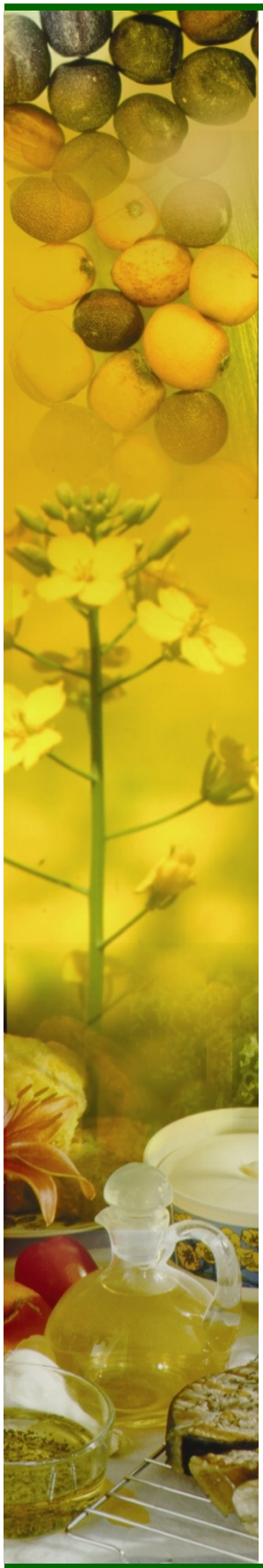

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Quality of western Canadian Canola 2016

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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.

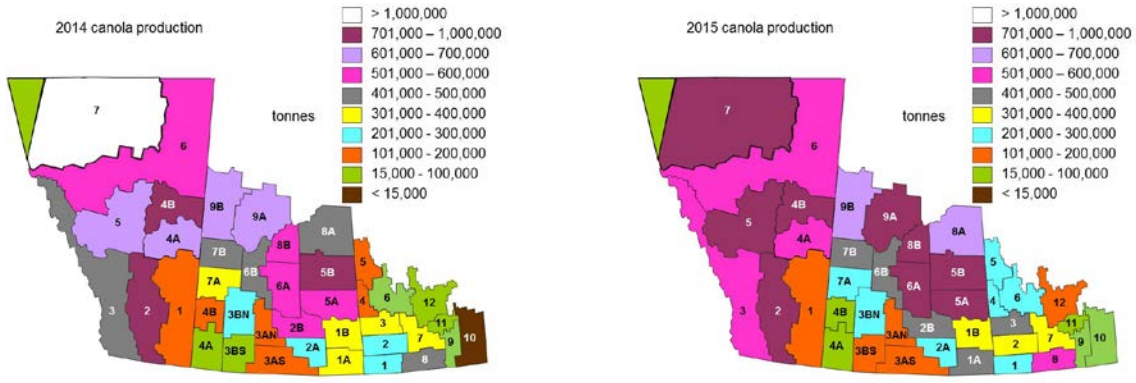
Note: Samples for the Canadian Grain Commission's canola harvest sample program were collected from producers, crushing plants and grain handling offices across western Canada. The samples were cleaned to remove dockage prior to grading and testing. Industry Services grain inspectors assigned grade level 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 Sample Canada samples by western Canada.

Introduction

This report presents quality data and information based on the Canadian Grain Commission's 2016 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 2014 and 2015 production data. Samples received from the Peace River area of British Columbia (B.C.) were combined with Alberta Crop District No. 7 samples, the area will will be referred as Alberta-B.C.

The 2016 harvest was stopped for over 3 weeks in Alberta-B.C. and Saskatchewan due to heavy rain and snow. A special report on the effect of snow on canola quality will also be published later this year.

Figure 1 – Maps of western Canada showing 2014 and 2015 canola production per crop district



Overview

The 2016 harvest showed a higher percentage of samples graded Canola, No. 1 Canada (95.4%) than the 2015 harvest (91.5%), this number was higher than the 10 year average (87.1%) (Figure 4). Large variations in grade distribution were observed. Alberta-B.C. area showed the lowest percent of samples graded Canola, No. 1 Canada (85.9%) when compared to Manitoba (94.5%) and Saskatchewan (93.7%) (Figure 5). The crop district 7 of Alberta-B.C. had the lowest percent of samples graded Canola, No. 1 Canada (65.8%).

The 2016 western Canadian canola (Canola, No.1 Canada) crop was characterized by an oil content average similar to the 2015 crop (44.3% in 2016 versus 44.2% in 2015) and a slight decrease in protein content average (20.0% in 2016 versus 20.7% in 2015) for samples graded Canola, No.1 Canada

(Table 1). Average chlorophyll content was similar in 2016 when compared to 2015 (11 mg/kg versus 12 mg/kg, respectively) (Table 1) with some areas showing averages higher than 15 mg/kg for samples graded Canola, No.1 Canada. Samples from Manitoba and Saskatchewan showed similar chlorophyll content averages whereas Alberta-B.C. showed a higher average: 10 and 11 mg/kg for Manitoba and Saskatchewan, respectively versus 13 mg/kg for Alberta-B.C..

Table 1 – Canola , No. 1 Canada: Quality data for 2015 and 2016 harvest plus the 5 year means

Quality parameter	2016	2015	2011-15 Mean
Number of received samples	1915	1941	1885
Number of Canola, No. 1 Canada samples	1827	1782	1632
Oil content[1] (%, 8.5% moisture)	44.3	44.2	44.4
Protein content[1] (%, 8.5% moisture)	20.0	20.7	20.2
Oil-free protein of the meal[1] (%, 12% moisture)	37.4	38.6	37.7
Chlorophyll content (mg/kg in seed)	11	12	14
Total seed glucosinolates (μmol/g, 8.5% moisture)	10	11	10
Oil-free total glucosinolates of the meal (μmol/g, dry basis)	22	23	21
Free fatty acids (%)	0.20	0.18	0.15
Oleic acid (% in oil)	62.6	62.6	62.7
Linoleic acid (% in oil)	18.9	18.8	18.8
α-Linolenic acid (% in oil)	9.6	9.7	9.5
Erucic acid (% in oil)	0.01	0.01	0.02
Total saturated fatty acids[2] (% in oil)	6.7	6.7	6.7
Iodine value	113.1	113.1	112.8
Total mono-unsaturated fatty acids (MUFA)[3] (% in oil)	64.2	64.2	64.4
Total poly-unsaturated fatty acids (PUFA)[4] (% in oil)	28.6	28.6	28.4

[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), α-linolenic (C18:3) and eicosadienoic (C20:2) acids.

The 2016 canola crop had a very similar oleic acid content, linoleic acid and α-linolenic acid contents when compared to the 2015 crop (62.6, 18.9 and 9.6% versus 62.6, 18.8 & 9.7% for oleic, linoleic acid, and α linolenic acid respectively). Total saturated fatty acid content for the 2016 canola crop was identical to what was observed in 2015 (6.7 %). This resulted in an identical iodine value for both the 2016 and the 2015 canola crops (113.1 units). Mean free fatty acids average levels in 2016 Canola, No.1 Canada seed was similar to what was observed in 2014 (0.20% in 2016 versus 0.18% in 2015) (Table 1), however Manitoba average was much higher (0.34%) (Table 4) with some crop district averages higher than 0.5% (data no shown in the report, see annual crop district table on the web).

