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# Quality of western Canadian mustard

## 2019

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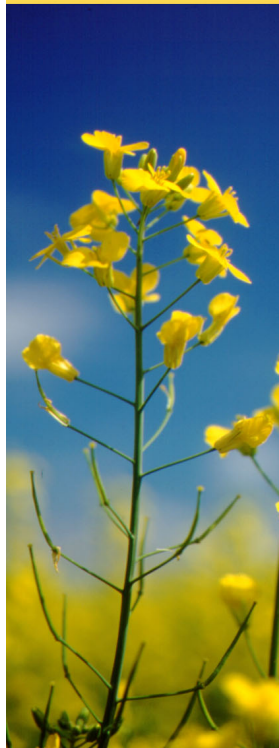
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The Canadian Grain Commission thanks mustard producers and grain handling plants in western Canada for supplying samples of mustard harvested in 2019. The Canadian Grain Commission recognizes its Industry Services grain inspectors for grading samples from the Harvest Sample Program and its Grain Research Laboratory staff for conducting the analyses and preparing the report.

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# Introduction

This report presents information on the oil, protein and total glucosinolate content, and the fatty acid composition of oriental (*Brassica juncea*), brown (*Brassica juncea*) and yellow (*Sinapis alba*) mustard grown in western Canada in 2019 (Figure 1). The data was obtained from analyses of harvest samples collected by the Canadian Grain Commission.

**Figure 1 – Mustard crops grown in Canada**



## Summary

Mean oil content for the top grade for oriental, brown and yellow mustard in the 2019 harvest was lower than the 10-year average (Figures 2, 3 and 4) at 41.4, 36.1 and 27.6% while the mean protein for the top grade oriental, brown and yellow mustard was higher at 26.8, 29.3 and 33.6%, respectively. Total glucosinolate content in the top grade mustard was 109 micromoles per gram ( $\mu\text{mole/g}$ ) for oriental and 104  $\mu\text{mole/g}$  for brown, which is lower than the 10-year average of 118  $\mu\text{mole/g}$  for oriental and 106  $\mu\text{mole/g}$  for brown mustard (Figure 5). Oil, protein and glucosinolates are reported on a dry matter basis.

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# Weather and production review

## Weather review

Relatively good weather over the month of May, albeit cooler and drier than normal, allowed nearly all the mustard to be seeded by the first week in June. Top soil moisture levels were a concern going into June and crop development was delayed. Towards the end of June, however, moisture conditions improved considerably along with the crop development.

The mustard crop continued to progress, although it was about two weeks behind normal, well into July and August with most of the reports claiming the crop was in good condition with the mustard growing regions receiving adequate moisture.

Harvest started by the last week in August but progress was slow and delayed by rain, snow and cool weather. After many starts and stops the harvest was essentially finished by the third week of October. (Saskatchewan Crop Reports - <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/market-and-trade-statistics/crops-statistics/crop-report/previous-crop-reports>) and Olds Products 2019 Crop Reports (<https://oldsproducts.com/crop-reports/>).

Temperature and precipitation patterns for the 2019 western Canadian growing season can be found on Agriculture and Agri-Food Canada's web site (<http://www.agr.gc.ca/DW-GS/historical-historiques.jsp?lang=eng&jsEnabled=true>).

## Production and grade information

As shown in Table 1, mustard seed production for 2019 decreased by at least 20% from 2018 to 134.6 thousand metric tonnes. The decrease was primarily a result of fewer seeded hectares. Yield was approximately 870 kilograms per hectare (Statistics Canada), which is about the same as last year's yield of 880 kilograms per hectare but lower than the 10-year average of 971 kilograms per hectare.

Saskatchewan accounted for 73% of western Canada's total seeded area and nearly 79% of mustard production while Alberta accounted for most of the remaining seeded area and production (Table 1).

This year 60% of samples were graded No. 1, very close to the 10-year average (2009-18). Growing and harvest conditions produced a mustard crop with some visible damage in all the mustards (Table 4). In Yellow mustard conspicuous admixtures from weed seeds and foreign material were also a major factor in lowering the grades of samples received in 2019.

