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Quality of Canadian canola 2023

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Canadian Grain Commission | Commission canadienne des grains

Canada

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Summary

In 2023, the percentage of canola samples graded No. 1 Canada was 95.7%, higher than in 2022 (92.9%) and the 5-year mean of 86.8% (Table 1). Alberta-Peace River had the lowest percentage of No. 1 canola samples at 92.7% (91.7% in 2022), followed by Manitoba at 95.8% (89.3% in 2022) and Saskatchewan at 98.5% (95.8% in 2022). Crop district 6 from Alberta-Peace River had the lowest percentage of No. 1 canola samples (84.2%).

Canadian No. 1 canola was characterized by a higher mean oil content in 2023 than in 2022 (43.2% versus 42.1%) and a lower mean protein content in 2023 than in 2022 (21.8% versus 22.4%) (Table 1). The mean chlorophyll content for No. 1 canola in 2023 was 9 milligrams per kilogram (mg/kg), identical to that in 2022 (Table 1). The mean total glucosinolate content of seeds in 2023 was 12 micromoles per gram (µmol/g), also identical to that in 2022.

The fatty acid composition data for the 2023 and 2022 canola crops are found in Table 1. The 2023 mean oleic acid content was slightly lower than in 2022 (64.1% versus 64.6%) and slightly higher than the 5-year-mean (63.9%). Alpha-linolenic acid content in 2023 was higher than in 2022 (9.1% versus 8.2%), while mean linoleic acid content was lower in 2023 than in 2022 (17.9% versus 18.1%). Total saturated fatty acid content was slightly lower in 2023 than in 2022 (6.6% versus 6.9%). This resulted in a much higher iodine value for the 2023 canola crop when compared to 2022 (111.3 units versus 109.5 units).

Mean free fatty acid content in No. 1 canola (0.21%) was similar to that in 2022 (0.26%) (Table 1). However, mean values from some Manitoba crop districts ranged from 0.44% to 0.61%.

Table 1 Quality data for 2023 and 2022 harvest samples of Canola, No. 1 Canada

Quality parameter	2023	2022	2018 to 2022 mean
Number of samples received	2,043	1,895	2,275
Number of samples graded Canola, No. 1 Canada	1,955	1,761	1,884
Percentage of samples graded Canola, No. 1 Canada	95.7	92.9	86.8
Oil content,%, 8.5% moisture	43.2	42.1	43.2
Protein content of seeds[1], %, 8.5% moisture	21.8	22.4	21.7
Protein content of oil-free meal, %, 12% moisture[2]	39.5	39.9	39.6
Chlorophyll content, mg/kg[3]	9	9	10
Total glucosinolate content of seeds, µmol/g[4], 8.5% moisture	12	12	10
Total glucosinolate content of oil-free meal, µmol/g, 8.5% moisture	23	21	20
Free fatty acids, %	0.21	0.26	0.19
Oleic acid, % in oil	64.2	64.6	63.9
Linoleic acid, % in oil	17.9	18.1	18.3
Alpha-linolenic acid, % in oil	9.1	8.2	8.9
Erucic acid, % in oil	0.02	0.00[5]	0.00
Total SFA[6], % in oil	6.6	6.9	6.7
Iodine value of oil, units	111.3	109.5	111.2
Total MUFA[7],% in oil	65.7	66.1	65.4
Total PUFA[8], % in oil	27.0	26.3	27.3

[1] Protein content of seeds calculated from nitrogen (N) content using N x 6.25 on an 8.5% moisture basis.

[2] Trading rules for the North American sale of canola meal requires that calculations for protein claims must be reported on a 12% moisture basis with N x 6.25.

[3] mg/kg = milligrams per kilogram.

[4] µmol/g = micromoles per gram.

[5] Level was below the limit of quantification.

[6] SFA = saturated fatty acids. Total SFA is the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0) acids.

[7] MUFA = monounsaturated fatty acids. Total MUFA is the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids.

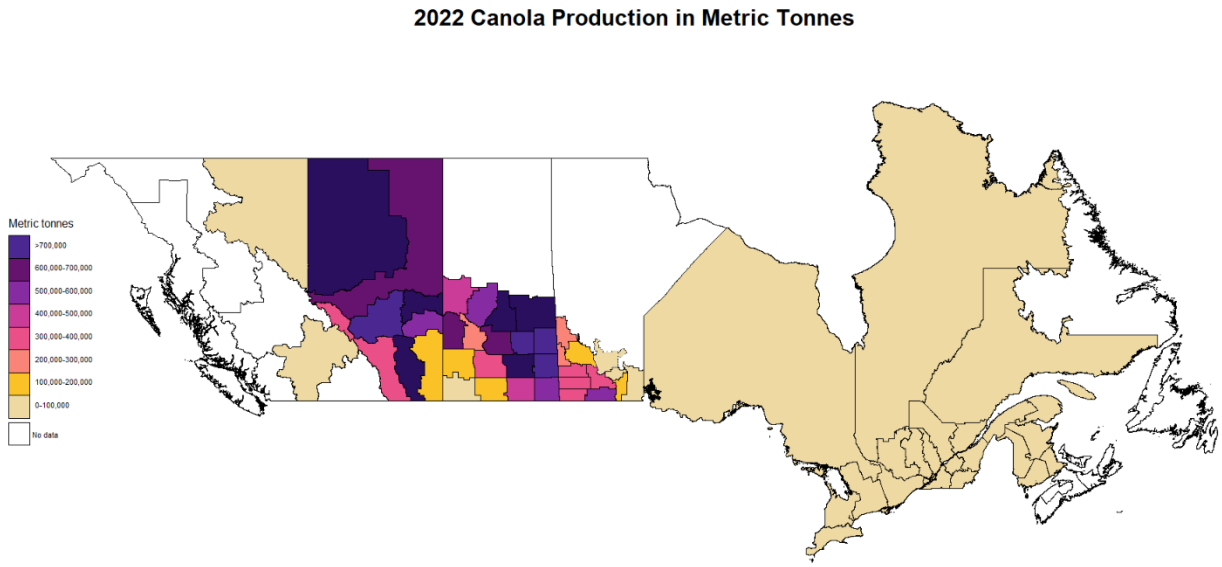
[8] PUFA = polyunsaturated fatty acids. Total PUFA is the sum of linoleic (C18:2), alpha-linolenic (C18:3) and eicosadienoic (C20:2) acids.

Introduction

This report presents quality data and information based on canola samples received from western Canada and eastern Canada (Ontario and Québec) by the Canadian Grain Commission's Harvest Sample Program in 2023. Samples were submitted throughout the harvest period by producers, grain companies and oilseed crushing companies. The following canola quality parameters were measured: oil, protein, chlorophyll, total glucosinolates, free fatty acids and fatty acid composition. Means based on all Canadian samples are weighted according to the production estimates for small areas in western provinces and all areas of Ontario and Québec. As a result, the eastern canola quality data have little influence on the Canadian means.

Figure 1 shows the distribution of canola production across Canada in 2022 for crop districts in Manitoba and Alberta, census agricultural regions (CARs) in Saskatchewan, Ontario and Québec. Prior to 2018, all canola production reporting in the Prairie provinces was based on small area data (SAD) that corresponded to crop districts. In 2018, Statistics Canada began using CARs to describe production areas in Saskatchewan instead of SAD. The new CAR approach did not correspond well with the crop districts in Saskatchewan, affecting the comparison of historical data. Samples received from the Peace River area of British Columbia (crop district 8) were combined with Alberta samples to calculate the Alberta-Peace River means. Quality data for theses samples are listed under Alberta-Peace River. No small area production data are available for Ontario and Québec.

Figure 1 2022 canola production in Canada according to crop districts (Manitoba and Alberta-Peace River), census agricultural regions (Saskatchewan) and eastern provinces



Weather and production review

The agroclimate maps (Figures 2 to 5) were obtained from Agriculture and Agri-Food Canada. Seeding and harvest progress graphs for each province (Figures 6 and 7) were created using data obtained from provincial reports for Manitoba, Saskatchewan and Alberta. The growing conditions and the harvest information for Québec and Ontario were obtained from La Financière agricole du Québec: État des cultures 2023, Crop Reports – Field Crop News and Prograin | Crop reports for Western & Eastern Canada and Maritimes. The number of hectares (ha) seeded with canola (Figure 8) and production data (Figure 9) were obtained from Statistics Canada.

Canada recorded many wildfires in 2023. The wildfire season has historically started in May but in 2023 it started in March and was fueled by hot and dry conditions, especially during May and June. In 2023, there were 700 wildfires in Ontario and Québec, 1,088 in Alberta and 2,245 in British Columbia. This corresponded to a total of 6,132 wildfires that burnt a total of 16.5 million ha in Canada. As a result, many areas in Canada were blanketed by smoke for several days during the 2023 growing season.

Seeding

Temperatures in south eastern Québec and Ontario were higher than normal in April and slightly lower than normal in May (Figure 2). Precipitation was higher than normal in April and early May in eastern Canada, leading to floods in certain areas. Later in May, precipitation decreased and 70% (Eastern Ontario) to 85% (Eastern Québec) of the canola crop was seed by May 23. By the first week of June, 94% of the crop was seeded in Québec, with seeding completed in the Chaudière-Appalaches, Capitale-Nationale and Montérégie (Saint-Hyacinthe) regions. The regions of Abitibi-Témiscamingue (95%), Saguenay-Lac-Saint-Jean (95%) and Bas-Saint-Laurent (90%) were slightly behind.

Like last year, below normal temperatures in April and spring snowstorms caused seeding to be delayed in western Canada compared to historical dates. May temperatures and a lack of precipitation, however, allowed seeding to progress smoothly in most areas. By the end of May, seeding was slightly ahead of the 5-year average in Alberta and slightly behind in Saskatchewan and Manitoba. Seeding was considered complete in the Prairies by the second week of June (Figure 6).