The 2016 harvest conditions were very difficult. Early to mid-October, heavy precipitation and snow stopped the harvest for over 3 weeks. At the time, 23 and 33% of the canola grown in Saskatchewan and Alberta, respectively, was not harvest. With a break in the weather, a large part of this "snowed-in" canola was harvested in November. These samples were analyzed on their own as most were received after composites were made. Most of the samples were graded Canola, No.1, the results of the individual analysis for these samples will be presented in an additional report on the effect of snow on canola quality published later this year.

Weather and production review

Weather review and effects on seeding and harvest

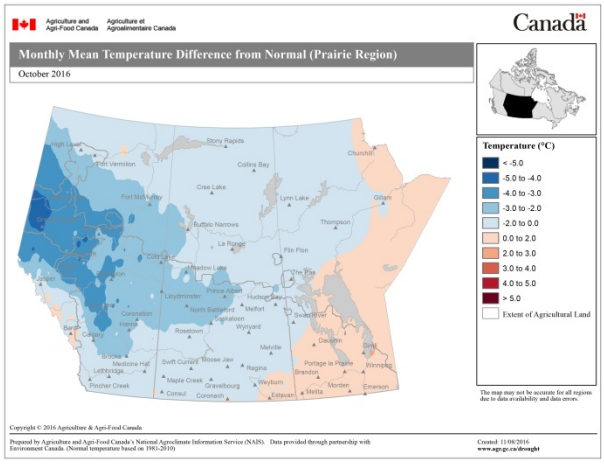
The weather maps presented in Figures 2a and 2b were obtained from Agriculture and Agri-Food Canada (http://www.agr.gc.ca/DW-GS/current-actuelles.jspx?lang=eng&jsEnabled=true). Seeding and harvest progress for each provinces are presented in Figure 3. The graphs were done using the crop reports for each province. Manitoba: http://www.gov.mb.ca/agriculture/crops/seasonal-reports/crop-report-archive/index.html. Saskatchewan: http://www.agriculture.gov.sk.ca/crop-report Alberta: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd4191.

As in 2015 and 2014, extreme conditions were the norm for the 2016 growing season. A warm and dry winter with little snow allowed an early seeding in most of the western provinces. In Alberta, cool temperatures and frost (mid-May) slowed down the 2016 seeding progress, but by June 7th about 99.4% of the seeding was completed, the rest was not seeded due to excessive moisture. In Saskatchewan, seeding started early, by April 25th about 3% of the crop was seeded. The seeding progress advanced rapidly and by the end of May about 94% of the crop was seeded. The last week of May and early June, cool temperatures and rain slowed down the progress but by June 13th, the 2016 seeding period was considered terminated with 99.5% of the crop in the ground. The seeding progress was faster that what has been observed for the 5 year average, with only 94% of the crop seeded in the same period (Figure 3). In Manitoba, the seeding started in April in some areas and was considered 99% completed by June 6th.

The 2016 harvest period was the longest harvest period observed in a very long time (Figure 3). It started in August and was not completely done by end of November, some producers will have to

harvest their crop still standing or in swath during the 2017 spring. The Manitoba harvest started the first week of August as some producers were able to swath their canola, however heavy rain in mid-September (Figure 2b) slowed its progress. By mid-October, it was reported that 95% of the Manitoba canola crop was harvested (Figures 3 & 4). In Saskatchewan and Alberta the harvest progressed rapidly in August and September but mid-September precipitations slightly slowed it down (Figure 3). By mid-October, about 77 and 67% of the canola was harvested in Saskatchewan and Alberta, respectively. Then a combination of heavy rain and snow completely stopped the harvest progress (Figures 2b, 3b & 4) for over 3 weeks. A warmer and drier than normal November (Figure 2a) allowed harvest resume in both provinces. By end of November, Alberta reported that only 86.8% of the canola crop was harvested compared to 96% in Saskatchewan.

Figure 2a – Maps - Monthly mean temperature difference from normal in Canada (Prairies) during the 2016 growing season (October and November 2016).



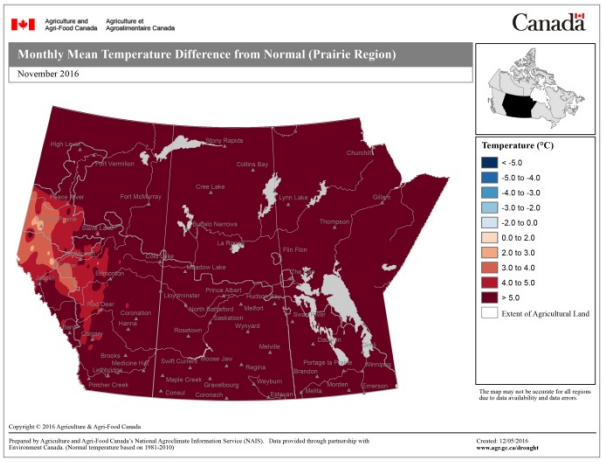
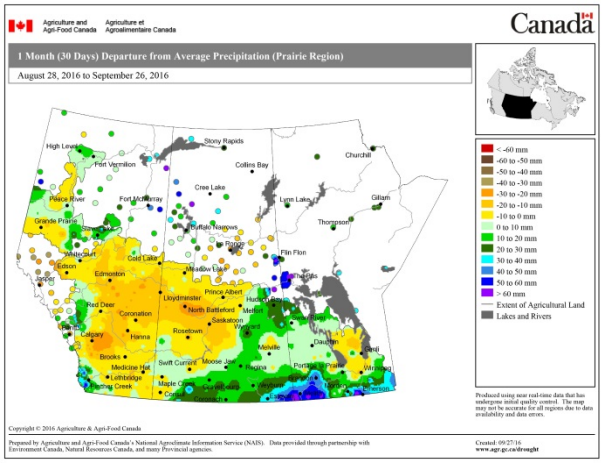
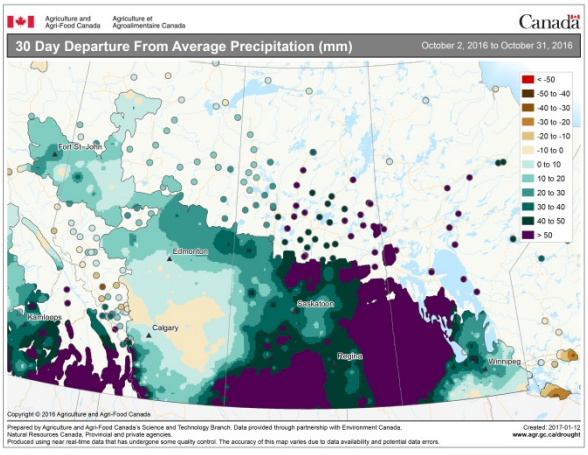


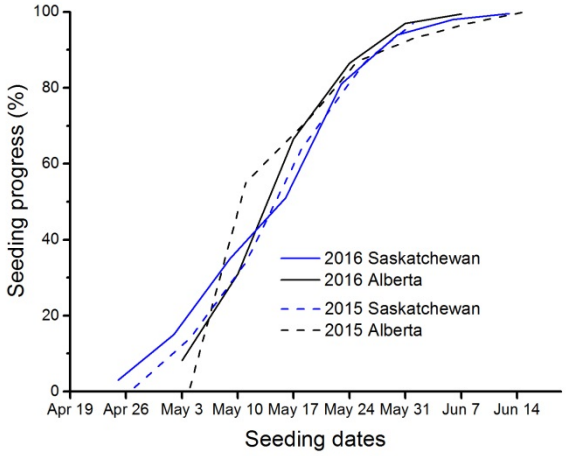
Figure 2b – Map - Accumulated precipitation and departure from normal in Canada (Prairies) during the 2016 growing season (April 28th to September 26th, and October 2016).