**Table 1 – Seeded area and production for western Canadian mustard<sup>1</sup>**

Region	Seeded area	Seeded area	Production	Production	Mean production
	2019	2018	2019	2018	2009-18
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	0.7	2.0	0.8	2.2	0.2
Saskatchewan	118.2	152.0	106.2	134.7	122.0
Alberta	42.4	49.4	27.6	36.7	42.4
<b>Western Canada</b>	<b>161.1</b>	<b>203.4</b>	<b>134.6</b>	<b>173.6</b>	<b>164.6</b>

<sup>1</sup> Statistics Canada. Table 001-0010 - Estimated areas, yield, and production of principal field crops, in metric units. <https://www150.statcan.gc.ca/t1/tb1/en/tv.action?pid=3210035901>

## Harvest samples

This year's Harvest Sample Program included 153 mustard samples, down considerably from the 238 samples received in 2018. This included 93 yellow, 42 brown and 18 oriental mustard samples. Overall, 55% of the samples came from Saskatchewan, 43% from Alberta followed by 2% from Manitoba.

Producers and grain companies that routinely handle mustard seed submitted samples of mustard grown in 2019 to the Canadian Grain Commission. The individual samples were cleaned to remove dockage and were graded by Canadian Grain Commission inspectors, following Chapter 12 of the Official Grain Grading Guide (<https://www.grainscanada.gc.ca/oggg-gocg/ggg-gcg-eng.htm>).

Oil and protein contents on all individual whole-seed samples were determined by using a FOSS NIRSystems 6500 NIR spectrometer, calibrated to and verified against the appropriate listed reference methods. Total glucosinolate content was also determined on individual brown and oriental mustard samples. The reference procedures are listed under Oilseeds Methods <http://www.grainscanada.gc.ca/oilseeds-oleagineux/method-methode/omtm-mmao-eng.htm>.

Composite samples were analysed for oil, protein, total glucosinolates and chlorophyll content, as well as for fatty acid composition. Composites were prepared by combining No. 1 mustard samples by province and type and by combining No. 2, No. 3, No. 4 and Sample grades by western Canada and type. Composites were also prepared for the most common mustard varieties.

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## Effects of weather on quality

The mustard crop grown in western Canada in 2019 showed general characteristics of a crop well matured but with some damage due to inclement harvest conditions. The Grain Research Laboratory's long-term Harvest Sample Program results show that warm and dry growing conditions tend to produce an oilseed crop with higher protein and lower oil content, this trend was noticed in all the mustard types. Research also shows that total glucosinolate levels may decrease when *Brassica* crops are grown under cooler than normal conditions.

## Quality of Domestic Mustard Seed: Oriental and Brown

Oil, protein and total glucosinolate content for oriental and brown mustard is summarized by grade in Table 2. Comparisons to previous years' data are in Figures 2, 3 and 5.

Mean oil content (41.4%) in Oriental Mustard, No. 1 Canada was higher than the mean in 2018 (38.8%) while protein content (26.8%) was lower than the 2018 mean (29.2%) (Figure 2). Oil content in samples of Oriental Mustard, No. 1 Canada ranged from 36.6 to 43.4%, whereas protein content ranged from 22.8 to 29.5% (Table 2). The number of oriental mustard samples in the survey was significantly lower than in previous years which reduces the confidence in the results.

Mean oil content (36.1%) in Brown Mustard, No. 1 Canada was higher than in 2018 (35.2%) while protein content (29.3%) was lower than the 2018 mean (30.0%) (Figure 3). Oil content in samples of Brown Mustard, No. 1 Canada ranged from 29.3 to 40.8% while the protein content ranged from 24.0 to 32.0% (Table 2).

