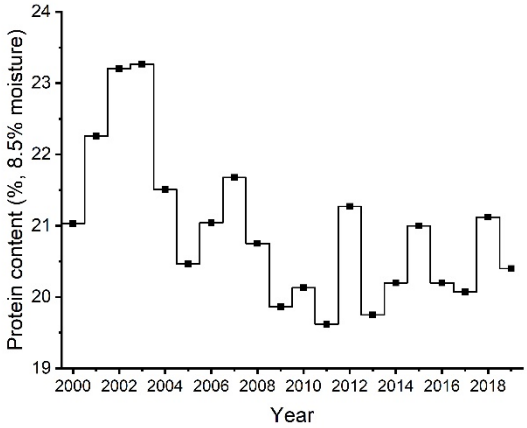
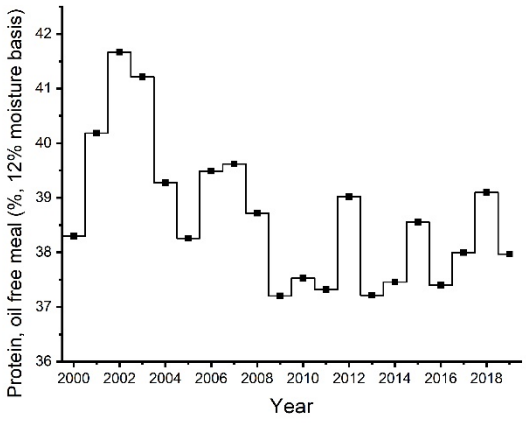


Figure 7 – Canola, No. 1 Canada - harvest samples, 2000–2019
Protein content of the meal (%, at 12% moisture)



The protein content calculated to an oil-free meal at 12% moisture basis was 37.9% in 2019, which is significantly lower than what was observed in 2018 (39.1%) and slightly higher than the 5-year average (38.1%) (Table 1, Figure 7). The calculated protein content of the oil-free meal (100% defatted at 12% moisture) was much higher for samples from Manitoba (39.7%) than Alberta-Peace River

(38.1%) and Saskatchewan (38.1%). Trading rules for the North American sale of canola meal requires that calculations for protein claims must be reported on a 12% moisture basis. . It is to be understood that the reported value is the maximum meal protein content that could be obtained when a crushing plant is able to extract 100% of the oil from the seeds.

Commercially clean exports of Canola, No. 1 Canada, had a calculated meal protein content average for the oil-free meal of 38.3% (12.0% moisture) in December 2019. The meal protein content average for the August-November 2019 exports was 38.0% (12% moisture). These results are similar to what was observed during last shipping season, the average being 38.0% (12% moisture) for commercially clean exports of Canola, No. 1 from August 2018 to July 2019 (Table 6).

It is expected that the meal protein content of Canadian exports will be in the 20% range.

Chlorophyll content

Chlorophyll content averages of producer samples graded Canola, No. 1 Canada were 5, 11, and 17 mg/kg in Manitoba, Saskatchewan and Alberta-Peace River, respectively (Table 3). The overall average for Canola, No. 1 Canada was 12 mg/kg, higher than what was observed for the 2018 harvest (10 mg/kg) (Figure 8). This is identical to the calculated 5-year average (12 mg/kg). However, individual producer samples of Canola, No. 1 Canada showed wide variations due to the very variable growing conditions. Chlorophyll contents of samples graded Canola, No. 1. Canada from Manitoba ranged 3 to 53 mg/kg, the ones from Saskatchewan 3 to 52 mg/kg and the ones from Alberta ranged from 3 to 56 mg/kg (Table 3). Chlorophyll content means vary greatly from year to year (Figure 8) due to environmental conditions. Once again, this year, location had an important effect on chlorophyll contents measured in the canola samples. Samples graded Canola, No.1 Canada from crop districts 3,4, 5. 6 and 7 from Alberta-Peace River had chlorophyll content averages significantly higher than samples from Saskatchewan and Manitoba and other crop districts from Alberta-Peace River

Chlorophyll levels (Table 3) for Canola, No. 2 Canada samples averaged 38 mg/kg which is much lower than what was observed for the 2018 harvest (43 mg/kg). Samples graded Canola, No. 3 Canada and Sample had an average chlorophyll content of 76 and 63 mg/Kg, much lower that what was observed in 2018 (101 and 201 mg/kg, respectively).