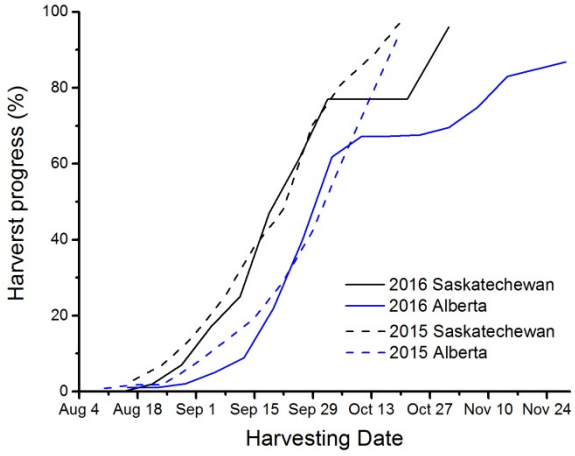


Source: http://www4.agr.gc.ca/DW-GS/historical-historiques.jspx?lang=eng&jsEnabled=true

Figure 3 – Seeding and harvest progress in Saskatchewan and Alberta for the 2015 and 2016 growing seasons

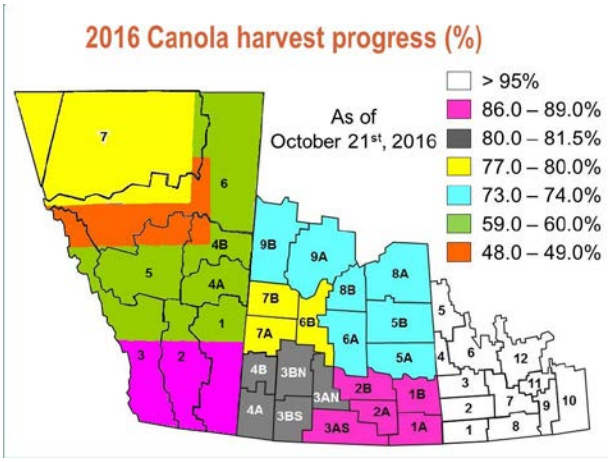


Seeding progress in 2015 and 2016



Harvest progress in 2015 and 2016

Figure 4 – Canola harvest progress as of October 21st, 2016. Provincial crop reports were used to estimate the harvest progress in each province.



Production

On average since 2012, Western Canadian farmers have planted over 8.0 million hectares of canola, in 2016, they seeded 8,242.3 thousand hectares, about 1.5% less than what was seeded in 2015 and slightly less (0.8%) than the 5-year average (Table 2).

Weather had a significant effect on the harvested areas this year. In October, snow halted the 2016 canola harvest in some areas of Alberta, Saskatchewan and British Columbia. The percent of lost seeded hectares were 1.6, 6.0, 7.6 and 9.4% for Manitoba, Saskatchewan, Alberta and British Columbia, respectively.

Statistics Canada reported that the 2016 western Canada average yield was 2,400 kg/ha higher than the 5-year yield average of 2,000 kg/ha. In 2016, the highest yield average was observed in Alberta at 2,600kg/ha , followed by Saskatchewan and British Columbia (2,300 kg/ha). Manitoba yield was the lowest at 2,200 kg/ha but this is still higher than the 5 year average.

As of January 2017, Statistics Canada reported that the 2016 production for western Canada was 18.36 million metric tonnes, this was the second highest production recorded in western Canada. It was only 100,200 tonne lower than the 2013 record production of 18.46 million metric tonnes and well above the 5-year average production (16.27 million tonnes). In 2016, the provincial production for Manitoba, Saskatchewan, Alberta and British Columbia accounted for14.9, 53.1, 31.5 and 0.4% (16.6, 51.3, 31.7 and 0.4% in 2015) of the total canola production, 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		
	2016	2015	2011-15	2016	2015	2011-15	2016	2015	2011-15
Manitoba	1,276.8	1,270.7	1,280.0	1,256.5	1,266.7	1,266.7	2,744.2	2,857.6	2,448.0
Saskatchewan	4,492.0	4,512.2	4,374.7	4,224.9	4,492.0	4,338.2	9,752.2	9,536.8	8,104.3
Alberta	2,407.9	2,517.1	2,577.2	2,225.8	2,501.0	2,558.0	5,783.3	5,851.3	5,652.4
British Columbia	38.4	36.4	40.8	34.8	36.4	40.4	81.6	70.8	74.0
Western Canada	**8,215.1**	**8,336.4**	**8,272.6**	**7,742.0**	**8.296.1**	**8,203.3**	**18,361.3**	**18,316.5**	**16,278.8**
Canada	**8,242.3**	**8,362.6**	**8,312.7**	**7,768.8**	**8,322.0**	**8,242.6**	**18,423.6**	**18,376.5**	**16,362.8**

[1] For all production data please consult Statistics Canada's website at: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010010&tabMode=dataTable&srchLan=-1&p1=-1&p2=9

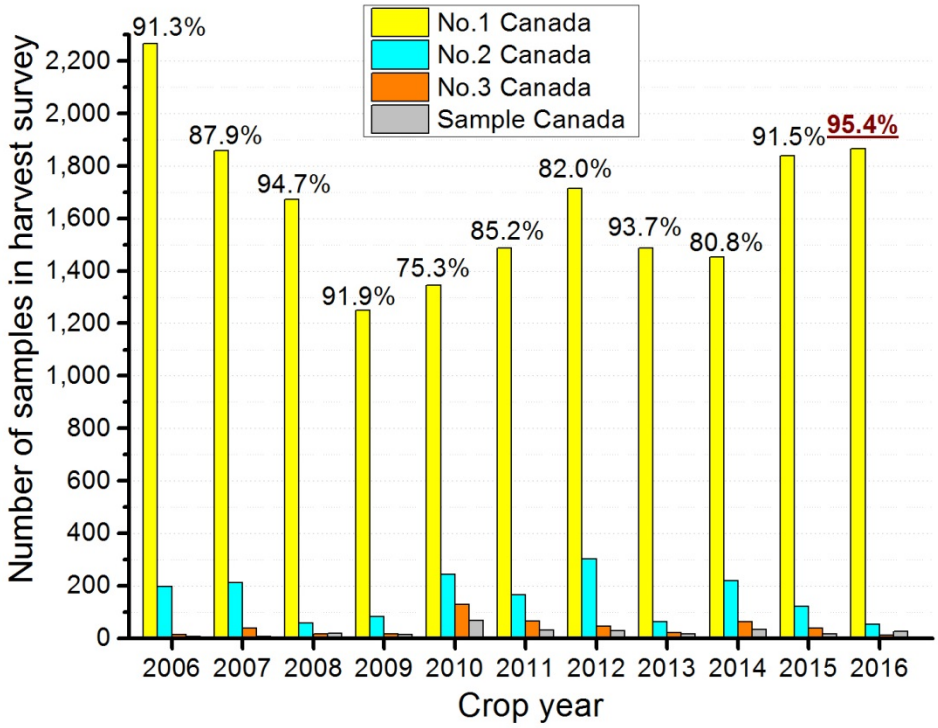
Harvest sample program samples and grade distribution