Total glucosinolate content in Oriental Mustard, No.1 Canada was 109  $\mu\text{mole/g}$ , lower than the 2018 value of 126  $\mu\text{mole/g}$  (Figure 5). The value for Brown Mustard, No.1 Canada was slightly lower than the value for 2018, 104 versus 111  $\mu\text{mole/g}$  (Figure 5). Total glucosinolate content in samples of Oriental Mustard, No. 1 Canada ranged from 68 to 131  $\mu\text{mole/g}$  while in Brown Mustard, No. 1 Canada the values ranged from 71 to 119  $\mu\text{mole/g}$  (Table 2).

Fatty acid composition of oriental and brown mustard composites is provided in Table 3. Erucic acid (C22:1) levels for Oriental Mustard, No.1 Canada (21.8%) and Brown Mustard, No.1 Canada (22.7%) were slightly lower than the 2018 values of 21.9% and 23.6% respectively (<https://www.grainscanada.gc.ca/en/grain-research/export-quality/oilseeds/mustard/2018/05-oriental-brown.html>). These values for oriental and brown mustard are typical of *Brassica juncea* condiment mustards.

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Total saturated fatty acids for Oriental and Brown Mustard, No.1 Canada composites were 6.4 and 6.3% which is slightly higher than last year's values for both types at 6.3 and 6.0%, respectively. There were only slight changes in the levels of oleic, linoleic and linolenic acid, as a result, the iodine value (an indicator of oil unsaturation) were similar to the 2018 values for both oriental and brown mustard at 116 and 118 units, respectively.

Chlorophyll content of Oriental and Brown mustard composites is provided in Table 4. Chlorophyll was 1.1 and 2.9 mg/kg for Oriental and Brown Mustard, No. 1 Canada, respectively (Figure 6) which is lower than the long-term average of 1.9 and 3.5 mg/kg, respectively. Low chlorophyll is an indicator of well matured seeds. The lower grades in both types had higher levels of chlorophyll and commonly corresponds to higher distinctly green seed count (DGR).

Free fatty acids (FFA), which is an indicator of the degradation of the oil, generally corresponds to higher levels of damage of the seed (Table 4). Common types of damage this year included sprouting and insect damage. The FFA values are considered low and are similar to the 2018 values.

## Quality of Domestic Mustard Seed: Yellow

Oil and protein contents for yellow mustard is summarized by grade in Table 2. Comparisons to previous years' data are in Figures 4.

Yellow mustard has characteristically lower oil content and higher protein content than oriental and brown mustard (Table 2). Mean oil content (27.6%) in Yellow Mustard, No. 1 Canada was higher than the mean value in 2018 (27.3%). The mean protein content (33.3%) was lower compared to the 2018 value (34.7%) (Figure 4). Oil content in samples of Yellow Mustard, No. 1 Canada ranged from 23.4 to 33.7% while protein ranged from 26.9 to 37.4%. Protein content for all mustards, but yellow mustard in particular, has been higher than normal for 2019 when compared to the long-term average because of warm and dry conditions during the seed development stage. Yellow mustard protein has seen a 2.7% increase from the 10-year average. Conversely oil content for all the mustards are lower than normal for the same reasons.

Fatty acid composition for yellow mustard composites is provided in Table 3. The oil in yellow mustard contained higher amounts of oleic (C18:1) and erucic acid (C22:1) but lower amounts of linoleic (C18:2) and linolenic acid (C18:3), compared to the oil in oriental and brown mustard. Mean erucic acid content in Yellow Mustard, No.1 Canada was 35.5%, compared to 34.8% in 2018. Total saturated fatty acids (5.3%) and iodine values (102 units) were similar to the 2018 values.

Chlorophyll content of yellow mustard composites is provided in Table 4. Chlorophyll in Yellow Mustard, No. 1 Canada was 0.7 mg/kg (Figure 6), which corresponds to the low DGR. The lower grades had increased levels of chlorophyll, as high as 23.2 mg/kg for Sample grade. Chlorophyll content for No. 1 Canada was slightly lower than the long-term mean of 0.8 mg/kg.