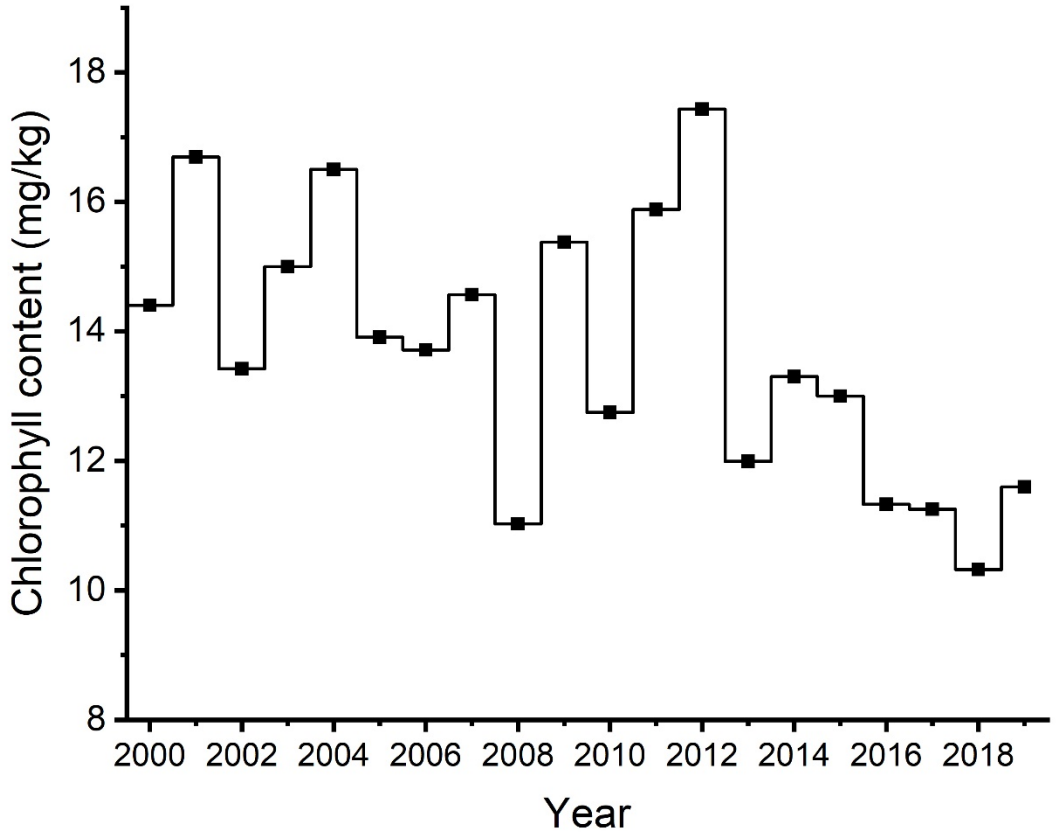
To be graded Canola, No. 1 Canada, samples must contain no more than 2.00% distinctly green seeds (DGR). DGR averages were 0.28% (0.31% in 2018), 0.35% (0.32% in 2018) and 0.57% (0.48% in 2018) in Manitoba, Saskatchewan and Alberta-Peace River, respectively for samples graded Canola, No. 1 Canada.

The chlorophyll content of Canadian canola exports is affected by DGR and dockage content (1.66 and 1.40% for December and August-November 2019 exports, respectively, no more than 2.5% dockage for commercially clean exports).

It is expected that chlorophyll data for the 2019-20 exports will be similar to what was observed in for the 2018-19 shipping season due to (1) slightly higher chlorophyll content in the individual Canola, No. 1 Canada samples compared to last year crop and (2) the high percent of samples of lower grades that have to be commercialized and will likely be blended with top grade samples, the blended

samples still fitting Canola, No. 1 Canada specifications (no more than 2.0% green seeds, 0.1% heated seeds) as defined by the Official Grain Grading Guide (https://grainscanada.gc.ca/oggg-gocg/10/oggg-gocg-10d-eng.htm).

Figure 8 – Canola, No. 1 Canada - harvest samples, 2000–2019
Chlorophyll content of the seed (mg/Kg, as is moisture content)



Glucosinolate content

The 2019 total glucosinolate content of the seeds (Figure 9) averaged 9 μmol/g, similar to what was observed in 2018 and 2017 (10 μmol/g). Since 2009, total glucosinolate content averages remained in the 10 μmoles/gram range (Table 1, Figure 9). There was no real difference in total glucosinolates content between various crop districts or provinces. This is a direct result of breeding efforts from various breeding programs to maintain low glucosinolate contents and linked to the Canadian canola registration program (Western Canadian Canola Rapeseed Registration Committee).

The average level of total seed glucosinolates for the December 2019 commercially clean canola exports was 10 μmol/g of seed, similar to what was observed in the 2019 harvest survey (Table 6).

Glucosinolate contents of canola exports for the 2019-20 shipping season will remain similar to the averages observed during the 2018-19 shipping season (Table 6).