This report of quality data for the 2016 harvest is based on analyses of 1,915 individual canola samples. Composites of various grades from various crop districts composites 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. Slightly less canola samples were received in 2016 when compared to the 2015 harvest (1941 samples) but more samples were received when compared to the 5-year average (1885 samples).

The composition of 2016 samples was compared to 2015 results and to long-term sample program means (Table 1). Comparison with the quality of Canadian canola exports shipments is provided in Table 6 and in Figure 6.

In 2016, 95.4% of the samples were graded Canola, No. 1 Canada, compared to 91.5 in 2015 and 80.8% in 2014 (Figure 5). This is much higher than the 5-year average of percentage of Canola, No. 1 Canada (86.6%). The grade distribution of the 2016 canola crop varied slightly between crop districts, but differences were less than what was found the previous year. The lowest percent of samples graded Canola, No. 1 Canada was found in the crop district 6 of Manitoba (90.2 %).

Figure 5 – Canola samples received in harvest sample program and the historical grade distribution, 2006-16



The main degrading factor for Canola, No. 1 to Canola, No. 2 was distinctly green seed counts. Distinctly green seed counts (DGR) were 0.47% in Canola, No. 1 Canada, 2.25% in Canola, No. 2 Canada, 2.21% in Canola, No. 3 Canada and 1.66% in Sample. Most of samples with grades lower than

Canola No. 2 were downgraded because of admixtures and sprouting, not because of DGR counts. The Official Grain Grading Guide defines conspicuous admixture as material found in the sample after cleaning and is easily distinguished from canola without the use of magnification.

Quality of western Canadian canola 2016

Tables 3 to 5 show detailed information on the quality of western Canadian canola harvested in 2016 whereas Table 6 compares the quality of 2016 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 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 a 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 greater reductions in measured quality components.

Oil content

For Canola, No.1 Canada, the 2016 mean oil content (44.3%) was identical to the 2015 average (44.2%) (Table 1). This average is much lower than the record average observed in 2011 (45.2%) (Figure 6). However, this average is close to the 5-year average (2011-2015) of 44.4% (Table 1, Figure 6). The oil content mean in Manitoba (43.5%) was lower than in Alberta-B.C. (43.9%) and Saskatchewan (44.8%) (Table 3). The oil content of individual Canola, No.1 Canada samples harvested in 2016 by producers across western Canada ranged from 37.5% to 49.5% in Manitoba, 37.1% to 50.0% in Saskatchewan and 38.9% to 49.5% in Alberta-B.C. (Table 3).

Oil content for Canola, No. 2 Canada (42.7%) was lower than for Canola, No. 1 Canada (44.3%). Oil content for Canola, No. 2 Canada samples from western Canada ranged from 37.4% to 48.2% (Table 3).

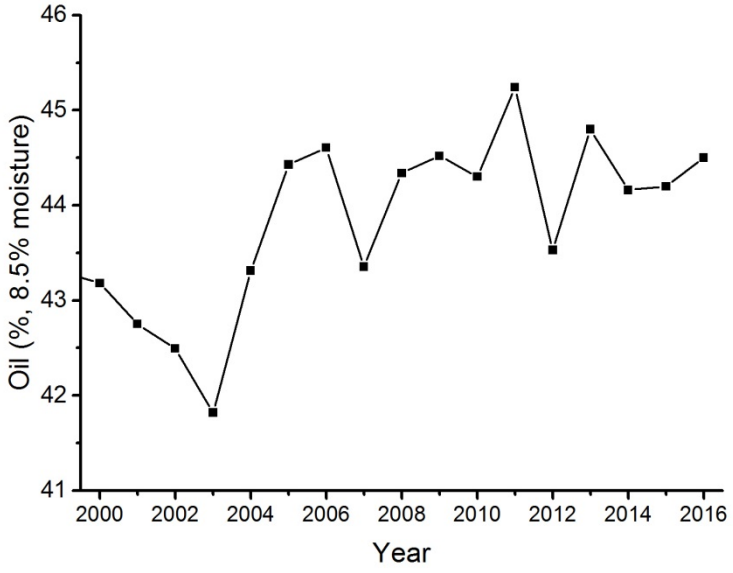
Oil content is influenced by both genetics and environment. For any known canola variety cool growing conditions will give higher oil content when compared to hot growing conditions.

Mean oil content of commercially clean canola exports of Canola, No.1 Canada was 43.8% in December 2016 and averaged 43.5% for the August-November 2016 exports (Table 6). The oil content average of non-commercially clean exports was 43.7% for August-December 2016 exports. Last year's shipping season, commercially clean cargoes of canola averaged 43.2% for oil content (at 8.5% moisture).

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 of the dockage. Harvest samples are completely cleaned (0.00% dockage) whereas the dockage averages for the August-November 2016 exports and December 2016 exports were 1.79 and 1.77% respectively for the commercially clean exports. From August 206 to December 2016, it was found that the dockage ranged from 0.2 to 2.5% for commercially clean canola export shipments. Dockage average was 2.72% for the August-December 2016 non-commercially (NCC) exports (Table 6).

It is expected that the mean oil content of Canadian exports will be in the 43.0% range for most of the 2016-17 shipping season.

Figure 6 – Canola, No. 1 Canada - harvest samples, 2000–2016
Oil content of the seed (%, at 8.5% moisture)



Protein content

Crude protein content averages were 20.0% for Canola, No.1 Canada, 21.3% for Canola, No. 2 Canada and 19.9% for Canola, No. 3 Canada. Average protein seed content for Canola, No.1 Canada was lower in 2016 (20.0%) than in 2015 (20.7%). This is slightly lower than the 5-year average (20.2%) (Table 1). Protein content of individual producer samples ranged from 16.4 to 26.0% for Canola, No. 1 Canada samples and from 16.8 to 26.2% for Canola, No. 2 Canada samples (Table 3).