**Table 2 – Quality of 2019 western Canadian mustard**

Grade	No. of samples	Oil content % <sup>1</sup>			Protein content % <sup>2</sup>			Glucosinolate content $\mu\text{mole/g}$ <sup>3</sup>		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
<b>Domestic Mustard Seed, Canada, Oriental</b>										
<b>No. 1 - W. Canada</b>	<b>12</b>	<b>41.4</b>	<b>36.6</b>	<b>43.4</b>	<b>26.8</b>	<b>22.8</b>	<b>29.5</b>	<b>109</b>	<b>68</b>	<b>131</b>
Saskatchewan	12	41.4	36.6	43.4	26.8	22.8	29.5	109	68	131
No. 2	2	40.0	37.3	42.6	27.5	23.6	30.3	125	116	135
No. 4	3	36.5	34.8	38.9	30.4	28.9	30.9	131	92	149
Sample	1	35.3	-	-	28.5	-	-	158	-	-
Cutlass, No.1	10	38.8	35.0	43.4	29.3	24.5	32.0	108	68	131
<b>Domestic Mustard Seed, Canada, Brown</b>										
<b>No. 1 - W. Canada</b>	<b>34</b>	<b>36.1</b>	<b>31.3</b>	<b>40.8</b>	<b>29.3</b>	<b>24.0</b>	<b>32.0</b>	<b>104</b>	<b>71</b>	<b>119</b>
Saskatchewan	33	36.2	31.3	40.8	29.2	24.0	32.0	104	71	119
Alberta	1	32.9	-	-	31.2	-	-	110	-	-
No. 2	5	36.4	32.9	36.8	29.1	27.9	29.6	107	94	118
No. 3	1	34.1	-	-	32.5	-	-	128	-	-
No. 4	2	39.6	37.6	40.6	24.6	24.1	25.1	80	70	78
Centennial Br., No. 1	25	36.6	31.6	40.8	29.0	24.0	31.3	100	71	119
Duchess, No. 1	5	33.7	31.3	35.6	30.3	27.5	32.0	107	102	114
<b>Domestic Mustard Seed, Canada, Yellow</b>										
<b>No. 1 - W. Canada</b>	<b>46</b>	<b>27.6</b>	<b>23.4</b>	<b>33.7</b>	<b>33.3</b>	<b>26.9</b>	<b>37.4</b>	-	-	-
Manitoba	1	30.7	-	-	28.9	-	-	-	-	-
Saskatchewan	15	28.5	24.3	33.5	32.3	26.9	37.0	-	-	-
Alberta	30	27.1	23.4	33.7	34.0	28.6	37.4	-	-	-
No. 2	9	28.2	26.1	32.3	33.3	29.5	35.5	-	-	-
No. 3	17	28.2	24.1	33.3	34.0	27.9	38.0	-	-	-
No. 4	18	28.6	24.4	33.7	33.2	27.2	38.2	-	-	-
Sample	3	27.2	26.4	27.8	35.2	35.0	35.3	-	-	-
AC Pennant, No. 1	5	29.8	27.6	33.7	31.8	26.9	36.1	-	-	-
Andante, No. 1	34	27.3	23.4	33.6	33.6	27.5	37.4	-	-	-

<sup>1</sup> Dry matter basis<sup>2</sup> % N x 6.25; dry matter basis<sup>3</sup> Total glucosinolates ( $\mu\text{mole/g}$ ); dry matter basis - ISO 9167-3:2007 (Glucose Release).