Growing season

In Québec, June precipitation was higher than normal, but a moisture deficit still affected all growing areas. Cooler temperatures also affected the development of the canola crops in the area. Temperatures were higher than normal in July for Québec and Ontario (Figure 2). In Québec, wind, rain, and hail in July led to crop damage. In Ontario, record precipitations and field ponding in July affected crop development. In August, the Abitibi-Témiscamingue region in Québec finally received some moisture, which greatly helped crop development. All other growing regions in Québec had very humid conditions and wet fields that limited producer access. During this period, weather conditions improved in Ontario.

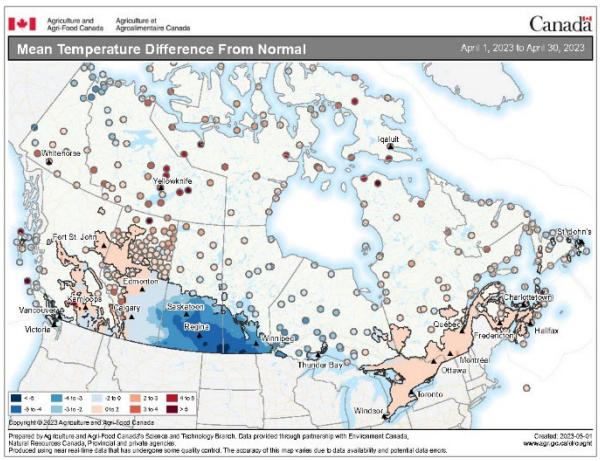
June temperatures were higher than normal in the Prairies (Figure 2) and precipitation was variable. The hot and dry weather in June accelerated crop development. July daytime temperatures were, for the most part, in the high 20°C to 30°C range (Figure 5), but the nights were cool with temperatures in the single digits (Figure 3). This resulted in July temperatures that were lower than normal in Manitoba and most of Saskatchewan, and slightly higher than normal in Alberta and the Peace River area (Figure 2). The cooler nights slowed crop development somewhat and most canola fields began flowering in July. Warmer than normal temperatures returned in August (Figure 2). The lack of moisture was an issue again this year (Figure 4) and precipitation was mostly localized, in the form of thundershowers. The southern and central regions of Alberta and the west-central and southwestern regions of Saskatchewan experienced drought like conditions during the 2023 growing season (Figure 4). Damage to canola fields was mainly due to heat, lack of moisture and grasshoppers.

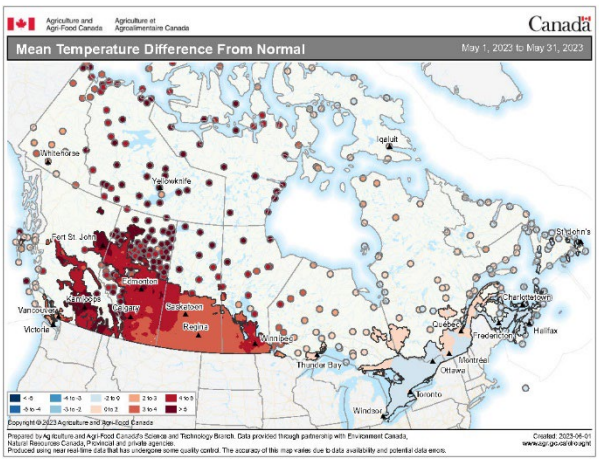
Harvest conditions

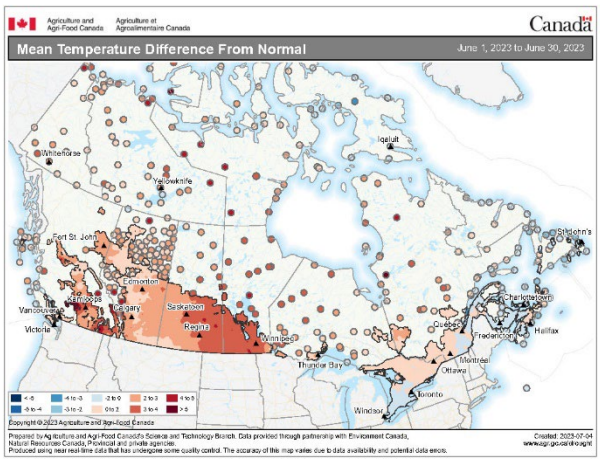
Good weather conditions allowed Québec producers to start their harvest in September. By September 12, 70% of the canola was harvested in the Montérégie (Saint Hyacinthe) region, which is consistent with the typical harvest. The canola harvest advanced slowly in September, but the pace picked up in early October due to favorable weather conditions. The Aitibi-Témiscamingue and Bas-Saint Laurent regions still had harvest delays compared to previous years. By the end of October, only 87% of the Québec canola was harvested compared to 91% in 2022 and 98% in 2021. In most regions of Ontario, canola planted in the spring remained in the fields until the end of September. Canola in northern Ontario was harvested in October, like the Aitibi-Témiscamingue region in Québec.

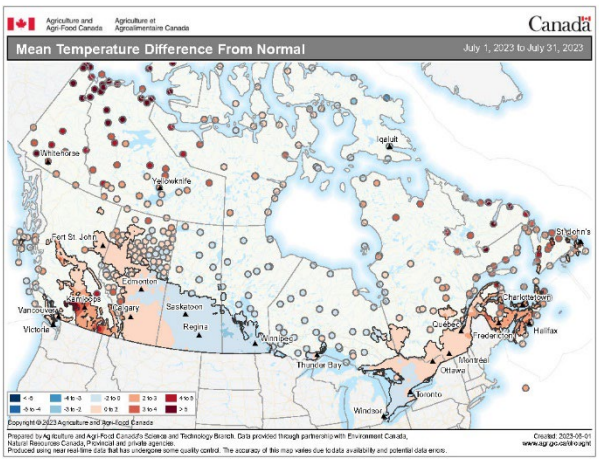
The swathing of canola started on a limited number of fields in mid-August in Manitoba and in the third week of August in Saskatchewan and Alberta. The 2023 canola harvest progressed quickly in the Prairies, due to low precipitation and warm temperatures (Figure 2). The harvest was considered complete by early October (Figure 7), a few days earlier than last year.

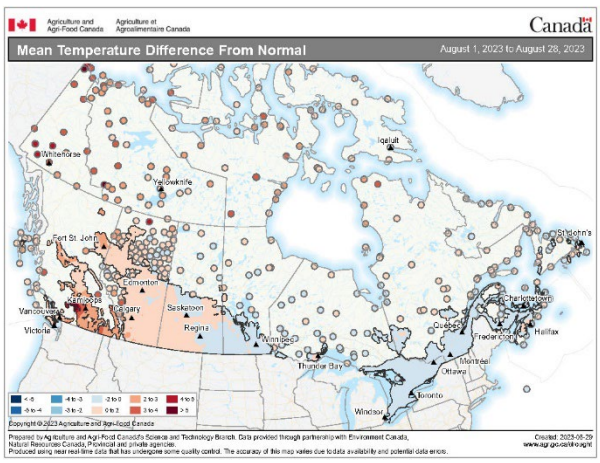
Figure 2 Mean temperature differences from normal in Canada from April 1 to September 30, 2023