Average protein of Canola, No. 1 Canada commercially clean exports was 20.2% in December 2016. Average protein was 20.5% for commercially clean Canola. No. 1 Canada exports from August to November 2016 (Table 6). Protein content averages (Tables 6) for the actual shipping season are slightly higher to what was observed for last shipping season (20.9% for August 2015 to July 2016). From August to December 2016, non-commercially clean exports of Canola. No. 1 Canada had a seed protein content average of 19.8% at 8.5 % moisture (Table 6).

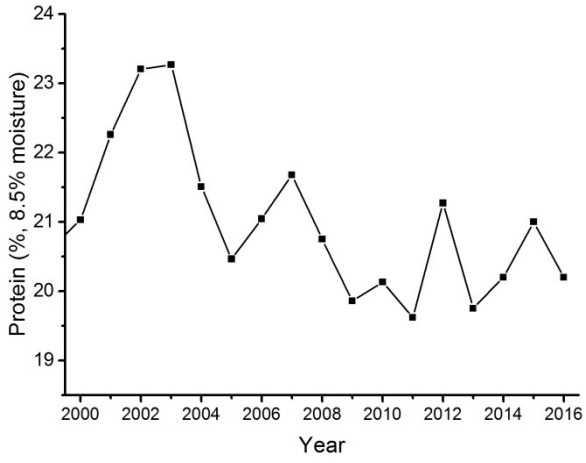
2016 protein content calculated to an oil-free meal at 12% moisture basis was 37.4%, which is significantly lower than what was observed in 2015 (38.6%) and lower than the 37.7% calculated for the 5-year average (Table 1). The calculated protein content of the oil-free meal (100% defatted at 12% moisture) was much higher in Alberta-B.C. (38.0%) than in Manitoba (37.8%) and in Saskatchewan (36.9%). The Canadian Oilseed Processors Association's meal trading rules requires that calculations for protein claims must be reported on a 12% moisture basis, to enable comparisons. (Table 1, Figure 8). It is to be understood that the reported value is only an indication since this 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.

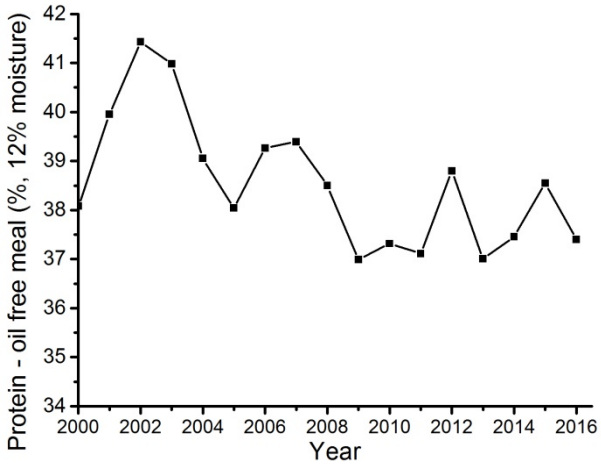
The calculated protein content average of oil-free meal was 37.2% at 12.0% moisture for December 2016 commercially clean exports of Canola, No. 1 Canada. The meal protein content average for the August-November 2016 exports was also 37.5% (12% moisture). These results are about 0.5 to 0.8% lower than what was observed during last shipping season, the average being 38.0% (12% moisture) for commercially clean exports of Canola, No. 1 from August 2015 to July 2016 (Table 6).

It is expected that the protein content of Canadian exports will be slightly lower than what was observed during last year shipping season.

Figure 7 – Canola, No. 1 Canada - harvest samples, 2000–2016
Protein content of the seed (%, at 8.5% moisture)

Figure 8 – Canola, No. 1 Canada - harvest samples, 2000–2016
Protein content of the meal (%, at 12% moisture)



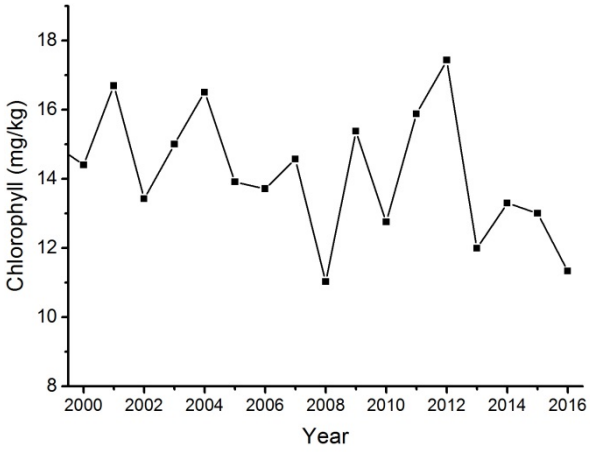


Chlorophyll content

Chlorophyll content averages of producer samples graded Canola, No. 1 Canada were 10, 11 and 13 mg/kg in Manitoba, Saskatchewan and Alberta-B.C., respectively (Table 3). The overall average for Canola, No. 1 Canada was 11 mg/kg, similar to what was observed for the 2015 harvest (12 mg/kg) (Figure 9). This is slightly lower than the calculated 5 year average (14 mg/Kg). Individual producer samples of Canola, No. 1 Canada from Manitoba, Saskatchewan and Alberta-B.C. had chlorophyll levels ranging from 4 to 27 mg/kg, 4 to 38 mg/kg and 4 to 41 mg/kg, respectively (Table 3). The mean chlorophyll content varies greatly from year to year (Figure 9) due to environmental conditions. Once again, location had an important effect on chlorophyll levels in the analyzed samples.

Chlorophyll levels (Table 3) for Canola, No. 2 Canada samples averaged 23 mg/Kg, much lower than what was observed for the 2015 harvest (31 mg/kg). Samples graded Canola, No. 3 Canada showed an average chlorophyll content of 15 mg/kg, lower than what was observed in 2015 (45 mg/kg), confirming that the down grading from Canola, No. 2 Canada to Canola, No. 3 Canada was not due to seed immaturity.

Figure 9 – Canola, No. 1 Canada - harvest samples, 2000–2016
Chlorophyll content of the seed (mg/Kg, as is moisture content)



To be graded Canola, No. 1 Canada, samples must contain no more than 2.00% distinctly green seeds. Distinctly green seed averages were 0.57, 0.37 and 0.60% in Manitoba (0.56% in 2015), Saskatchewan (0.45% in 2015) and Alberta-B.C. (0.57% in 2015) for Canola, No. 1 Canada samples, respectively.

The chlorophyll content of Canadian canola exports is affected by distinctly green seeds and dockage content (no more than 2.5% for commercially clean exports). Dockage averages for Canola, No. 1 Canada was 1.77 and 1.79% for commercially clean cargoes for December and August to December 2016 exports, respectively, whereas the dockage average for the non-commercially clean August to December 2016 exports was 2.72%. Since August 1st, 2015, the distinctly green seed contents for individual cargoes of Canola, No. 1 Canada ranged from 0.2 to 0.8% and the chlorophyll content averages ranged from 10 to 17 mg/kg (Table 6). These chlorophyll content variations reflected the distinctly green seed variations within the exports (0.2 to 0.8%) and between harvest DGR averages (0.47%) and export DGR averages (0.43 to 0.5%) (Table 6); the higher distinctly green seeds content and the higher chlorophyll content in exports (Table 6).