Figure 9 – Canola, No. 1 Canada - harvest samples, 2000–2019
Total glucosinolate content of the seed (µmol/g seed, at 8.5% moisture)

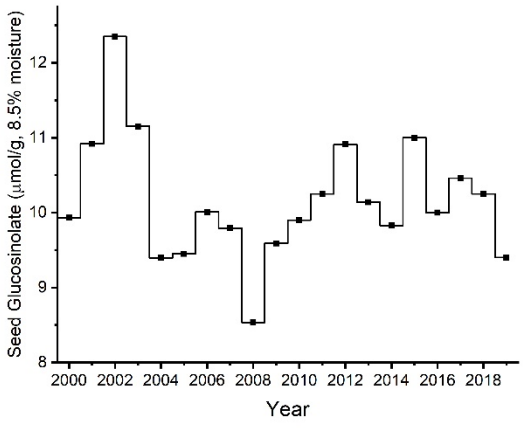
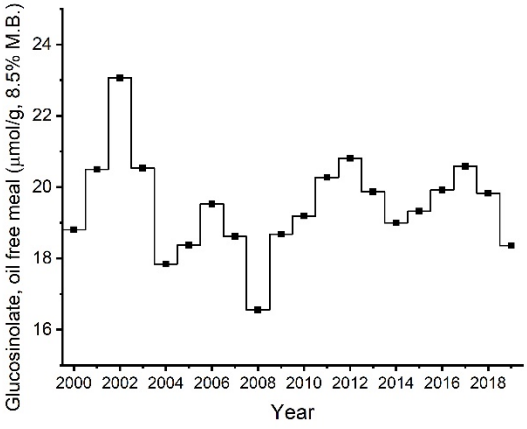


Figure 10 – Canola, No. 1 Canada - harvest samples, 2000–2019
Total glucosinolate content of oil-free meal (µmol/g seed, 8.5% moisture)



In 2019, 9 µmoles/gram of total glucosinolates in the seed corresponded to 18 µmoles/gram in oil-free meal on at 8.5% moisture basis, slightly lower than both the 5-year average (20 µmol/g, 8.5% moisture basis) and the 2018 harvest average (20 µmol/g dry basis) (Figure 10). The total glucosinolate of the Canadian canola meal obtained from conventional crushing plants (expeller press followed by solvent extraction) is much lower than this calculated value. The calculated values assumes that 100% of the oil is recovered from the seed during crushing and that no glucosinolate is destroyed during processing, which is never the case.

Free fatty acids content

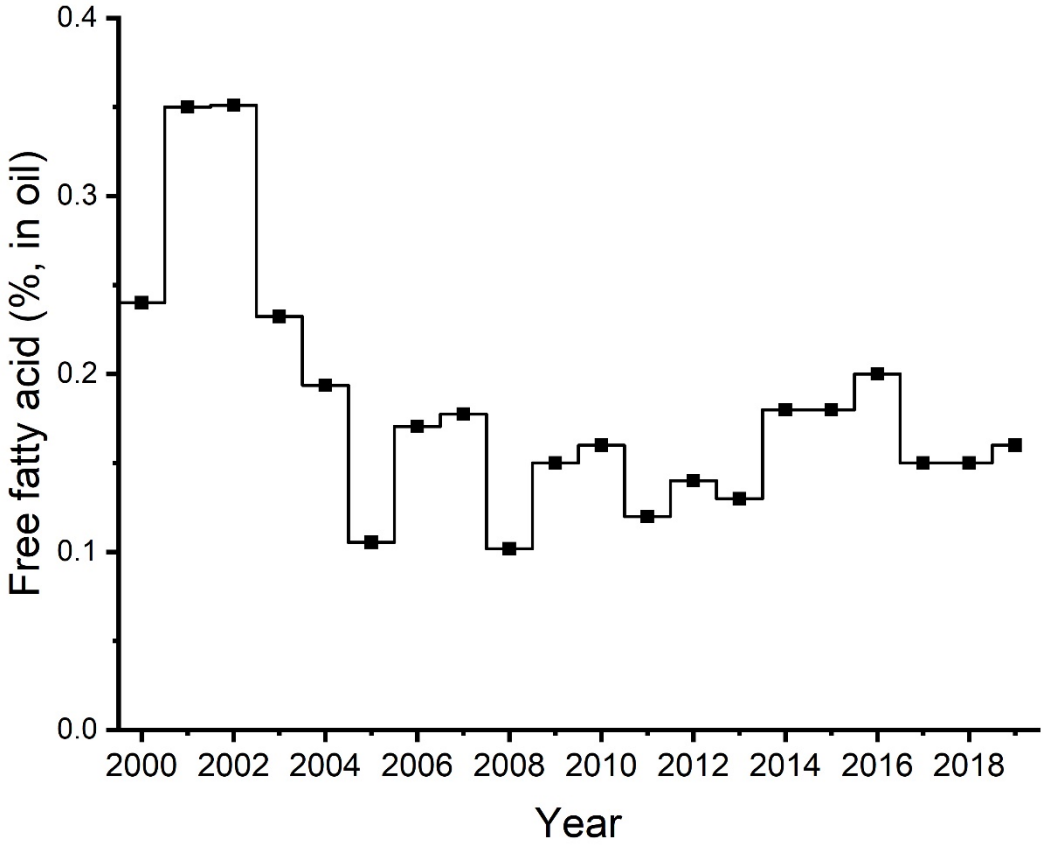
The average free fatty acids (FFA) content of the oil for the 2019 canola was 0.16%, slightly higher than what was observed in 2018 (0.15%) and slightly lower than the calculated for the 5-year average (0.17%) (Tables 1 and 4, Figure 11). FFA averages for Canola, No. 1 Canada samples from Alberta-Peace River (0.17%) and Manitoba (0.24%) were higher than what was observed in the samples from Saskatchewan (0.13%) (Table 4).