**Table 3 – Fatty acid composition of 2019 western Canadian mustard**

Category	No. of samples	Fatty acid composition (%) <sup>1</sup>					Saturated fatty acids <sup>2</sup>	Iodine value
		C18:0	C18:1	C18:2	C18:3	C22:1		
<b>Domestic Mustard Seed, Canada, Oriental</b>								
<b>No. 1 - W. Canada</b>	<b>12</b>	<b>1.6</b>	<b>23.0</b>	<b>22.0</b>	<b>11.1</b>	<b>21.8</b>	<b>6.4</b>	<b>116</b>
Saskatchewan	12	1.6	23.0	22.0	11.1	21.8	6.4	116
No. 2	2	1.6	24.1	22.2	11.2	20.7	6.4	116
No. 4	3	1.6	24.5	24.5	11.2	18.8	6.5	118
Sample	1	1.6	23.9	25.4	11.9	17.7	6.7	120
Cutlass, No.1	10	1.6	22.2	21.8	11.2	22.5	6.3	116
<b>Domestic Mustard Seed, Canada, Brown</b>								
<b>No. 1 - W. Canada</b>	<b>34</b>	<b>1.4</b>	<b>20.9</b>	<b>20.8</b>	<b>13.0</b>	<b>22.7</b>	<b>6.3</b>	<b>118</b>
Saskatchewan	33	1.4	21.0	20.8	13.0	22.7	6.2	118
Alberta	1	1.3	19.6	21.6	11.9	23.8	6.6	116
No. 2	5	1.4	21.4	20.9	13.4	22.0	6.2	119
No. 3	1	1.2	17.8	21.1	15.2	24.1	5.6	122
No. 4	2	1.3	17.3	19.8	15.2	24.4	5.9	121
Centennial Br., No. 1	25	1.3	20.5	20.7	13.4	22.9	6.1	119
Duchess, No. 1	5	1.3	21.1	21.1	11.5	23.4	6.6	115
<b>Domestic Mustard Seed, Canada, Yellow</b>								
<b>No. 1 - W. Canada</b>	<b>46</b>	<b>1.0</b>	<b>25.0</b>	<b>9.6</b>	<b>10.5</b>	<b>35.5</b>	<b>5.3</b>	<b>102</b>
Manitoba	1	1.1	26.1	10.0	10.7	33.1	5.5	103
Saskatchewan	15	1.0	25.5	9.6	10.7	34.5	5.3	103
Alberta	30	1.0	24.9	9.6	10.4	35.6	5.3	102
No. 2	9	1.0	24.8	9.4	10.8	35.7	5.1	103
No. 3	17	1.0	24.5	9.4	11.4	35.5	5.1	104
No. 4	18	1.0	24.3	9.6	11.3	35.4	5.2	104
Sample	3	1.1	24.4	10.5	11.9	33.9	5.3	106
AC Pennant, No. 1	5	1.0	23.7	9.0	10.3	37.8	5.1	101
Andante, No. 1	34	1.1	25.3	9.9	10.5	34.6	5.4	103

<sup>1</sup> Percentage of total fatty acids including: stearic (C18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3), erucic (C22:1)