It is expected that chlorophyll data for the 2016-17 exports might be lower than chlorophyll average reported for the 2015-2016 shipping season.

Glucosinolate content

The 2016 total glucosinolate content averaged 10 μmoles/g, similar to what was observed in 2015 (11 μmoles/g). Since 2009, total glucosinolate content averages remained in the 10 μmoles/gram range (Table 1, Figure 10). 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 glucosinolates in the December 2016 canola exports was 12 µmol/g of seed, similar to what was observed in the 2016 harvest survey (Table 6). Glucosinolate contents of canola exports for the 2015-16 shipping season will remain similar to the averages observed during the 2015-16 shipping season (Table 6).

Figure 10 – Canola, No. 1 Canada - harvest samples, 2000–16
Total glucosinolate content of the seed (µmol/g seed, at 8.5% moisture)

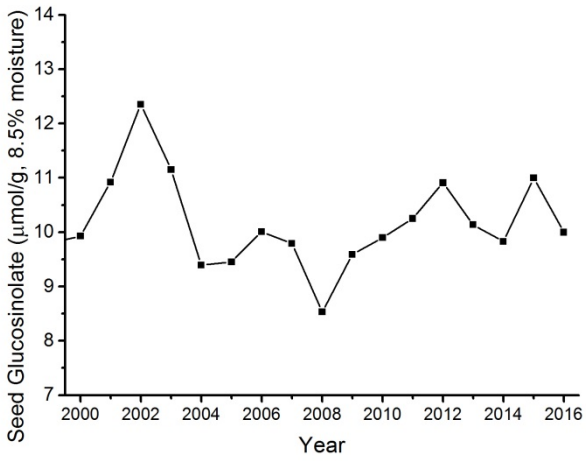
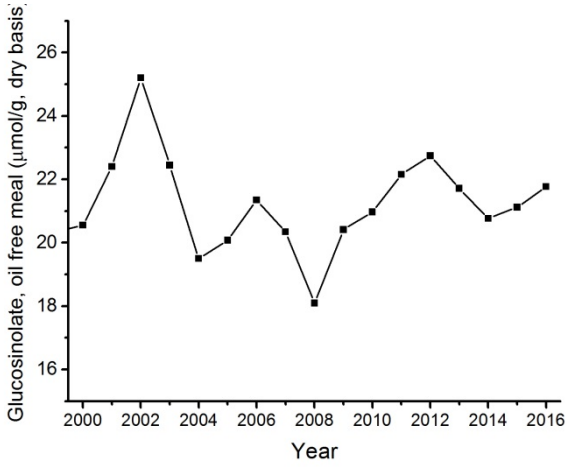


Figure 11 – Canola, No. 1 Canada - harvest samples, 2000–16
Total glucosinolate content of oil-free meal (µmol/g meal, dry basis)



In 2016, 10 µmoles/gram of total glucosinolates in the seed corresponded to 22 µmoles/gram in oil-free meal on dry basis, similar to the 5-year average (21 µmol/g of meal dry basis) and slightly lower than the 2015 harvest average (23 µmol/g of meal dry basis) (Figure 11). This calculated value agrees with the canola definition (less than 30 µmol of total glucosinolates per g of oil-free meal on dry basis). However, it gives an overestimation of total glucosinolate in canola meal obtained from Canadian conventional crushing plants (expeller press followed by solvent extraction) since it assumes that 100% of the oil was recovered from the seed during crushing and that no glucosinolate was destroyed during processing, which is not the case.

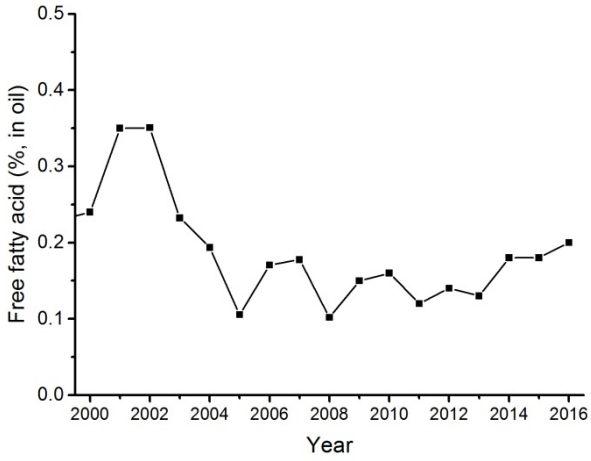
Free fatty acids content

The average free fatty acids content (FFA) of the oil for the 2016 canola was 0.20%, similar to what was observed in 2015 (0.18%) (Tables 1 and 4, Figure 12). This level is higher than the 5-year average of 0.15% (Table 1). Average free fatty acids levels in Canola, No. 1 Canada samples from Manitoba (0.34%) were higher than what was found in Saskatchewan (0.16%) and Alberta-B.C. (0.21%) (Table 4). Manitoba FFA average contents were higher in 2016 (0.34%) than the Manitoba 5 year average

(0.24%). In 2016, in Manitoba only two crop districts had FFA averages lower than 0.24 % (), crop district 4 and crop district 5, 0.17 and 0.22%, respectively. Alberta-B.C. crop district 7 had the highest FFA average in Alberta-B.C. (0.36%), followed by crop district 6 (0.26%) and crop district 5 (0.25%).

For samples graded Canola, No. 2 Canada, FFA levels were much higher than for samples grades Canola No. 1, Canada, 0.58% versus 0.20%. There was an important difference between the three provinces. Samples from Saskatchewan graded Canola, No. 2 Canada had low FFA content, 0.17%, very similar to the Saskatchewan Canola, No. 1 Canada 0.16%. On the other hand, FFA contents for Alberta-B.C. Canola, No. 2 Canada samples averaged 0.73% and Manitoba Canola, No. 2 Canada averaged 1.22% (Table 4).

Figure 12 – Canola, No. 1 Canada - harvest samples, 2000–16
Free fatty acid content (in % as oleic acid)



We have observed that free fatty acids in canola can be high due to field heat stress (high temperatures during the growing season) or to high seed moisture and sprouting because of precipitations at harvest. Heavy rains delays harvest in all three provinces, (Figures 2b and 3b). Excess of moisture at harvest tend to promote sprouting in the seeds leading to an increase of the free fatty acid levels in the canola oil. High canola moisture at harvest is also a problem for seed storage as it could lead to bin heating/burning if seeds are improperly stored.

In December (2016), free fatty acids level of commercially clean Canola, No.1 Canada exports averaged 0.29% (0.32% for the 2016 August to November exports). The free fatty acids level of individual commercially clean Canola, No.1 Canada exports ranged from 0.12 to 0.83%. These averages were similar to not commercially clean exports, 0.27% for the 2016 August to December exports (Table 6).

Free fatty acid content might be a problem with canola exports this year, it is expected that the FFA will remain higher this year that they were during last year shipping season (0.36%). As it was observed in the August-December exports, it is likely that large variations will be observed with shipments showing high FFA levels. Over the year it has also been noticed that FFA levels increase during the shipping season as hydrolytic enzymes are still active in the seeds.