Overall, samples graded Canola, No. 2 Canada presented an FFA average much higher than the Canadian average observed for samples graded Canola No. 1, Canada, 0.25% versus 0.16% (Table 4).

There was a significant difference between the FFA averages observed for samples from Manitoba, Saskatchewan and Alberta-Peace River. FFA averages for samples from Manitoba were higher than for the samples from Saskatchewan and Alberta-Peace River averages (Table 4). Canola, No. 1 Canada

samples from Manitoba crop districts 1, 2, 6, 9+10, 11 and 12 had FFA averages higher than 0.3%, a direct result from the wet harvest conditions experienced in the province.

Figure 11 – Canola, No. 1 Canada - harvest samples, 2000–2019
Free fatty acid content (in % as oleic acid)



Growing conditions varied in the prairies, this year, the main damage was green seed counts linked to seed immaturity mainly in the northwestern part of Alberta-Peace River. It is likely that seeds were quite mature in Manitoba when the September rains obliged the producers to pause their canola harvest in some areas; moisture on mature grains usually leads to germination which usually result in higher FFA in some canola samples.

In December (2018), FFA level of commercially clean Canola, No.1 Canada exports averaged 0.22% (0.23% for the 2018 August to November exports). The FFA level of individual commercially clean Canola, No.1 Canada exports ranged from 0.12 to 0.53% (Table 6).

Over the year, it has also been noticed that FFA levels can increase during the shipping season as storage condition can affect the activation of the seed hydrolytic enzymes leading to FFA production. We also observed that FFA in canola seed can be high due to field heat stress (high temperatures

during the growing season) or to high seed moisture and sprouting due to precipitations at harvest and they could vary from to load. This year, in the prairies, we experienced rain and snow at harvest, leading to the harvest of tough or wet seeds, leading to higher seed FFA levels. It was also noted that there were more uneven canola fields this year than normal due to the May cold weather and the lack of rain delaying germination; producers were obliged to swath their canola fields whereas they would have been straight combining them. Swathed canola seeds sitting in high moisture conditions for several days due to the bad harvest conditions was the recipe for high FFA levels.

Fatty acid composition

The average level of erucic acid in the 2019 canola crop was 0.00% (below limit of quantification), which is very similar to what was observed for the last 5 years (0.01%) (Tables 1, 5, Figure 12). Similar to the total glucosinolate content, these low values are a direct result of breeding efforts of the Canadian canola industry.

For Canola, No.1 Canada samples, mean α-linolenic acid (C18:3) was 10.0%, which is more than one point higher than the 2018 mean (8.7%) and 0.7% higher than the 5-year average (9.3%) (Table 1, Figure 13). This year, samples from Manitoba had the lowest average compared to samples from Saskatchewan and Alberta-Peace River, 9.2, 10.0 and 10.6%, respectively (Table 5). The total content of poly-unsaturated fatty acid (PUFA) averages were 27.9 (27.1% in 2018), 28.4 (26.8 in 2018) and 29.8% (27.5% in 2018) in Manitoba, Saskatchewan and Alberta-Peace River, respectively, for a western Canada average of 28.8% (27.3% in 2018). For canola, the PUFA contents are directly related to the contents α-linolenic acid (C18:3) and linoleic acid (C18:2). This year, the ratio omega-6/omega-3 (linoleic acid/α-linolenic acid) was 1.87 significantly lower than the 2.12 observed in 2018.

For Canola, No.1 Canada samples, the oleic acid (C18:1) content average of the 2019 crop was 62.4%, significantly lower than what was observed in 2018 (64.3%) and the calculated 5-year average (63.1%) (Table 1, Figure 14). The lowest oleic acid content average was observed for the samples from, Alberta-Peace River (61.4%) and the highest average was obtained with the samples from Manitoba (63.3%). Oleic acid content average for the samples from Saskatchewan was 62.9% (Table 5). The total content of mono-unsaturated fatty acids (MUFA) was 64.8 (65.8% in 2018), 64.5 (66.% in 2018) and 63.1% (65.3% in 2018) in Manitoba, Saskatchewan and Alberta-Peace River, for a western Canada average of 64.0% (65.8% in 2018).