<sup>2</sup> Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

**Table 4 – Chlorophyll content, DGR, free fatty acids and total damage in 2019 western Canadian mustard**

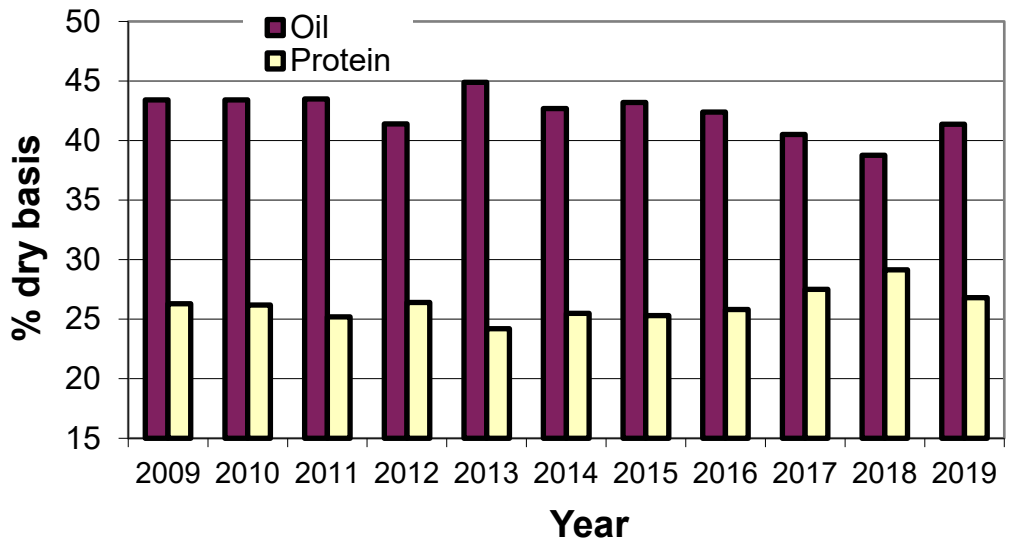
Category	No. of samples	Chlorophyll mg/kg	%DGR <sup>1</sup>	DGR range	FFA <sup>2</sup>	Total Damage <sup>3</sup>
<b>Domestic Mustard Seed, Canada, Oriental</b>						
<b>No. 1 - W. Canada</b>	<b>12</b>	<b>1.1</b>	<b>0.11</b>	<b>0.0-1.5</b>	<b>0.10</b>	<b>0.3</b>
Saskatchewan	12	1.1	0.07	0.0-1.1	0.10	0.3
No. 2	2	1.7	0.00	0.0	0.24	2.2
No. 4	3	1.2	0.00	0.0	0.16	4.4
Sample	1	6.8	0.00	0.0	0.06	0.6
Cutlass, No.1	10	1.1			0.09	
<b>Domestic Mustard Seed, Canada, Brown</b>						
<b>No. 1 - W. Canada</b>	<b>34</b>	<b>2.9</b>	<b>0.15</b>	<b>0.0-1.2</b>	<b>0.12</b>	<b>0.7</b>
Saskatchewan	33	3.0	0.16	0.0-1.2	0.12	0.5
Alberta	1	0.5	0.00	0.0	0.14	0.0
No. 2	5	19.8	0.40	0.0-1.7	0.12	0.9
No. 3	1	24.4	2.60	-	0.06	5.0
No. 4	2	8.2	0.00	0.0	0.05	0.0
Centennial Br., No. 1	25	3.4			0.10	
Duchess, No. 1	5	1.4			0.11	
<b>Domestic Mustard Seed, Canada, Yellow</b>						
<b>No. 1 - W. Canada</b>	<b>46</b>	<b>0.7</b>	<b>0.04</b>	<b>0.0-0.8</b>	<b>0.08</b>	<b>0.4</b>
Manitoba	1	0.7	0.00	-	0.09	0.0
Saskatchewan	15	1.3	0.01	0.0-0.2	0.04	0.3
Alberta	30	0.4	0.05	0.0-0.8	0.05	0.4
No. 2	9	1.7	0.13	0.0-1.2	0.05	1.5
No. 3	17	2.8	0.70	0.0-2.7	0.09	3.0
No. 4	18	3.7	0.35	0.0-1.8	0.09	1.6
Sample	3	23.2	1.60	0.0-6.1	0.41	4.6
AC Pennant, No. 1	5	0.6			0.03	
Andante, No. 1	34	0.7			0.06	

<sup>1</sup> Distinctly green tolerances are applied to crushed seeds which are a distinct green throughout. Pale green or immature seeds are taken into account in the evaluation of colour. The %DGR results are the averages of the individual samples included in the composite.

<sup>2</sup> Free fatty acid content in percentage.