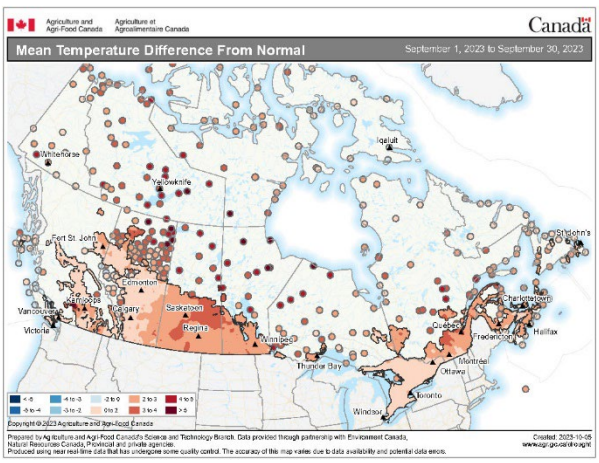






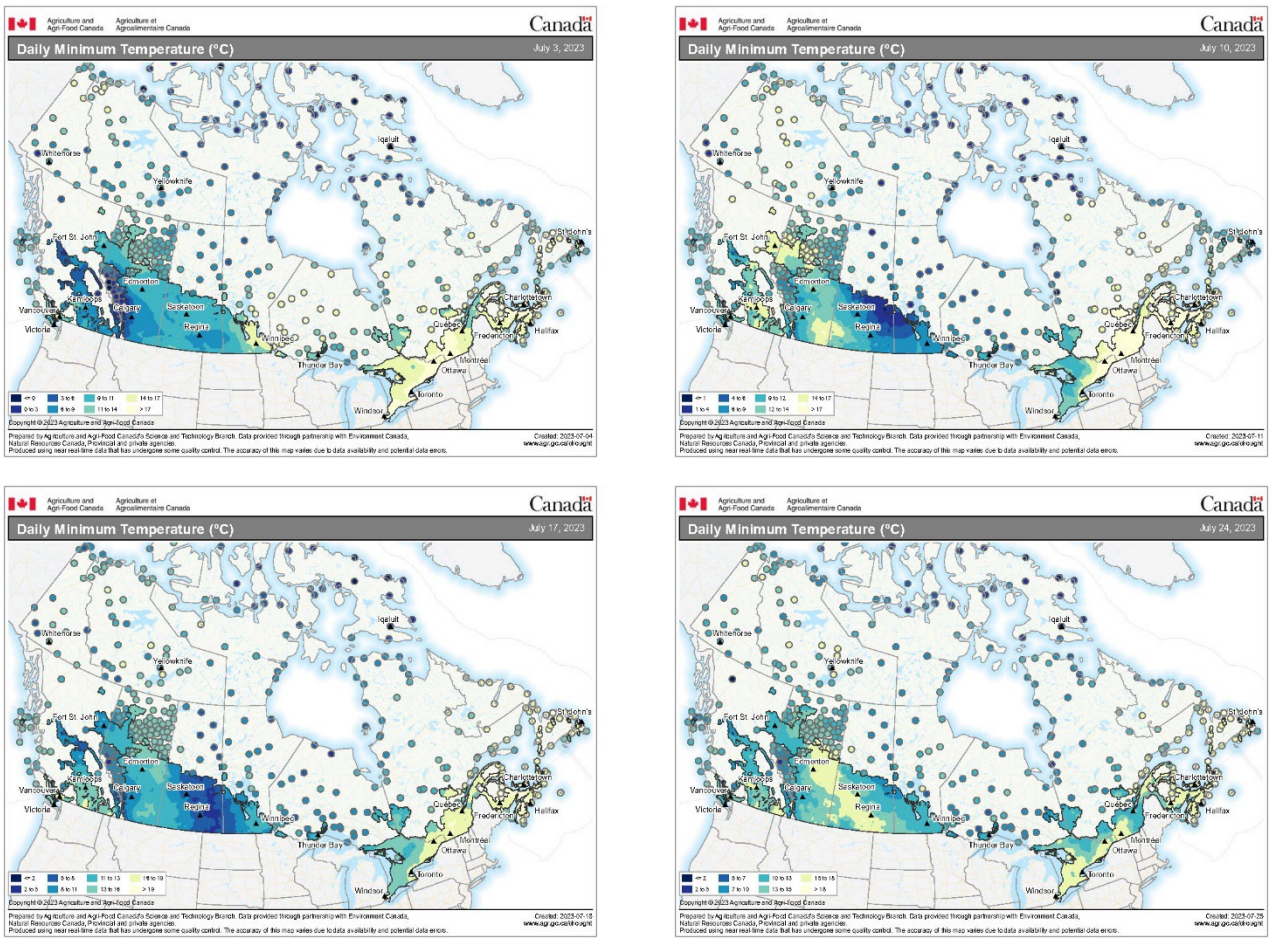






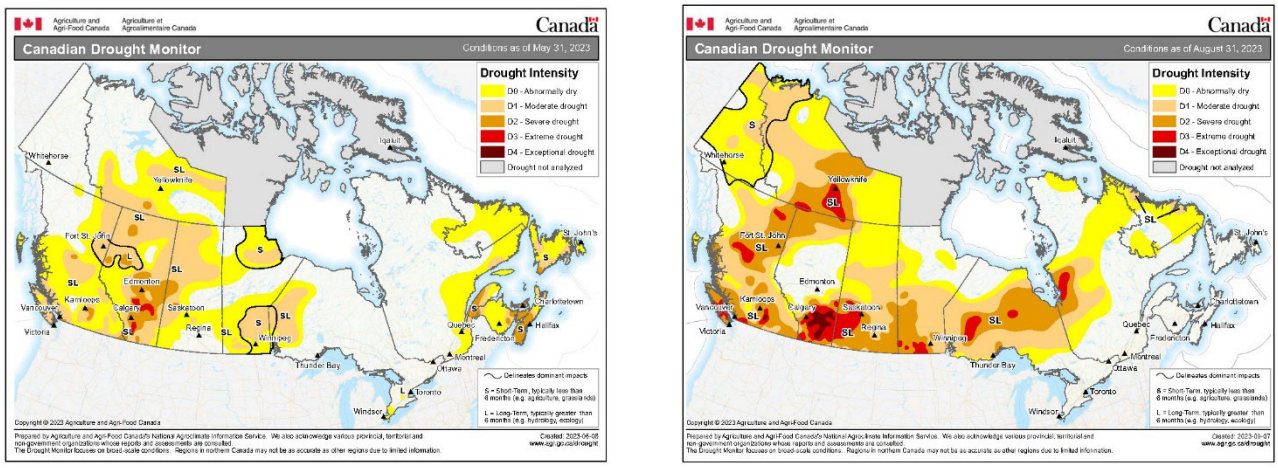
Source [Agriculture and Agri-Food Canada]

Figure 3 Daily minimum temperature (°C) in Canada on July 3, July 10, July 17 and July 24, 2023



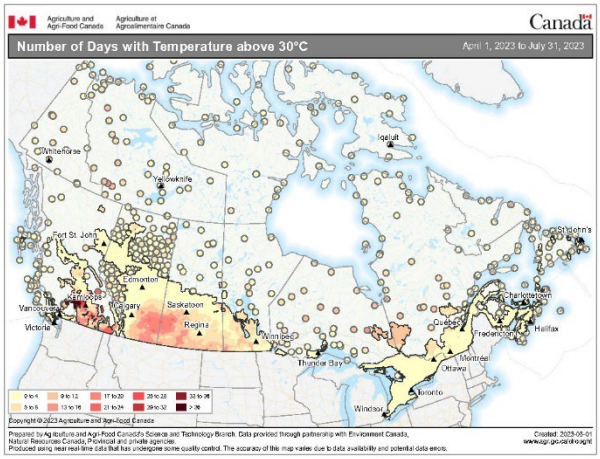
Source: Agriculture and Agri-Food Canada

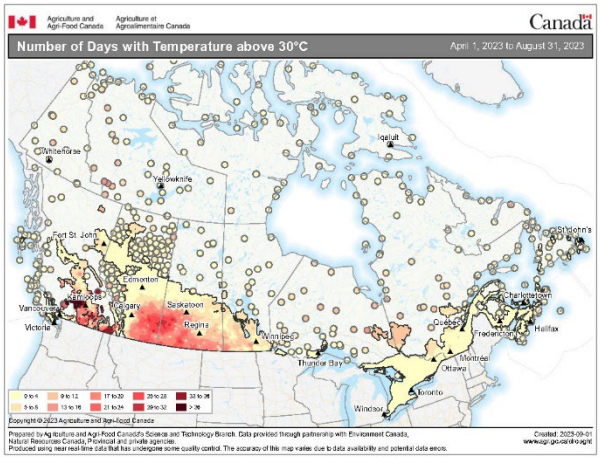
Figure 4 Drought intensity in Canada on May 31 and August 31, 2023



Source: Agriculture and Agri-Food Canada

Figure 5 Number of days with temperatures above 30°C in Canada from April 1 to July 31 and April 1 to August 31, 2023





Source: Agriculture and Agri-Food Canada

Figure 6 Seeding in Manitoba, Saskatchewan and Alberta during the 2022 and 2023 growing seasons[1]

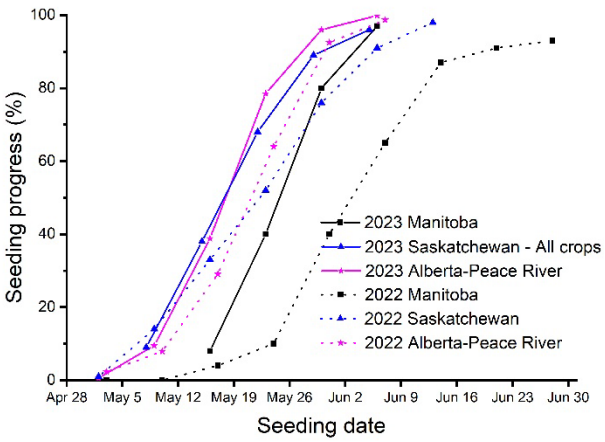
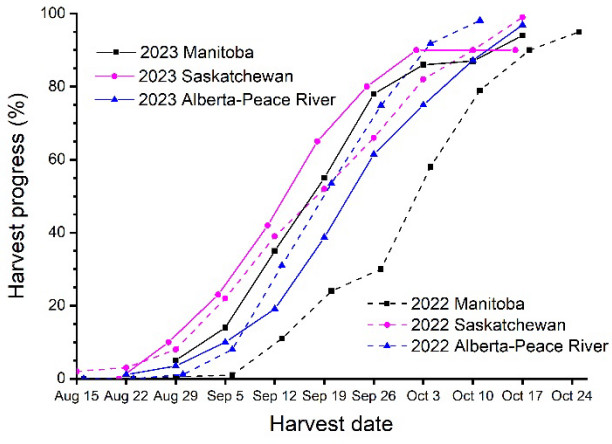


Figure 7 Harvest progress in Manitoba, Saskatchewan and Alberta during the 2022 and 2023 growing seasons[1]



[1] No data were available to produce similar graphs for Québec and Ontario.

Production

The number of hectares seeded with canola in Canada since 2000 is given in Figure 8. In 2023, it was estimated that canola producers seeded approximately 277,500 ha more than in 2022 (8,936,100 versus 8,658,600 ha). This is approximately 1.8% more than the 5-year average of 8,777,070 ha and 377,300 ha less than the record set in 2017, when 9,313,400 ha of canola was seeded (Figure 8).

Statistics Canada estimated the average yield of canola in 2023 in western Canada to be 2,070 kilograms per hectare (kg/ha). This is slightly lower than the yield reported in 2022 (2,114 kg/ha) and the 5-year average yield (2,146 kg/ha). In 2023, the highest average yield was reported in Ontario at 2,992 kg/ha (2,850 kg/ha in 2022), followed by Manitoba at 2,421 kg/ha (2,427 kg/ha in 2022), Québec at 2,292 kg/ha (2,236 kg/ha in 2022) and Alberta at 2,124 kg/ha (2,134 kg/ha in 2022). The lowest yields were observed in British Columbia at 1,967 kg/ha (1,699 kg/ha in 2022) and Saskatchewan at 1,950 kg/ha (2,127 kg/ha in 2022). The lack of water and the drought like conditions were once again responsible for these low yields in 2023.

As of February 2023, Statistics Canada estimated Canadian canola production at 18,328,233 metric tonnes (MT). This is slightly lower than last year's production of 18,694,768 MT and the 5-year average of 18,612,710 MT (Figure 9). The decrease in canola production in Canada over the last 3 years (Figure 9) can be attributed to the growing conditions, especially the high temperatures and low moisture levels. In 2023, 53.0% of the canola in Canada was produced in Saskatchewan (52.2% in 2022). Québec produced 0.16% (0.21% in 2022), Ontario 0.29% (0.33% in 2022), Alberta 16.7% (16.9% in 2022), Manitoba 29.4% (29.9% in 2022) and British Columbia 0.45% (0.37% in 2022).