The fatty acid composition (oleic acid, linoleic acid and α-linolenic acid) of the 2019 crop presented a very different composition when compared to the 2018 fatty acid composition (-1.9%, +0.4% and +1.3% for oleic, linoleic and linolenic fatty acid contents). As a result, the iodine value which is a representation of the total unsaturation on the oil was very different in 2019 when compare to 2018. The 2019 iodine value averaged 113.7 units, 2.7 points higher than the 2018 iodine value average (111.0 units) and 1.2 units higher than the 5-year average (112.5 units) (Table 1, Figure 16). For Canola, No. 1 Canada, the iodine value averages were 112.1 (110.9 units in 2018), 113.4 (110.6 units in 2018) and 115.1 units (111.7 units in 2018) for Manitoba, Saskatchewan and Alberta-Peace River, respectively (Table 5). This year, iodine value of individual samples of Canola, No.1 Canada samples ranged from 105.2 to 121.5 units (103.2 to 122.0 units in 2018).

Samples graded Canola, No. 2 Canada showed higher iodine value averages, with higher linoleic and α-linolenic acid contents and lower oleic acid contents that the samples Canola, No. 1 Canada (Table 5).

Average of saturated fatty acid content was 6.6% in 2019 was similar to the 2018 average (6.7%) and the 5-year average (6.7%) (Tables 1 and 5). Since 2009, the saturated fatty acid content averages varied from 6.6 - 6.9% (Table 1, Figure 17). In 2019, the saturated fatty acid content averages were similar for the 3 provinces, (6.8, 6.6 and 6.6% for Manitoba, Saskatchewan and Alberta-Peace River, respectively). Total saturated fatty acids are usually affected by temperature, high temperatures lead to higher oil saturation.

As all quality parameters, the fatty acid composition is greatly affected by variety and/or environment, however over the last couples of years, a lot of effort has been made to control the total saturates content of the oil in order to produce a healthy oil - the oil with the lowest total saturates content as possible when compared to other vegetable oils. As a result, total saturates content has been very stable since 2009 but all other fatty acid contents – except erucic acid – can vary. This year, individual samples of Canola, No.1 Canada, oleic acid, linoleic acid and α-linolenic acid ranged from 55.2 to 69.4%, 14.6 to 23.7% and 5.4 to 12.5%, respectively. Samples from southern Alberta-Peace River (crop districts 1, 2, and 3) had a very different fatty acid composition than samples from the north of Alberta - Peace River (crop districts 4, 5, 6 and 7). Samples from the northern areas from Alberta had higher unsaturation than samples from the southern areas. The cool growing conditions this year compared to last helped to increase the unsaturation averages compared to last year.

Environment and genetic (variety) usually played a role on crop composition and variation from one year to the other. However, this year the top five varieties in 2019 were L233P at 31% of the acres (24% last year), followed by L252 (8% of the acres in 2019 versus 13% in 2018), L255PC (6% of the acres in 2019 versus 3% in 2018), L234PC (4% of the acres in 2019, non in 2018) and L230 (3% of the acres in 2019 and 6% in 2018). The same four varieties were responsible for 48% of the acres in 2019 versus 46% in 2018, suggesting that environment was the main factor responsible for the 2019 different fatty acid composition when compared to 2018 averages. The varieties distribution in the 2019 survey was compared to the 2018 variety insured acreages reported by the Statistics Unit of the Canadian Grain Commission (https://www.grainscanada.gc.ca/statistics-statistiques/variety-variete/varieties-en.htm).

In 2018, the variety L233P showed the lowest α-linolenic acid contents (8.1% in Manitoba, 7.8% in Saskatchewan & 8.0% in Alberta) and the highest oleic acid contents (65.4% in Manitoba, 66.2% in Saskatchewan and 65.9% in Alberta) when compared to L252 (9.1 & 62.6% in Manitoba, 9.2 & 62.9% in Saskatchewan and 9.6 & 62.6% in Alberta, for α-linolenic acid and oleic acid, respectively) and L230P (9.3 & 63.0% in Manitoba, 9.3 & 62.9% in Saskatchewan and 10.1 & 62.3% in Alberta, for α-linolenic acid and oleic acid, respectively).

Long-term averages, as presented in Figures 15, 16 and 17 (2000-2019), also showed an important continuous change in the fatty acid composition of Canadian Canola. These long-term changes are a direct result from breeding targets. To fulfill the definition of a low saturated oil, canola oil needs to contain less than 7% total saturated fatty acid. This means that companies need to select seeds that have total saturated lower than 7.0% over different climates and geographic locations. This selection

pressure has an effect on the other fatty acid contents, as the only method to maintain low total saturates is to increase unsaturation. In canola oil there are two types of unsaturation, the monounsaturated fatty acids (MUFA) and the polyunsaturated fatty acids (PUFA), since there is no breeding pressure on the MUFA or PUFA contents, they can vary greatly from one variety to the other. However, unsaturation for *Brassica napus*, the canola species grown right now in Canada means more oleic acid, a MUFA than PUFAs being α-linolenic acid (omega 3, PUFA) or linoleic acid (omega-6, PUFA), leading to the trends seen in Figures 15, 16 and 17.