Fatty acid composition

The average level of erucic acid in the 2016 crop was 0.01%, which is identical to what was observed for the last 5 years (0.02%) (Tables 1, 5, Figure 12). Similar to 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 9.6%, similar to what was observed in 2015 (9.7%) and similar to the 5-year average (9.5%) (Table 1, Figure 13). This year, the α-linolenic acid averages were lower in Manitoba (9.3%) than in Saskatchewan (9.5%). Alberta-B.C. had the highest average (9.9%) (Table 5). The total content of poly-unsaturated fatty acids or PUFA was 28.7, 28.5 and 28.6% in Manitoba, Saskatchewan and Alberta-B.C., for a western Canada average of 28.6%. For canola, the PUFA contents are directly related to the contents of α-linolenic acid (C18:3) and linoleic acid (C18:2). This year, the ratio omega-6/omega-3 (linoleic acid/α-linolenic acid) was 1.97 compared to 1.94 in 2015.

For Canola, No.1 Canada samples, mean oleic acid (C18:1) content of the 2016 crop was 62.6%, similar to what was observed in 2015 (63.6%) and the 5-year mean (62.7%) (Table 1, Figure 14). Oleic acid contents were similar in Manitoba (62.4%), Saskatchewan (62.6%) and Alberta-B.C. (62.6%) (Table 5). The total content of mono-unsaturated fatty acids or MUFA was 64.0, 64.2 and 64.2% in Manitoba, Saskatchewan and Alberta-B.C., for a Western Canada average of 64.2%.

The fatty acid composition (oleic acid, linoleic acid and α-linolenic acid) of the 2016 crop was similar when compared to the 2015 fatty acid contents). This led to an identical iodine value average for both 2016 and 2015, 113.1 units (Table 1, Figure 15). For Canola, No. 1 Canada, the iodine value averages were 112.8, 113.0 and 113.3 units for Manitoba, Saskatchewan and Alberta-B.C., respectively, reflecting the similar contents in both α-linolenic acid (C18:3) and linoleic acid (C18:2). The iodine value of individual samples ranged from 107.2 to 118.7, 106.0 to 119.1 and 107.1 to 120.0 units, in Manitoba, Saskatchewan and Alberta-B.C., respectively (Table 5).

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 6.7% in 2016 as in 2015 (Tables 1 and 5). Since 2009, the saturated fatty acid content averages varied from 6.6 - 6.9% (Table 1, Figure 18). In 2016, the saturated fatty acid content averages were similar for the 3 provinces, (6.8, 6.7 and 6.7% for Manitoba, Saskatchewan and Alberta-B.C., respectively). Total saturated fatty acids are usually affected by temperature, high temperatures lead to higher oil saturation.

For the first 5 months of the 2016-17 shipping season, α-linolenic acid averages for clean samples ranged from 8.9 to 10.2%, averaging 9.9 and 9.6% in December and in August-November respectively for commercially clean exports (Table 6). This is similar to what was observed during last shipping season (9.9%). When compared to last year's average, iodine value averages ranged from 111.6 to

114.5 units (until December 2016) similar to what was observed during the last shipping season (111.3 to 115.1 units). It is likely that the iodine value will remain similar to what was observed last year. The level of saturated fatty acids until December 2016 canola (6.7%) exports remained very similar to 2015-16 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 2016 harvest.

Figure 13 – Canola, No. 1 Canada, erucic acid content of harvest samples, 2000-16

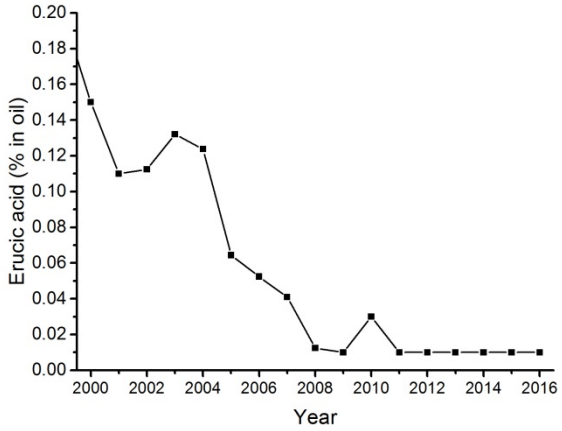


Figure 14 – Canola, No. 1 Canada, α-linolenic acid content of harvest samples, 2000-16

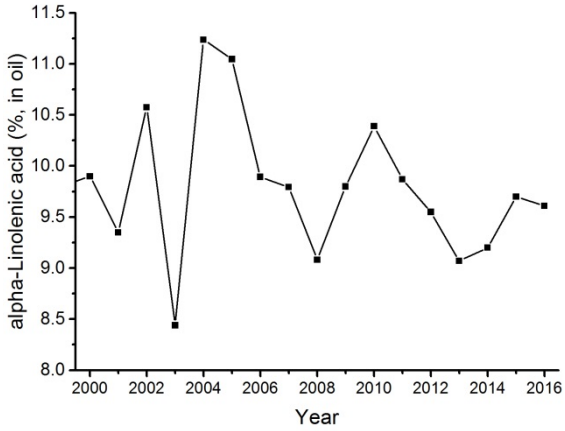


Figure 15 – Canola, No. 1 Canada, oleic acid content of harvest samples, 2000 - 16

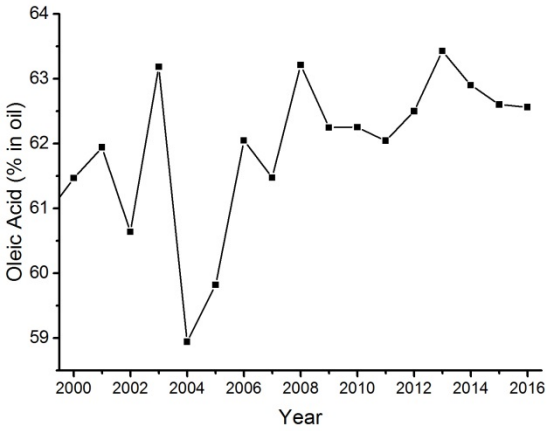


Figure 16 – Canola, No. 1 Canada, linoleic acid content of harvest samples, 2000 – 16