Figure 8 Area seeded with canola (hectares) in Canada from 2000 to 2023

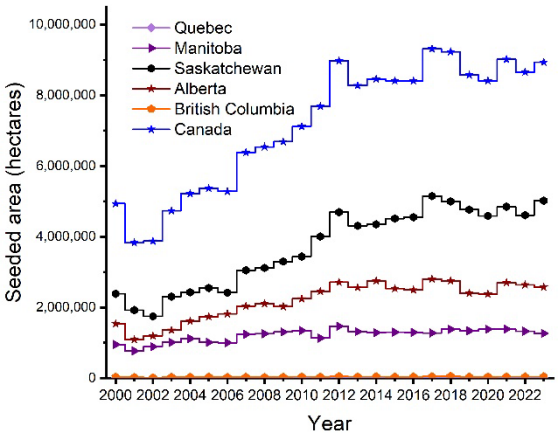
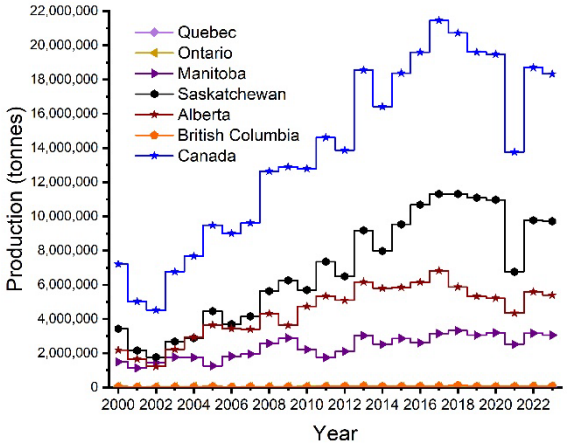


Figure 9 Canola production (metric tonnes) in Canada from 2000 to 2023



Harvest samples and grade distribution

The Canadian Grain Commission's Harvest Sample Program collected canola samples from producers, crushing plants and grain handling offices across Canada. The samples were cleaned to remove dockage prior to grading and testing. Canadian Grain Commission grain inspectors assigned grades based on Chapter 10 of the Official Grain Grading Guide, which applies to canola and rapeseed.

Individual harvest samples were analyzed for oil, protein, chlorophyll and total glucosinolate content using a near-infrared (NIR) spectrometer. This report, however, is based on the analyses, by reference methods, of composite samples. Canola composites were prepared by combining:

- No. 1 Canada samples from western Canadian crop districts and CARs, Ontario and Québec
- No. 2 Canada and No. 3 Canada samples from each province
- Sample Canada samples from western Canada

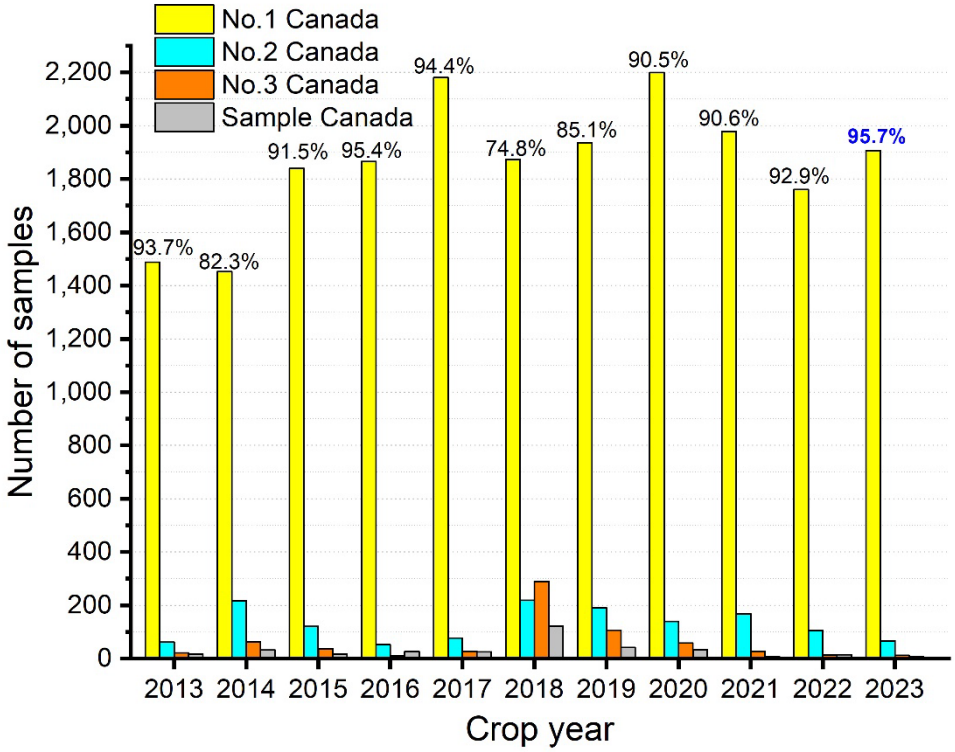
Oil, protein and total seed glucosinolate content are reported on an 8.5% moisture basis to permit annual and regional comparisons. The protein content of oil-free meal is reported on a 12% moisture basis, while the glucosinolate content of oil-free meal is reported on an 8.5% moisture basis to reflect meal-trading rules established by the Canadian Oilseed Processors Association (COPA).

Quality data for Manitoba and Alberta crop districts, Saskatchewan CARs and western Canadian canola varieties are published in Canadian Grain Commission Grain harvest and export quality reports.

This report for the 2023 harvest is based on the analyses of 2,043 individual canola samples, which included 1,955 that were graded No.1 (Table 1). Composites of No. 1 canola were made from samples from each crop district (Manitoba, Saskatchewan, Alberta and British Columbia) and from Ontario and Québec. Crop district and provincial composites of No. 1 canola samples were prepared from 2,011 samples. Specialty oil samples, such as high oleic acid, low linolenic acid and high erucic acid, are excluded from this report. In 2023, we received 148 more samples than in 2022, which is 232 fewer samples than the 5-year mean (Table 1).

Canadian export samples of commercially clean (CC) canola from August 2023 to December 2023 had a mean dockage of 1.3% and ranged in value from 0.60% to 2.50%. This negatively affected quality factors such as oil, chlorophyll and free fatty acids content. Canola exports containing more than 2.5% dockage are considered not commercially clean (NCC) and the values of their quality parameters are usually reduced even further.

Figure 10 Number of canola samples received by the Harvest Sample Program and their grade distribution from 2013 to 2023



In 2023, 95.7% of the canola harvest samples were graded No. 1. This is 2.8% higher than in 2022 (92.9%) and 8.8 % higher than the 5-year mean of 86.1% (Figure 10). The grade distribution of the 2023 canola crop varied

greatly between provinces and between crop districts within provinces. The main degrading factors observed in the 2023 canola were distinctly green (DGR) seeds, sprouting and admixture. The level of DGR seeds was 0.53% (0.56% in 2022) for No. 1 canola, 2.92% (3.13% in 2022) for No. 2 canola, 8.18% (7.33% in 2022) for No. 3 canola and 0.81% (0.94% in 2022) for Sample grade.

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. There were sufficient samples, however, to provide good quality information for each province and grade. Provincial and western Canadian means were calculated using the quality results for each crop district or CAR, weighted with the production data (5-year mean) and the grade percentile per crop district or CAR.

Quality characteristics

Tables 2 and 3 contain detailed information on the quality of Canadian canola harvested in 2023 in Québec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. Table 4 compares the quality of harvest samples to recent canola export samples. The weighted means from eastern Canada had little effect on the Canadian means since eastern production (Québec and Ontario) is minimal compared to western production (83,072 MT versus 18.24 million MT). The provincial data that have the most influence on the Canadian means are from Saskatchewan, as over 50% of Canadian canola is produced in Saskatchewan.

There were not enough samples graded No. 2 or lower from eastern Canada to prepare eastern composites of the lower grades and run statistical analyses. The lower grade results reflect the quality of canola from western Canada.

Oil content

In 2023, canola graded No.1 had an oil content of 43.2% (Table 1). This is higher than the 2022 mean of 42.1% and identical to the 5-year mean, but lower than the 10-year mean of 43.9%. The 2023 and 5-year means are the same because the low mean oil content from 2021 (41.3%) and 2022 (42.1%) greatly influence the 5-year mean calculation and bring down the 5-year mean oil content compared to means from 2005 to 2020 (Figure 11). The 2023 mean oil content for No. 1 canola showed some recovery compared to 2021 and 2022 but compared to the values from 2005 to 2020 it is still low (Figure 11).

Canola graded No. 1 from the Alberta-Peace River region had a mean oil content of 43.8% (42.6% in 2022), higher than canola No. 1 from Manitoba (42.8% in 2023 versus 42.1% in 2022) and Saskatchewan (43.1% in 2023 versus 41.9% in 2022) (Table 2). Samples from eastern Canada had a higher mean oil content than samples from western Canada. Samples from Québec had a mean oil content of 43.6% (44.0% in 2022), whereas samples from Ontario had a mean oil content of 43.9% (44.9% in 2022).

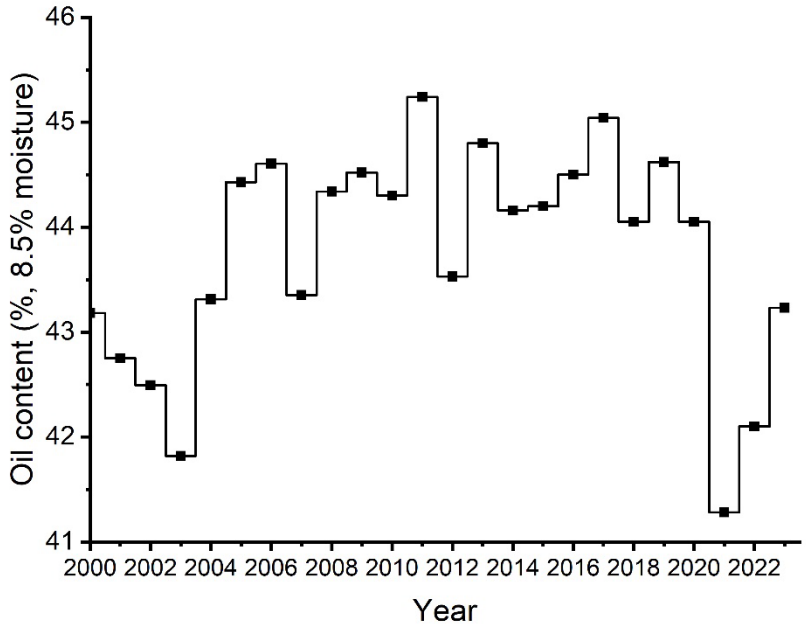
The oil content of individual canola samples graded No. 1 ranged from 37.4% to 49.1% in Manitoba (39.3% to 49.2% in 2022), 35.6% to 49.3% in Saskatchewan (34.9% to 48.2% in 2022), 35.9% to 52.3% in the Alberta-Peace River region (35.5% to 48.7% in 2022), 41.0% to 46.3% in Québec (41.8% to 46.7% in 2022) and 38.5% to 47.2% in Ontario (42.4% to 48.4% in 2022)(Table 2).