The different fatty acid composition of the 2019 harvest was reflected with the different fatty acid composition of the first 5 months exports of the 2018-19 shipping season (Table 6). Oleic acid and α-linolenic acid averages, as well as the resulting iodine value averages, of commercially clean exports were different at the beginning of the shipping season compare to the 2019 December exports and last year shipping season. September and October export averages where 9.1 and 9.8%, and 63.3 and 62.3% for α-linolenic acid and oleic acid averages (iodine value averages were 112.1 and 113.5 units) as exports were mainly constituted of early harvest canola from the southern part of Alberta. November and December exports averages increased for α-linolenic acid and decreased for oleic acid as more canola crop from the northern part of Alberta-Peace River was incorporated to the exports.

The level of saturated fatty acids until December 2019 canola (6.6%) exports remained very similar to 2018-19 means (6.6%). It is expected that levels of erucic acid will remain very low for the new shipping season (below 0.1%) since erucic acid contents were very low in the 2019 harvest.

Figure 12 – Canola, No. 1 Canada, erucic acid content of harvest samples, 2000-2019

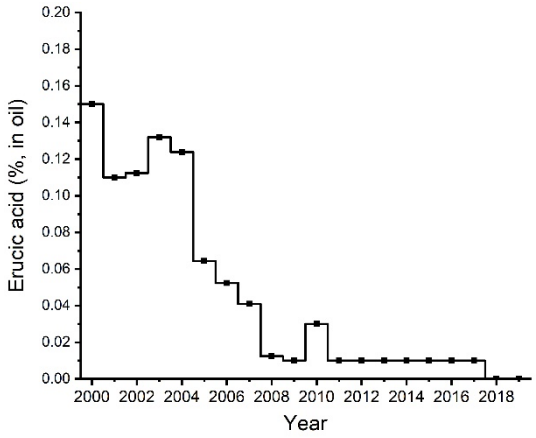


Figure 13 – Canola, No. 1 Canada, α-linolenic acid content of harvest samples, 2000-2019

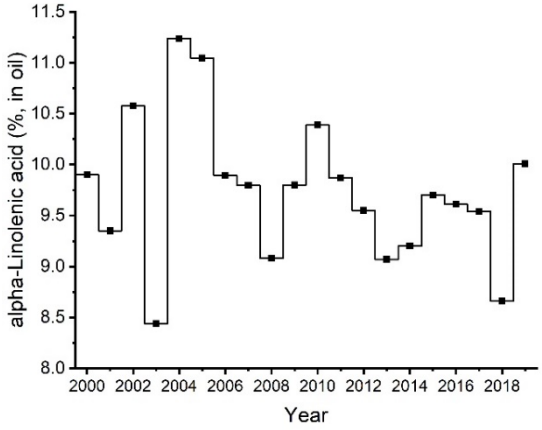


Figure 14 – Canola, No. 1 Canada, oleic acid content of harvest samples, 2000-2019

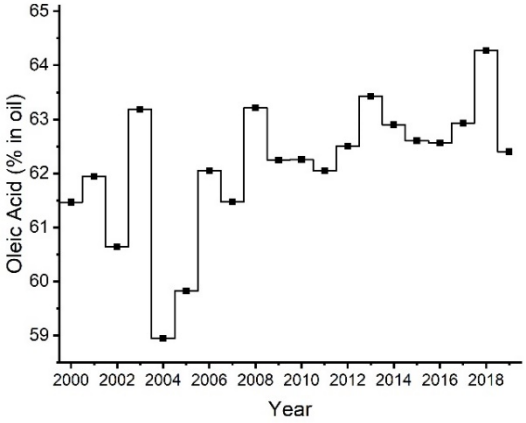


Figure 15 – Canola, No. 1 Canada, linoleic acid content of harvest samples, 2000–2019