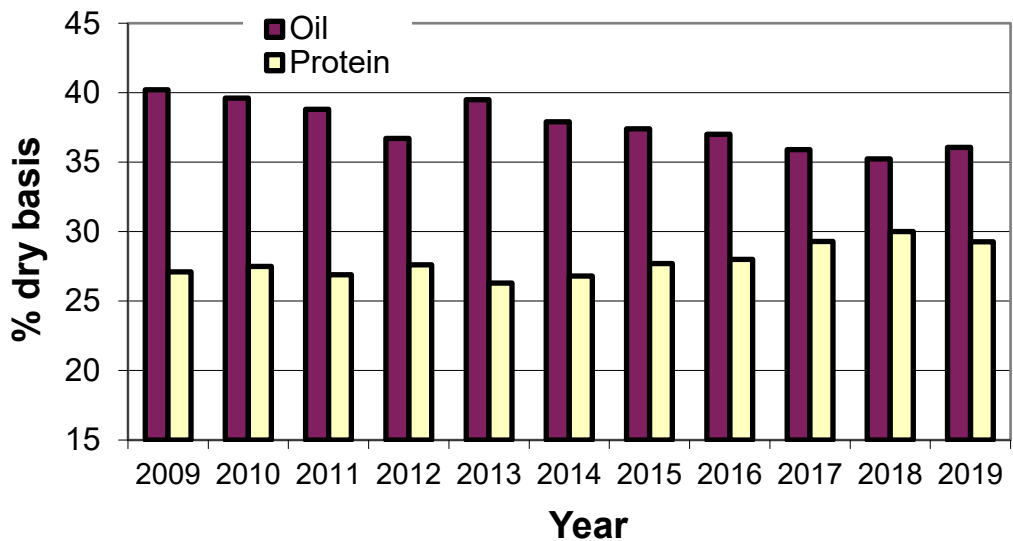
<sup>3</sup> Insect damaged, excessively weathered, sprouted, distinctly green, heated or otherwise damaged

**Figure 2 – Oriental Mustard, No.1 Canada  
Oil and protein content of harvest samples, 2009-19**



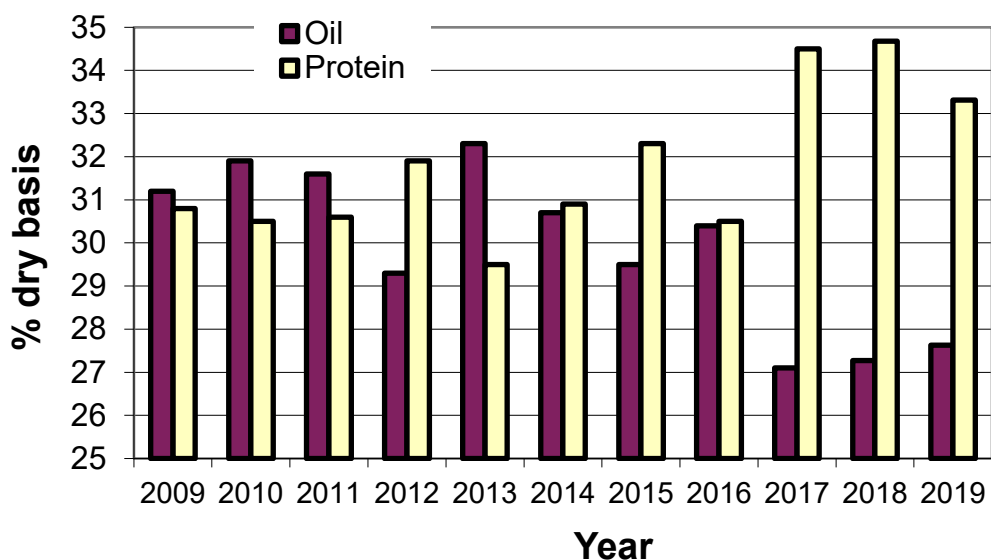
2019 Oil content.....	41.4%	2019 Protein content .....	26.8%
2018 Oil content .....	38.8%	2018 Protein content .....	29.2%
2009–18 Mean oil content.....	42.4%	2009–18 Mean protein content.....	26.2%