In 2023, the oil content of No. 2 canola from western Canada (42.6%) was lower than that of No. 1 canola from western Canada (43.2%). Most of the samples graded No.2 were from Alberta-Peace-River. These samples had a mean oil content of 43.7%, significantly higher than the mean from Saskatchewan (43.1%) and Manitoba (40.3%). Oil content for No. 2 canola samples from western Canada ranged from 37.4% to 47.6%, compared to 35.4% to 47.2% in 2022 (Table 2). The mean oil content of canola graded No. 3 and Sample from western Canada was 42.3% and 44.0%, respectively.

Oil content is influenced by both genetic and environmental factors. For any canola variety, hot and dry growing conditions, rather than cool conditions, results in canola seeds with low oil content. The 2023 growing season was again very dry. Some of the canola crop that began the growing season under moderate drought conditions completed the season under severe drought, with some areas of Alberta reporting extreme to exceptional drought conditions (Figure 4). However, timely rains in the form of thundershowers helped the crop to develop, even if the rain did not replenish the soil moisture. In 2023, there was again a large number of days with temperatures over 30°C. These conditions occurred mainly in August, after most of the crop had finished flowering. The main difference from the 2022 growing season was the low night temperatures in July, as low as single digits in some areas (Figure 3). This helped the canola plants recover from the heat of the day and the morning dew also likely helped them recover from the lack of moisture. The Peace-River area in British-Columbia (crop district 8) and Alberta crop district 7 had above average temperatures during the entire growing season (Figure 2), in addition to a lack of moisture (Figure 4). Night temperatures were quite low (Figure 3),however, and this likely helped the canola crop since the mean oil content was the highest observed in 2023 at 46.6% (8.5% moisture) for both the Peace River area and Alberta crop district 7.

One factor that has an unknown effect on the quality of the 2023 crop is the blanket of smoke from the intense forest fires that ravaged Canada this year. Currently, there is no study examining the effects of smoke on canola crop quality.

Figure 11 Oil content (%, 8.5% moisture) for Canola, No. 1 Canada



The mean oil content of CC No.1 canola exports was 42.7% for December 2023 and 41.8% for August to November 2023 (Table 4). Compared to the harvest samples, the CC and the NCC export samples of No.1 canola had a lower mean oil content due to dilution from dockage. Harvest samples are completely clean (0.00% dockage). Mean dockage for the CC exports was 1.2% for December 2023 and 1.3% for August to November 2023. Dockage for the 2022 to 2023 shipping season was 1.3% (Table 4). NCC exports had a mean dockage of 2.7% for August to December 2023 (Table 4). The export samples from the beginning of this year's shipping season showed an increase in oil content compared to last year, which corresponds to the increase in oil content found in the 2023 harvest samples compared to 2022.

Protein content

The mean protein content of canola seed (8.5% moisture) and the calculated mean protein content of oil-free meal (12% moisture) from 2000 to 2023 are given in Figures 12 and 13, respectively. The Canadian mean protein content of seeds was 21.8% for No. 1 canola, 22.4% for No. 2 canola, 21.9% for No. 3 canola and 19.9% for canola graded Sample (Table 2). The mean protein content of seeds for No. 1 canola in 2023 (21.8%) was lower than in 2022 (22.4%) and much lower than the record high observed in 2021 (24.0%), but similar to the 5-year mean of 21.7% (Table 1 and Figure 12). The protein content of seeds for individual No. 1 canola samples ranged in value from 20.0% to 23.6% for Québec, 17.8% to 24.5% for Ontario, 17.4% to 26.7% for Manitoba, 15.5% to 29.6% for Saskatchewan and 15.5% to 29.2% for Alberta-Peace River. The mean protein content of seeds for western Canadian samples ranged in value from 19.0% to 25.5% for No. 2 canola, 20.4% to 28.5% for No. 3 canola and 19.1% to 20.7% for canola graded Sample (Table 2).

A strong inverse relationship between oil and protein content can be observed in canola seeds. In 2023, mean seed oil content was about 1.1% higher than in 2022 and seed protein content concurrently decreased by 0.6% compared to 2022.

The mean protein content of seeds for CC exports of No. 1 canola was 21.9% for December 2023 and 22.3% for August to November 2023 (Table 4). Mean protein content of seeds for the previous shipping season (August 2022 to July 2023) was higher than that for this year's shipping season, which is consistent with the 2023 canola protein content of harvest samples (Table 4).

Figure 12 Protein content of seeds (%, 8.5% moisture) for Canola, No. 1 Canada

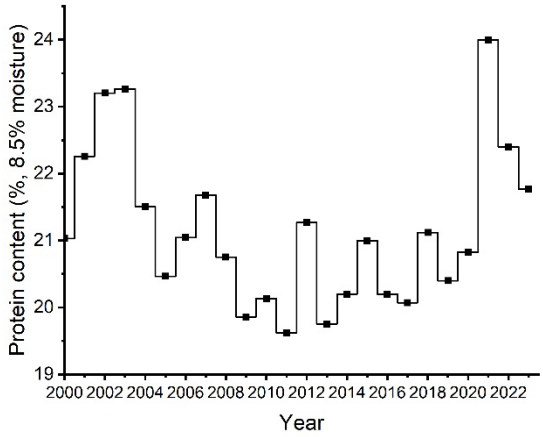
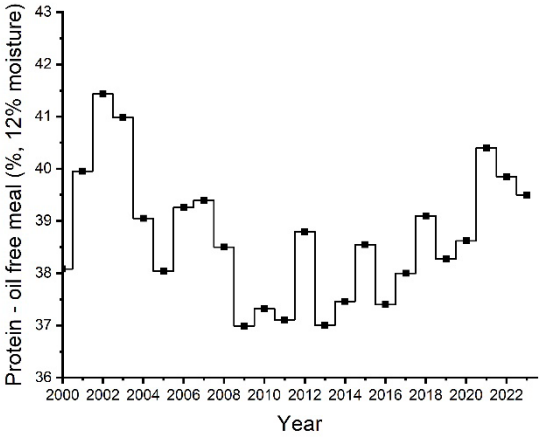


Figure 13 Protein content of oil-free meal (%, 12% moisture) for Canola, No. 1 Canada



The calculated protein content of oil-free meal is the maximum protein content of a theoretical meal that would be obtained if a crushing plant was able to extract 100% of the oil from the seeds. In 2023, the calculated mean protein content of oil-free meal at 12% moisture was 39.5%. This is slightly lower than the 2022 value of 39.9% and much lower than the value from 2021 (42.0%), but similar to the 5-year mean of 39.6% (Table 1 and Figure 13). The calculated protein content of oil-free meal at 12% moisture was highest for samples from Alberta-Peace River (39.9% in 2023 versus 40.4% in 2022), followed by Saskatchewan (39.7% in 2023 versus 39.8% in 2022) and Manitoba (38.2% in 2023 versus 38.9% in 2022).

The calculated mean protein content of oil-free meal at 12% moisture for CC export samples of No. 1 canola was 39.5% for August to November 2023 and 39.4% for December 2023. These results are slightly lower than the value of 39.7% determined for the previous shipping season (August 2022 to July 2023) for CC export samples of No. 1 canola (Table 4).

Chlorophyll content

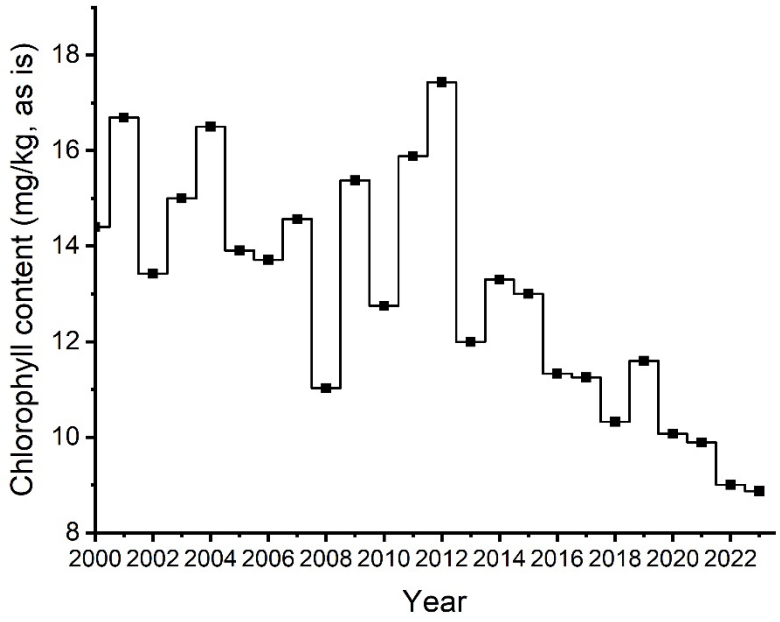
In 2023, the mean chlorophyll content for all Canadian samples graded No. 1 was 9 mg/kg, 5 mg/kg for Québec samples, 4 mg/kg in Ontario samples, 7 mg/kg in Manitoba samples, 7mg/kg in Saskatchewan samples and 12 mg/kg in Alberta-Peace River samples (Table 2). The Canadian mean is identical to that from the 2022 harvest (9 mg/kg) and lower than the 5-year mean of 10 mg/kg (Table 1). This is the lowest mean chlorophyll content value observed in the last 10 years (Figure 14). Individual samples of No. 1 canola showed variations in

chlorophyll content due to variable growing conditions. The chlorophyll content of No. 1 canola samples ranged in value from less than 3 mg/kg to 11 mg/kg in Québec, 3 mg/kg to 9 mg/kg in Ontario, 3 mg/kg to 30 mg/kg in Manitoba, 3 mg/kg to 25 mg/kg in Saskatchewan and 3 mg/kg to 56 mg/kg in Alberta-Peace River (Table 2). Canola from Alberta crop districts 5 and 6 (western part of the central and the north-central districts) had the highest mean chlorophyll content values at 17 mg/kg and 18 mg/kg, respectively.