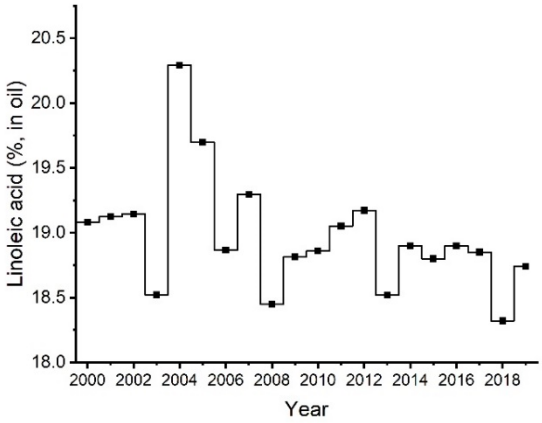


Figure 16 – Canola, No. 1 Canada, iodine value of harvest samples, 2000–2019

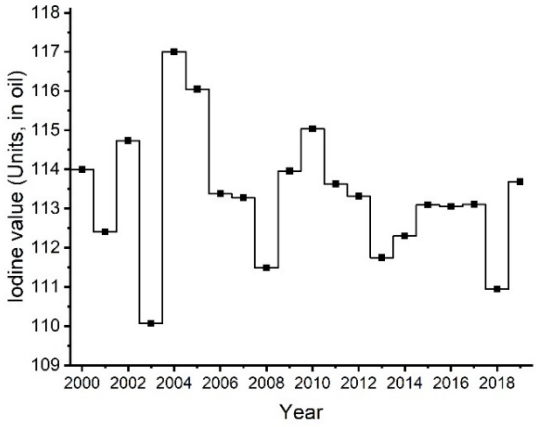


Figure 17 – Canola, No. 1 Canada, total Saturated fatty acid content of harvest samples, 2000-2019

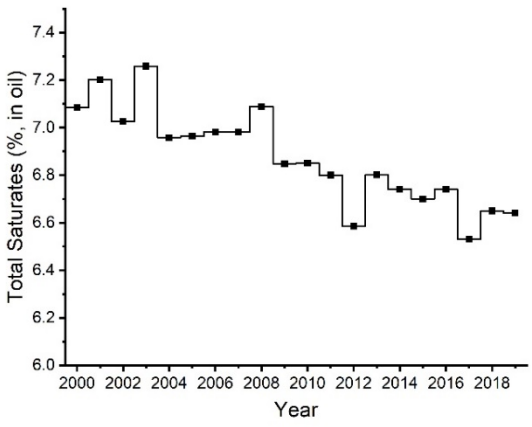


Table 3 – 2019 Harvest sample program
Canola quality data by grade and province – oil, protein and chlorophyll contents

	Number of samples	Oil content[1] %			Protein content[2] %			Chlorophyll content[5] mg/kg		
		mean	min.	max.	mean	min.	max.	mean	min.	max.
Canola, No. 1 Canada										
Manitoba	448	43.9	38.3	50.8	21.5	15.7	26.8	5	3	53
Saskatchewan	839	45.1	36.0	51.0	20.0	14.4	27.1	11	3	52
Alberta-Peace River[3]	649	44.2	37.0	51.9	20.5	14.7	27.8	17	3	56
Western Canada[4]	**1936**	**44.6**	**36.0**	**51.9**	**20.4**	**14.4**	**27.8**	**12**	**3**	**56**
Canola, No. 2 Canada										
Manitoba	13	42.7	38.8	48.0	22.0	18.0	24.7	9	4	33
Saskatchewan	63	44.6	39.4	49.2	20.5	15.8	25.6	36	5	91
Alberta-Peace River[3]	114	44.4	38.5	50.6	20.1	16.0	26.8	44	5	87
Western Canada[4]	**190**	**44.4**	**38.5**	**50.6**	**20.4**	**15.8**	**26.8**	**43**		
Canola, No. 3 Canada										
Manitoba	**0**									
Saskatchewan	**31**	**44.5**	38.9	49.2	**20.7**	16.0	27.1	**69**	4	165
Alberta-Peace River[3]	**75**	**44.9**	38.1	50.0	**20.4**	15.7	24.5	**79**	7	138
Western Canada[4]	**106**	**44.7**	**38.1**	**50.0**	**20.5**	**15.7**	**24.5**	**76**	**4**	**165**
Canola, Sample Canada										
Manitoba	1	45.0			21.0			6		
Saskatchewan	23	44.0	38.5	48.0	19.9	17.0	23.7	45	4	157
Alberta-Peace River[3]	18	43.2	35.4	48.0	20.3	17.2	24.6	97	5	204
Western Canada[4]	**42**	**43.7**	**35.4**	**48.0**	**20.1**	**17.0**	**24.6**	**63**	**4**	**204**

[1] 8.5% moisture basis
[2] N x 6.25; 8.5% moisture basis
[3] Includes part of the Peace River area that is in British Columbia
[4] Values are weighted averages based on production by province as estimated by Statistics Canada
[5] Individual canola samples are analyzed by Near-Infrared Spectroscopy, the accurate limit of quantification for chlorophyll is 4 mg/kg

Table 4 – 2019 Harvest sample program
Canola quality data by grade and province – glucosinolate and free fatty acid contents

	Number of samples	Glucosinolates[1] µmol/g			Free fatty acids (%)
		mean	min.	max.	mean
Canola, No. 1 Canada					
Manitoba	448	9	3	15	0.24
Saskatchewan	839	9	4	19	0.16
Alberta –Peace River[2]	649	10	4	18	0.17
Western Canada[3]	**1936**	**9**	**3**	**19**	**0.19**
Canola, No. 2 Canada					
Manitoba	13	9	4	14	0.76
Saskatchewan	63	10	5	15	0.23
Alberta-Peace River[2]	114	11	6	17	0.22
Western Canada[3]	**190**	**10**	**4**	**17**	**0.25**
Canola, No. 3 Canada					
Manitoba	**0**				
Saskatchewan	**31**	11	8	16	0.30
Alberta-Peace River[2]	**75**	11	5	19	0.25
Western Canada[3]	**106**	**11**	**5**	**19**	**0.27**
Canola, Sample Canada					
Manitoba	**1**	8			0.46
Saskatchewan	**23**	11	7	17	0.33
Alberta-Peace River[2]	**18**	12	8	23	0.72
Western Canada[3]	**42**	**11**	**7**	**23**	**0.47**