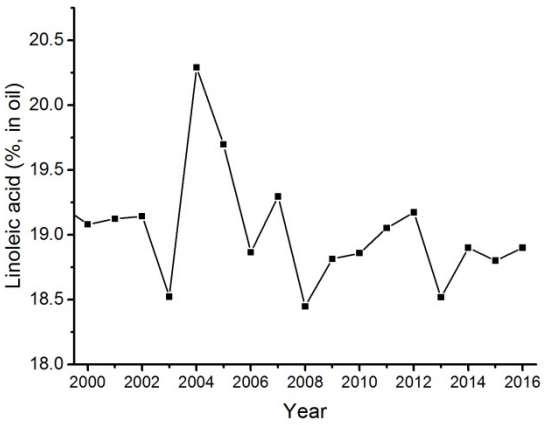


Figure 17 – Canola, No. 1 Canada, iodine value of harvest samples, 2000–16

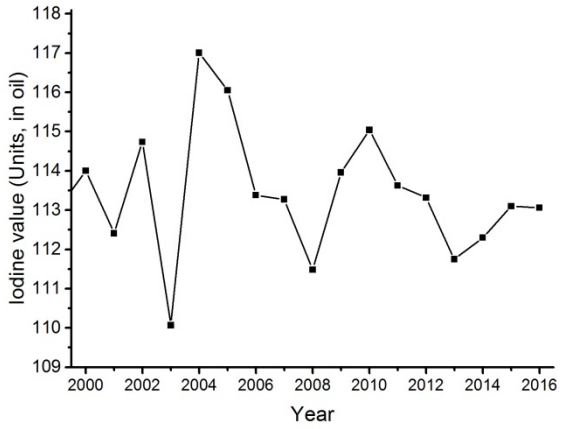


Figure 18 – Canola, No. 1 Canada, total Saturated fatty acid content of harvest samples, 2000-16

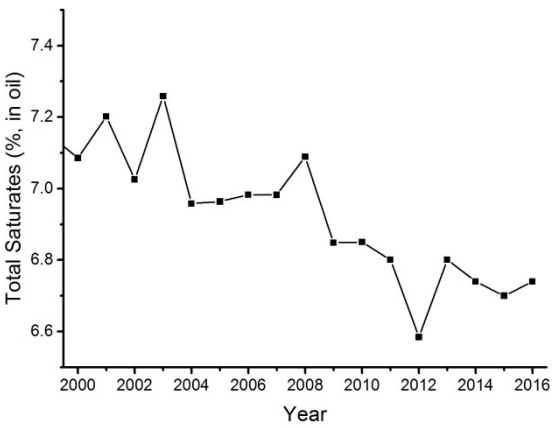


Table 3 – 2016 Harvest sample program
Canola quality data by grade and province – Oil, protein and chlorophyll contents

	Number of samples	Oil content[1] %			Protein content[2] %			Chlorophyll content mg/kg		
		mean	min.	max.	mean	min.	max.	Mean	min.	max.
Canola, No. 1 Canada										
Manitoba	417	43.5	37.5	49.5	20.6	16.4	24.8	10	4	27
Saskatchewan	806	44.8	37.1	50.0	19.6	15.6	26.0	11	4	38
Alberta-B.C.[3]	604	43.9	38.9	49.5	20.5	15.1	26.0	13	4	41
Western Canada[4]	**1827**	**44.3**	**37.1**	**50.0**	**20.1**	**15.1**	**26.0**	**11**	**4**	**41**
Canola, No. 2 Canada										
Manitoba	12	41.4	39.2	43.8	22.4	20.7	24.7	18	8	33
Saskatchewan	15	43.6	40.1	48.2	20.0	16.8	22.7	22	10	54
Alberta-B.C.[3]	24	42.4	37.4	46.3	21.9	19.1	26.2	25	5	49
Western Canada[4]	**51**	**42.7**	**37.4**	**48.2**	**21.3**	**16.8**	**26.2**	**23**	**5**	**54**
Canola, No. 3 Canada										
Western Canada[4]	**11**	**43.2**	**41.7**	**47.1**	**19.9**	**18.0**	**21.4**	**15**	**6**	**45**
Canola, Sample Canada										
Western Canada[4]	**26**	**41.8**	**30.4**	**46.0**	**20.0**	**17.1**	**25.6**	**17**	**4**	**51**

[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

Table 4 – 2016 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	417	10	4	15	0.34
Saskatchewan	806	10	4	16	0.16
Alberta –B.C.[2]	604	10	6	19	0.21
Western Canada[3]	**1827**	**10**	**4**	**19**	**0.20**
Canola, No. 2 Canada					
Manitoba	12	11	10	13	1.22
Saskatchewan	15	12	8	14	0.17
Alberta-B.C.[2]	24	10	7	15	0.73
Western Canada[3]	**51**	**11**	**7**	**15**	0.58
Canola, No. 3 Canada					
Western Canada[3]	**11**	**10**	**7**	**13**	**0.32**
Canola, Sample Canada					
Western Canada[3]	**26**	**12**	**8**	**30**	**0.32**

[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 – 2016 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	1.8	62.4	19.3	9.3	0.00	6.8	112.8
Saskatchewan	1.7	62.6	18.9	9.5	0.01	6.7	113.0
Alberta-B.C.[1]	1.7	62.6	18.7	9.9	0.01	6.7	113.3
Western Canada[2]	**1.7**	**62.6**	**18.9**	**9.6**	**0.01**	**6.7**	**113.1**
Canola, No. 2 Canada							
Manitoba	1.9	62.3	18.8	9.4	0.00	6.9	
Saskatchewan	1.7	61.8	19.3	9.9	0.04	6.8	
Alberta-B.C.[1]	17	62.7	18.3	9.8	0.00	6.6	
Western Canada[2]	**1.7**	**62.3**	**18.8**	**9.8**	**0.01**	**6.7**	**113.2**
Canola, No. 3 Canada							
Western Canada[2]	**1.7**	**60.4**	**19.8**	**11.0**	**0.14**	**6.4**	**116.5**
Canola, Sample Canada							
Western Canada[2]	**1.8**	**62.0**	**19.3**	**9.6**	**0.03**	**6.9**	**113.1**

[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 2016 harvest sample averages with export shipment average

Canola, No. 1 Canada - only	2016 Harvest program	Exports			
		December 2016	August to November 2016	August to December 2016	Previous year 2015-16
Quality parameter		**CC[4]**	**CC[4]**	**NCC[5]**	**CC[4]**
Oil content[1] (%)	44.3	43.8	43.5	43.7	43.2
Protein content[2] (%)	20.0	20.2	20.5	19.8	20.9
Oil-free protein content[2] (%) at 12% moisture (%)	37.4	37.2	37.5	36.5	38.0
Chlorophyll (mg/kg seed)	11	14	14	12	17
Total glucosinolates[1] of the seed (µmol/g seed)	10	12	12	13	13
Free fatty acids, %	0.20	0.29	0.32	0.27	0.36
Erucic acid (% in oil)	0.01	0.01	0.02	0.06	0.02
Oleic acid (% in oil)	62.6	62.3	62.6	62.4	62.4
α-Linolenic acid (% in oil)	9.6	9.9	9.6	9.7	9.9
Total saturated fatty acids[3] (% in oil)	6.7	6.7	6.7	6.7	6.6
Iodine value	113.1	113.6	113.1	113.2	113.4
MUFA	64.2	63.9	64.3	64.1	64.1
PUFA	28.6	28.9	28.5	28.7	28.7
Distinctly green seed (DGR, %)	0.47	0.50	0.51	0.43	0.80
Dockage (%)	0.00	1.77	1.79	2.72	1.99
Loading moisture (%)	NA	8.8	8.2	8.2	8.03
Number of export samples	NA	26	84	2	240
Tonnage	NA	901,961	2,660,100	64,529	9,004,301

[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).
[4] CC = Commernically Clean
[5] NCC = Not commercially clean
NA = Non applicable