The mean chlorophyll content of canola samples graded No. 2 was 21 mg/kg (Table 2), similar to that in 2022 (22 mg/kg). Canola samples graded No. 3 and Sample had a mean chlorophyll content of 42 mg/kg and 20 mg/kg, respectively. This is similar to that observed in 2022, which was 35 mg/kg for No. 3 canola and 17 mg/kg for Sample grade canola. Samples of the lowest grade of canola were downgraded for several factors other than immaturity.

Historical means of chlorophyll content vary greatly from year to year (Figure 14) due to variable growing conditions. High chlorophyll content can be related to a one or more factors, including delays in seeding because of cold temperatures and rain, poor growing conditions due to a lack of heat units, and an early frost. Seeding was delayed in 2023 due to cold weather in April and snow in early May, but temperatures throughout May and June were warmer than normal, which allowed for generally uninterrupted seeding. There was no early frost and temperatures remained above normal until the end of the growing season, allowing canola crops to mature without problems.

Figure 14 Chlorophyll content of seeds (mg/kg, as is moisture) for Canola, No. 1 Canada



Canola graded No. 1 must contain no more than 2.00% distinctly green (DGR) seeds. The mean DGR seed content in No. 1 canola samples in 2023 was 0.47% (0.54% in 2022) for Québec, 0.55% (0.28% in 2022) for

Ontario, 0.72% (0.80% in 2022) for Manitoba, 0.43% (0.48% in 2022) for Saskatchewan and 0.62% (0.59% in 2022) for Alberta-Peace River. This gave a Canadian mean DGR seed content of 0.53%.

The chlorophyll content of Canadian canola export samples is affected by DGR seed and dockage content. The mean DGR seed content was 0.5% for December 2023 CC canola export samples, 0.4% for August to November 2023 CC canola export samples and 0.3% for August to December 2023 NCC canola export samples (Table 4). The mean chlorophyll content for the CC December 2023 export samples (13 mg/kg of seeds) was slightly higher than that for the August to November 2023 CC canola export samples and the 2023 harvest samples, all of which had similar DGR seed content (Table 4).

Glucosinolate content

The mean total glucosinolate content of seeds at 8.5% moisture and the calculated mean total glucosinolate content of oil-free meal at 8.5% moisture from 2000 to 2023 are given in Figure 15 and Figure 16, respectively.

In 2023, canola No. 1 (Table 2) had a mean glucosinolate content of 12 µmol/g of seeds, identical to the 2022 mean but higher than the 5-year mean of 10 µmol/g of seeds. This is the highest mean glucosinolate content since 2015 (Figure 15). Mean total glucosinolate content was 9 µmol/g of seeds for Québec, 11 µmol/g of seeds for Ontario, 11 µmol/g of seeds for Manitoba, 12 µmol/g of seeds for Saskatchewan and 12 µmol/g of seeds for Alberta-Peace River. Samples from CARs 1, 2, 3 and 4 in southern Saskatchewan, CARs 7, 8 and 12 in west-central Saskatchewan, Alberta crop districts 1 and 2 in southeastern Alberta and the Peace River area in British Columbia all had a mean total glucosinolate content value greater than 14 µmol/g of seeds. These canola growing areas were most affected by the lack of moisture during the 2023 growing season (Figure 4). Figure 5 shows that there were a significant number of days in August with temperatures over 30°C in Alberta and parts of Saskatchewan. This year's results were consistent with the results from 2022 when both Alberta crop district 1 and Saskatchewan CAR 12 experienced severe to extreme drought conditions during the entire growing season. Samples from these specific areas had the highest total glucosinolate content at 18 µmol/g of seeds.

These observations and results agree with a research study from Australia that showed hot and dry conditions, post flowering, led to an increase in the total glucosinolate content of canola seeds. As in 2021 and 2022, heat and a lack of moisture were responsible for the increase in total glucosinolates observed in 2023.

The December 2023 and the August to November 2023 CC canola export samples had a mean total glucosinolate content of 9 µmol/g of seeds, which is similar to last year's shipping season (Table 4).

In 2023, 12 µmol/g of total glucosinolates in seeds corresponded to 23 µmol/g of total glucosinolates in oil-free meal on an 8.5% moisture basis (Table 1). This is higher than both the 5-year mean of 20 µmol/g and the 2022 mean of 21 µmol/g for oil-free meal (Figure 16 and Table 1). Total glucosinolate content in Canadian canola meal obtained from conventional crushing plants (expeller press followed by solvent extraction) is much lower than this calculated value. The calculated value assumes that 100% of the oil is recovered from the seed during crushing and that no glucosinolates are destroyed during processing, which is never the case.

Figure 15 Total glucosinolate content of seeds (µmol/g, 8.5% moisture) for Canola, No. 1 Canada

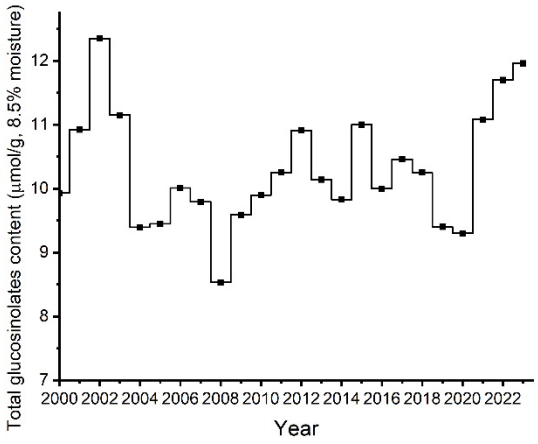
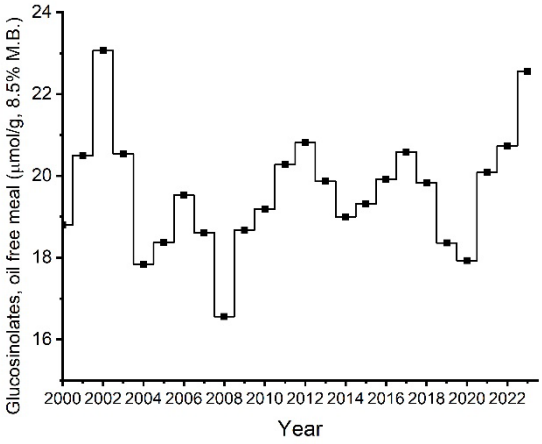


Figure 16 Total glucosinolate content of oil-free meal (µmol/g, 8.5% moisture) for Canola, No. 1 Canada



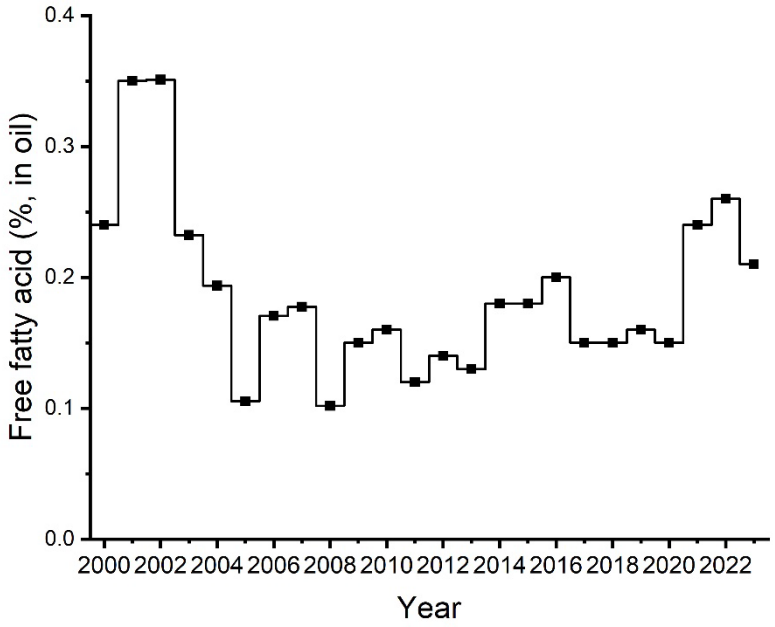
Free fatty acid content

In 2023, the mean free fatty acid (FFA) content of canola samples graded No. 1 was 0.21% (as oleic acid). This is slightly lower than the 2022 mean of 0.26% but similar to the 5-year mean of 0.19% (Table 1 and Figure 17). The mean FFA content for No. 1 canola samples (Table 2) from Manitoba (0.41% in 2023 versus 0.47% in 2022) was higher than that for Alberta-Peace River (0.20% in 2023 versus 0.31% in 2022) and Saskatchewan (0.16% in 2023 and 2022). These values are lower than the FFA means observed in samples from Québec (0.52% in 2023) and Ontario (0.49% in 2023). No. 1 canola samples from Manitoba had a higher mean FFA content than the western Canadian mean (0.21%) and ranged in value from 0.22% to 0.61%, which may pose a problem for local crushers.

In western Canada, canola samples graded No. 2 had a higher mean FFA content than those graded canola No. 1 (0.85% in 2023 versus 0.62% in 2022) (Table 2). Samples from Manitoba had the highest mean FFA content (1.61%), followed by Saskatchewan (0.92%) and Alberta (0.28%).

Plant stress and seed sprouting resulting from hot and dry growing conditions, rain at harvest, or both, can often lead to an increase in FFA content. Some Manitoba samples showed sprouting, which could explain their higher FFA content compared to samples from Alberta and Saskatchewan.

Figure 17 Free fatty acid content (% in oil, as oleic acid) for Canola, No. 1 Canada



The mean FFA level of CC canola No. 1 was 0.26% for the December 2023 exports and 0.27% for the August to November 2023 exports (Table 4). FFA levels of individual CC canola No. 1 export samples ranged in value from 0.14% to 0.46% (0.14% to 0.53% for last year's shipping season during the same period).