[1] 8.5% moisture basis
[2] Includes part of the Peace River area that is in British Columbia
[3] Values are weighted averages based on production by province as estimated by Statistics Canada

Table 5 – 2019 Harvest sample program
Canola quality data by grade and province – fatty acid composition, total saturate content and iodine value of the oil

	Relative fatty acid composition of the oil (%)					Total saturates[3] (%)	Iodine value[4] (Units)
	C18:0	C18:1	C18:2	C18:3	C22:1		
Canola, No. 1 Canada							
Manitoba	1.79	63.25	18.66	9.20	0.00	6.75	112.1
Saskatchewan	1.75	62.88	18.37	9.98	0.00	6.61	113.4
Alberta-Peace River[1]	1.64	61.36	19.12	10.63	0.00	6.59	115.1
Western Canada[2]	**1.73**	**62.40**	**18.74**	**10.01**	**0.00**	**6.64**	**113.7**
Canola, No. 2 Canada							
Manitoba	1.70	61.71	19.45	9.83	0.00	6.80	113.8
Saskatchewan	1.65	60.96	19.37	10.74	0.00	6.59	115.5
Alberta-Peace River[1]	1.57	59.99	19.70	11.24	0.00	6.65	116.6
Western Canada[2]	**1.61**	**60.52**	**19.54**	**10.94**	**0.00**	**6.63**	**116.0**
Canola, No. 3 Canada10.6							
Manitoba							
Saskatchewan	1.61	59.94	19.86	10.99	0.00	6.69	116.2
Alberta-Peace River[1]	1.54	59.86	19.78	11.27	0.02	6.60	116.8
Western Canada[2]	**1.57**	**59.89**	**19.81**	**11.16**	**0.01**	**6.64**	**116.5**
Canola, Sample Canada							
Manitoba	1.69	63.70	18.80	8.46	0.00	6.73	110.8
Saskatchewan	1.68	60.20	19.78	10.80	0.09	6.73	115.9
Alberta-Peace River[1]	1.51	58.12	20.39	11.94	0.20	6.61	118.3
Western Canada[2]	**1.62**	**59.57**	**19.98**	**11.16**	**0.13**	**6.69**	**116.6**

[1] Includes part of the Peace River area that is in British Columbia

[2] Values are weighted averages based on production by province as estimated by Statistics Canada

[3] Total saturated fatty acids are the sum of palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0), and lignoceric (C24:0)

[4] Calculated from fatty acid composition

Table 6 – Canola, No. 1 Canada
Comparison of the quality data of 2019 harvest sample averages with export shipment average

Quality parameter	2019 Harvest program	Export			
		December 2019	August to November 2019	Previous shipping season 2018-19	
		Commercially Clean			Non Commercially Clean
	Canola, No. 1 Canada				All grades
Oil content[1] (%)	44.6	43.8	43.7	43.3	43.2
Protein content[1,2] (%)	20.4	20.5	20.7	21.0	20.9
Oil-free protein content[2] (%) at 12% moisture (%)	38.3	37.9	38.0	38.0	38.3
Chlorophyll (mg/kg seed)	12	25	23	21	32
Total glucosinolates[1] of the seed (µmol/g seed)	9	11	10	11	11
Free fatty acids, %	0.16	0.26	0.30	0.23	0.29
Erucic acid (% in oil)	0.00	0.01	0.01	0.03	0.02
Oleic acid (% in oil)	62.4	62.0	62.6	63.6	63.2
α-Linolenic acid (% in oil)	10.0	10.3	9.7	9.1	9.2
Total saturated fatty acids[3] (% in oil)	6.6	6.6	6.7	6.6	6.6
Iodine value	113.7	114.3	113.1	111.7	112.2
MUFA	64.2	63.7	64.3	65.3	64.9
PUFA	28.8	29.2	28.6	27.5	27.9
Distinctly green seed (DGR, %)	0.39	1.58	1.4	1.35	2.68
Dockage (%)	0.00	2.02	1.78	1.73	2.31
Loading moisture (%)	NA	9.0	8.6	8.5	8.6
Number of export samples	NA	20	85	206	33
Tonnage (tonnes)	NA	615,713	2,391,341	7,352,284	1,166,263

[1] 8.5% moisture basis
[2] Calculated using N x 6.25
[3] Total saturated fatty acids are the sum of palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0), and lignoceric (C24:0).
NA = Non-applicable