It has been observed that FFA levels can increase during the shipping season. Storage conditions can activate hydrolytic enzymes in seeds which leads to an increase in FFA production. FFA content could vary considerably from each load throughout the entire shipping season.

Fatty acid composition

The Canadian mean erucic acid (C22:1) content was 0.02% in 2023, slightly higher than the limit of quantification. Over the last several years, the mean erucic acid content in canola samples graded No. 1 ranged from below the limit of detection to just over the limit of detection (Tables 1 and 3, Figure 18). These low values are a direct result of breeding efforts by the Canadian canola industry.

In 2023, the mean alpha-linolenic acid (C18:3) content of all Canadian samples of canola graded No. 1 was 9.1%, much higher than the 2022 mean (8.2%) and slightly higher than the 5-year mean of 8.9% (Table 1 and Figure 19). Samples from Ontario had the lowest mean alpha-linolenic acid content (8.7%) followed by samples from Manitoba (8.9%), Saskatchewan (9.0%) and Québec (9.4%). Samples from Alberta-Peace River had the highest mean alpha-linolenic acid content at 9.5% (Table 3). Unlike last year, location had some effect on alpha-linolenic acid content. Samples from Alberta crop districts 5, 6, and 7 and the Peace-River area had alpha-linolenic acid means equal to or higher than 10%.

In 2023, the Canadian mean oleic acid (C18:1) content for No. 1 canola was 64.1%, lower than the 2022 mean of 64.6%, but much higher than the 5-year mean of 63.4% (Table 1 and Figure 20). The lowest mean oleic acid was found in samples from Québec (63.2% in 2023 versus 62.0% in 2022) and the highest in Manitoba (64.3% in 2023 versus 64.2% in 2022) (Table 3). The mean oleic acid was lower in 2023 than in 2022 for samples from Ontario

(63.8% in 2023 versus 64.4% in 2022), Saskatchewan (64.2% in 2023 versus 64.6% in 2022) and Alberta-Peace River (63.8% in 2023 versus 65.1% in 2022).

The mean total monounsaturated fatty acid (MUFA) content in 2023 was 64.9% in Québec (63.6% in 2022), 65.6% in Ontario (65.9% in 2022), 65.9% in Manitoba (65.8% in 2022), 65.8% in Saskatchewan (66.2% in 2022) and 65.2% in Alberta-Peace River (66.4% in 2022). The Canadian mean total MUFA was 65.7% in 2023, slightly lower than the 2022 mean of 66.0% and slightly higher than the 5-year mean of 65.4% (Tables 1 and 3).

Mean linoleic acid (C18:2) content was lower than last year (17.9% in 2023 versus 18.1% in 2022) (Figure 21) and the 5-year mean of 18.3% (Table 1). While linoleic acid decreased, alpha-linolenic acid content increased (Figure 19). Over the last 10 years (2013 to 2022), linoleic acid content has generally decreased (Figure 21). This decrease is likely related to genetics since changes from one year to another are related to environmental conditions. This year's oleic acid content decreased compared to last year, while oil content and alpha-linolenic acid content both increased this year compared to last year (Table 1, Figures 11, 19 and 20), which agrees with the effect of the cool night temperatures in July. Cool night temperatures would have led to an increase in linoleic acid content compared to last year if only environmental factors were affecting canola since cool temperatures help to increase the content of all polyunsaturated fatty acids. However, the linoleic acid content decreased in 2023 compared to last year (Figure 21), which suggests that the 2023 decrease was likely due to genetic factors and not the environmental growing conditions.

In 2023, the mean total polyunsaturated fatty acid (PUFA) content was 27.8% in Québec (28.9% in 2022), 27.0% in Ontario (26.6% in 2022), 26.8% in Manitoba (26.6% in 2022), 26.9% in Saskatchewan (26.2% in 2022) and 28.1% in Alberta-Peace River (26.2% in 2022). This resulted in a Canadian mean PUFA content of 27.0% (26.3% in 2022), compared to the 5-year mean of 27.3% (Tables 1 and 3). In canola, PUFA content is directly related to alpha-linolenic acid (C18:3) and linoleic acid (C18:2) content. In 2023, there was a 0.9% increase in alpha-linolenic acid and a 0.2% decrease in linoleic acid, which accounted for the 0.7% increase in PUFA content compared to last year.

Fatty acid composition (oleic acid, linoleic acid and alpha-linolenic acid) in the 2023 crop differed from that in 2022. There was a 0.4% and 0.2% decrease in oleic acid and linoleic acid, respectively, and a 0.9% increase in alpha-linolenic acid. As a result, the iodine value, which represents the degree of unsaturation in oil, was higher in 2023 (111.3 units) compared to 2022 (109.5 units) (Table 1). The 2023 iodine value was 1.8 units higher than last year, but similar to the 5-year mean of 111.2 units (Table 1). Even though the 2023 iodine value recovered from last year's record low, which was the lowest iodine value observed since 2000 (Figure 22), it is still lower than the 10-year mean of 111.9 units. For No. 1 canola, the mean iodine value in 2023 was 112.1 units (113.4 units in 2022) for Québec, 110.7 units (110.0 units in 2022) for Ontario, 110.8 units (109.8 units in 2022) for Manitoba, 111.0 units (109.3 units in 2022) for Saskatchewan and 113.7 units (110.2 units in 2022) for Alberta-Peace River (Table 3). In 2023, the iodine value of Canadian samples graded No. 1 ranged from 103.2 units to 121.3 units, while in 2022 it ranged from 104.2 units to 117.8 units. Canola samples graded No. 2 had a higher iodine value, linoleic and alpha-linolenic acid content, and lower oleic acid content than No 1 canola samples (Table 3).

The Canadian mean saturated fatty acid (SFA) content for canola No. 1 samples was 6.6% in 2023, which is slightly lower than the 2022 mean of 6.9% and the 5-year mean of 6.7% (Tables 1 and 3, Figure 23). Since 2009, the mean SFA content has varied between 6.6% and 6.9% (Figure 23). In 2023, the mean SFA content for No. 1 canola was 6.8% for samples from Québec and Ontario, 6.6% for samples from Manitoba and Alberta and 6.7% for samples from Saskatchewan (Table 3).

The fatty acid composition of the 2023 harvest samples corresponded well with the fatty acid composition of the August to December 2023 export samples (Table 4). Up to December 2023, oleic acid content was lower, while alpha-linolenic acid content and iodine value were higher for canola samples from this year's shipping season compared to last season.

Figure 18 Erucic acid content (% in oil) for Canola, No. 1 Canada

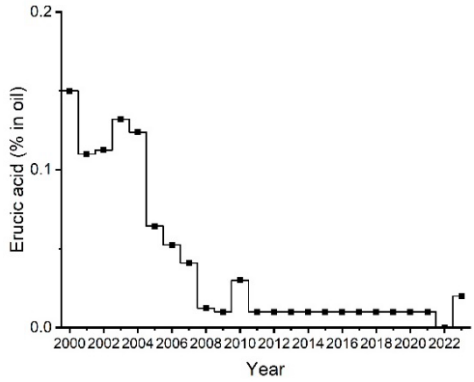


Figure 19 Alpha-linolenic acid content (% in oil) for Canola, No. 1 Canada

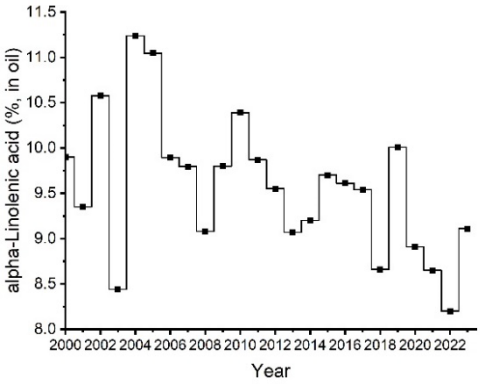


Figure 20 Oleic acid content (% in oil) for Canola, No. 1 Canada

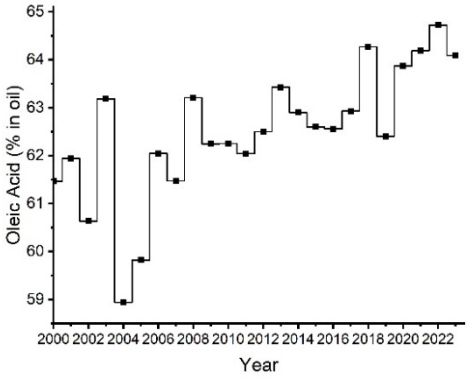


Figure 21 Linoleic acid content (% in oil) for Canola, No. 1 Canada

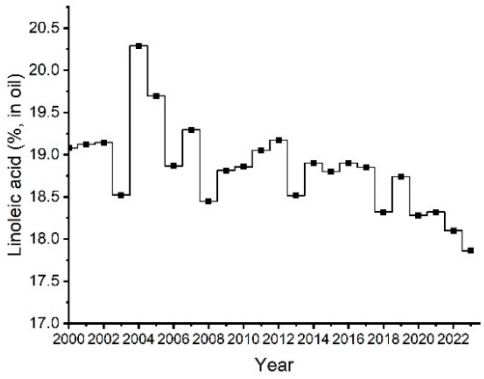


Figure 22 Iodine value of oil (units) for Canola, No. 1 Canada

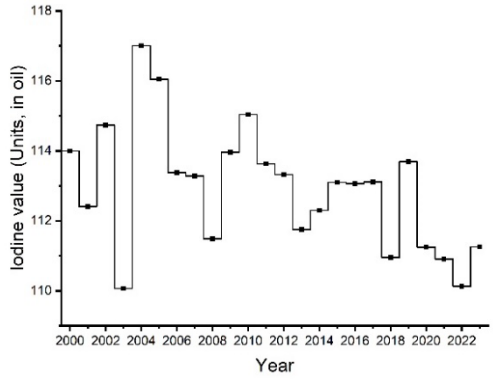


Figure 23 Saturated fatty acid content (% in oil) for Canola, No. 1 Canada

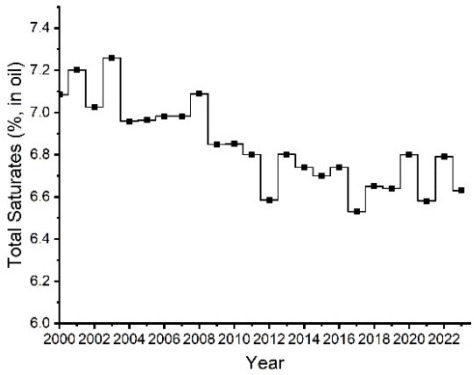


Table 2 Oil, protein, chlorophyll and total glucosinolate content and free fatty acid content of oil in 2023 canola harvest samples according to grade and province

Grade	Location	Number of samples	Oil content[1], %			Protein content[2], %			Chlorophyll content[3], mg/kg[4]			Glucosinolate content, µmol/g[5]			Free fatty acid content, %
			Mean	Min[6]	Max[6]	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Canola, No. 1 Canada	Québec	13	43.6	41.0	46.3	21.7	20.0	23.6	5	3	11	8	2	11	0.52
	Ontario	32	43.9	38.5	47.2	20.6	17.8	24.5	4	3	9	11	3	17	0.49
	Manitoba	402	42.8	37.4	49.1	21.7	17.4	26.7	7	3	30	11	2	15	0.41
	Saskatchewan	802	43.1	35.6	49.3	21.9	15.5	29.6	7	3	25	12	2	27	0.16
	Alberta-Peace River[7]	650	43.8	35.9	52.3	21.7	15.5	29.2	12	3	56	12	2	22	0.20
	Canada[8]	**1,899**	**43.2**	**35.6**	**52.3**	**21.8**	**15.5**	**29.6**	**9**	**3**	**56**	**12**	**2**	**27**	**0.21**
Canola, No. 2 Canada	Manitoba	15	40.3	37.4	43.2	24.0	21.6	25.5	13.	3	23	14	5	18	1.61
	Saskatchewan	7	43.1	40.2	46.2	22.1	19.0	24.5	18	8	28	11	5	10	0.92
	Alberta-Peace River	41	43.7	39.3	47.6	21.6	19.1	25.4	30	7	66	11	4	15	0.28
	Canada	**63**	**42.6**	**37.4**	**47.6**	**22.4**	**19.0**	**25.5**	**21**	**3**	**66**	**12**	**4**	**18**	**0.85**
Canola, No. 3 Canada	Manitoba														
	Saskatchewan	4	43.1	33.0	43.9	21.9	21.4	28.5	7	7	80	10	6	36	0.37
	Alberta-Peace River	6	41.3	40.0	45.2	21.8	20.4	24.0	82	36	63	11	6	13	0.37
	Canada	**10**	**42.3**	**33.0**	**45.2**	**21.9**	**20.4**	**28.5**	**42**	**7**	**80**	**10**	**6**	**36**	**0.37**
Canola, Sample Canada	**Canada**	**5**	**44.0**	**43.5**	**45.7**	**19.9**	**19.1**	**20.7**	**20**	**7**	**23**	**12**	**3**	**9**	**0.58**

[1] 8.5% moisture basis.
[2] Calculated from nitrogen (N) content using N x 6.25 on an 8.5% moisture basis.
[3] As-is moisture basis.
[4] mg/kg = milligrams per kilogram.
[5] µmol/g = micromoles per gram.
[6] Min = minimum, Max = maximum.
[7] Includes part of the Peace River area located in British Columbia.
[8] Values are weighted averages based on provincial production estimates from Statistics Canada

Table 3 Main fatty acid composition, total SFA[1], PUFA[2] and MUFA[3] content and iodine value of oil in 2023 canola harvest samples according to grade and province

		Relative fatty acid composition of oil (%)															
		Oleic acid (C18:1)			Linolenic acid (C18:2)			Alpha-linolenic acid (C18:3)			Erucic acid (C22:1)	SFA[1]	PUFA[2]	MUFA[3]	Iodine value[4] (units)		
Grade	**Location**	**Mean**	**Min[5]**	**Max[5]**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Min**	**Max**
Canola, No. 1 Canada	Québec	63.2	61.0	66.1	18.4	15.8	18.7	9.4	8.2	11.1	0.00	6.8	27.8	64.9	112.1	108.8	116.0
	Ontario	63.8	60.9	66.3	18.3	15.6	19.7	8.7	7.6	11.0	0.11	6.8	27.0	65.6	110.7	108.3	116.0
	Manitoba	64.3	59.1	70.5	17.8	15.8	20.6	8.9	5.4	11.7	0.01	6.6	26.8	65.9	110.8	103.2	117.9
	Saskatchewan	64.2	57.4	70.4	17.9	15.1	21.1	9.0	5.8	13.0	0.03	6.7	26.9	65.8	111.0	103.5	120.7
	Alberta-Peace River[6]	63.8	56.7	68.4	17.9	15.4	20.6	9.5	6.6	13.1	0.00	6.6	28.1	65.2	113.7	105.8	121.3
	Canada[7]	**64.1**	**56.7**	**70.5**	**17.9**	**15.1**	**21.1**	**9.1**	**5.4**	**13.1**	**0.02**	**6.6**	**27.0**	**65.7**	**111.3**	**103.2**	**121.3**
Canola, No. 2 Canada	Manitoba	63.0	60.3	65.8	18.2	15.9	19.5	9.6	8.3	11.3	0.02	6.6	27.9	64.8	112.3	108.7	115.7
	Saskatchewan	63.7	61.9	70.6	18.7	15.4	18.9	8.8	5.3	11.0	0.02	6.4	27.6	65.4	111.6	102.7	115.5
	Alberta-Peace River	62.5	59.5	65.9	18.6	16.7	20.1	9.9	8.8	12.0	0.02	6.6	28.5	64.2	113.2	110.1	117.9
	Canada	**63.1**	**59.5**	**70.6**	**18.6**	**15.4**	**20.1**	**9.4**	**5.3**	**12.0**	**0.02**	**6.5**	**28.0**	**64.8**	**112.4**	**102.7**	**117.9**
Canola, No. 3 Canada	Saskatchewan	63.14	57.7	64.5	19.2	17.8	20.3	8.8	8.4	11.3	0.00	6.5	28.1	64.7	111.9	110.1	116.6
	Alberta-Peace River	59.36	57.3	63.0	19.9	17.4	21.1	11.2	9.6	12.6	0.05	6.8	31.2	61.3	116.4	112.6	119.5
	Canada	**61.4**	**57.3**	**64.5**	**19.6**	**17.4**	**21.1**	**9.9**	**8.4**	**12.6**	**0.02**	**6.6**	**29.5**	**63.1**	**114.0**	**110.1**	**119.5**
Canola, Sample Canada	**Canada**	**63.9**	**60.1**	**69.1**	**19.1**	**15.7**	**19.6**	**7.9**	**5.9**	**11.9**	**0.00**	**6.5**	**27.1**	**65.6**	**110.2**	**103.7**	**117.1**

[1] SFA = saturated fatty acids. Total SFA is the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0) acids.

[2] PUFA = polyunsaturated fatty acids. Total PUFA is the sum of linoleic (C18:2), alpha-linolenic (C18:3) and eicosadienoic (C20:2) acids.

[3] MUFA = monounsaturated fatty acids. Total MUFA is the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids.

[4] Calculated from fatty acid composition.

[5] Min = minimum, Max = maximum.

[6] Includes part of the Peace River area located in British Columbia.

[7] Values are weighted averages based on provincial production estimates from Statistics Canada.

Table 4 Comparison of quality data from 2023 harvest samples and recent export shipments for Canola, No. 1 Canada

Quality parameter	2023 Harvest Sample Program	Commercially clean exports			Not commercially clean exports
		December 2023	August to November 2023	2022-2023 shipping season	August to December 2023
Oil content[1], %	43.2	42.7	41.8	41.3	41.2
Protein content of seeds[2], %	21.8	21.9	22.3	22.7	22.1
Protein content of oil-free meal[3], %	39.5	39.4	39.5	39.7	38.7
Chlorophyll[4], mg/kg of seeds[5]	9	13	12	10	10
Total glucosinolates[1], µmol/g of seeds[6]	12	9	9	10	9
Free fatty acids, % in oil, as oleic acid	0.21	0.26	0.27	0.29	0.44
Erucic acid, % in oil	0.02	0.01	0.01	0.02	0.00
Oleic acid, % in oil	64.2	63.6	64.2	65.0	65.1
Alpha-linolenic acid, % in oil	9.1	9.5	8.9	8.1	8.00
Total SFA[7], % in oil	6.6	6.6	6.7	6.9	6.9
Iodine value of oil[8], units	111.3	112.2	111.0	109.2	109.1
Total MUFA[9], % in oil	65.7	65.3	65.9	66.6	66.7
Total PUFA[10],% in oil	27.0	27.6	26.9	25.9	25.8
Distinctly green (DGR) seed, %	0.53	0.5	0.4	0.5	0.3
Dockage, %	n/a[11]	1.2	1.3	1.3	2.7
Loading moisture, %	n/a	7.77	7.66	7.27	7.77
Number of export samples	n/a	10	52	168	2
Tonnage, metric tonnes	n/a	393,042	1,879,562	6,953,857	67,325

[1] 8.5% moisture basis.
[2] Protein content of seeds calculated using nitrogen x 6.25, on an 8.5% moisture basis.
[3] Protein content of oil-free meal calculated using nitrogen x 6.25, on a 12% moisture basis.
[4] As-is moisture basis.
[5] mg/kg of seeds = milligrams per kilogram of seeds.
[6] µmol/g of seeds = micromoles per gram of seeds.
[7] SFA = saturated fatty acids. Total SFA is the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0) acids.
[8] calculated from fatty acid composition.
[9] MUFA = monounsaturated fatty acids. Total MUFA is the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids.
[10] PUFA = polyunsaturated fatty acids. Total PUFA is the sum of linoleic (C18:2), alpha-linolenic (C18:3) and eicosadienoic (C20:2) acids.
[11] n/a = not applicable.

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