**Figure 3 – Brown Mustard, No.1 Canada  
Oil and protein content of harvest samples, 2009-19**



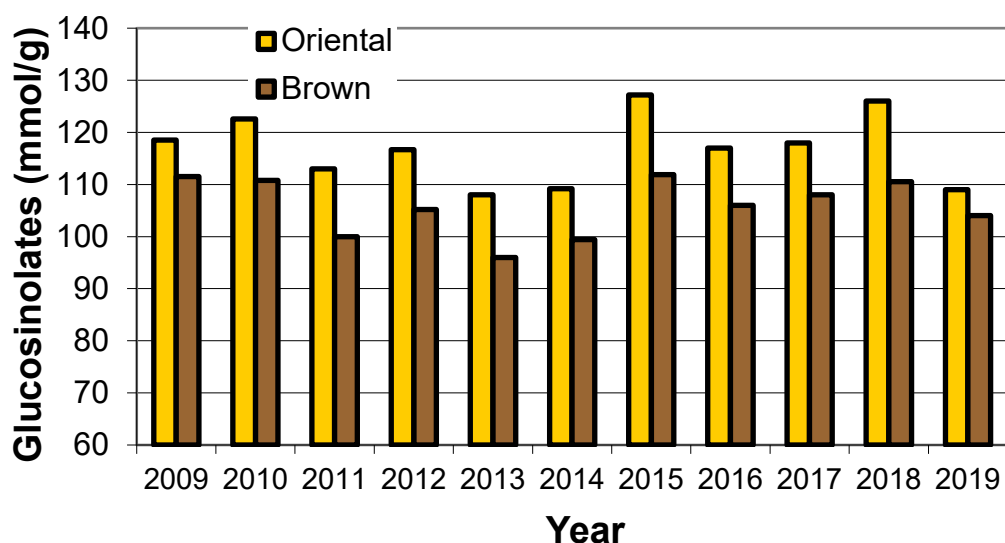
2019 Oil content.....	36.1%	2019 Protein content .....	29.3%
2018 Oil content .....	35.2%	2018 Protein content .....	30.0%
2009–18 Mean oil content.....	37.8%	2009–18 Mean protein content.....	27.7%

**Figure 4 – Yellow Mustard, No.1 Canada  
Oil and protein content of harvest samples, 2009-19**



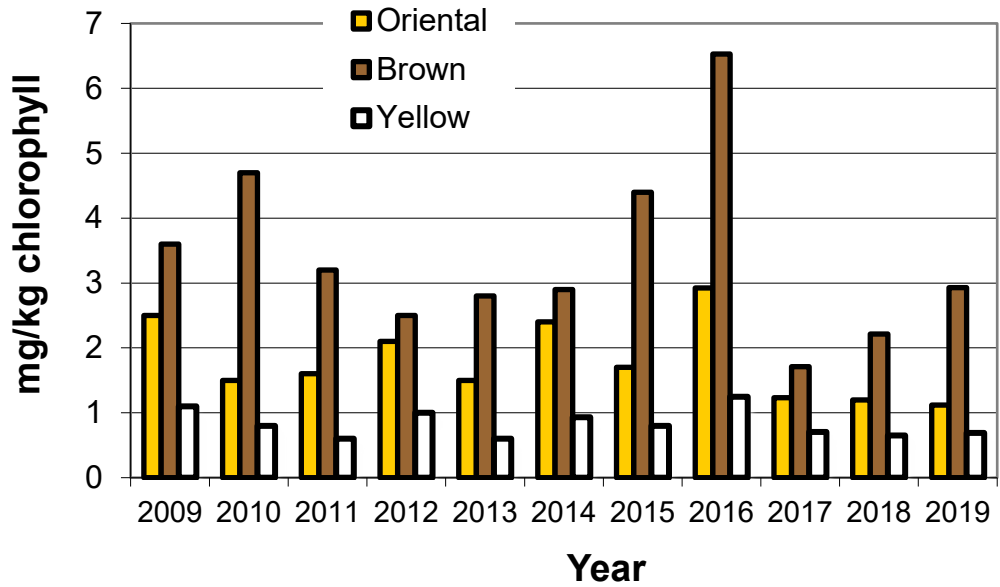
2019 Oil content.....	27.6%	2019 Protein content .....	33.3%
2018 Oil content .....	27.3%	2018 Protein content .....	34.7%
2009–18 Mean oil content.....	30.1%	2009–18 Mean protein content.....	31.6%

**Figure 5 – Oriental and Brown Mustard, No.1 Canada  
Total glucosinolate content of harvest samples, 2009-19**



2019 Oriental glucosinolate content.....	109 µmole/g	2019 Brown glucosinolate content.....	104 µmole/g
2018 Oriental glucosinolate content.....	126 µmole/g	2018 Brown glucosinolate content.....	111 µmole/g
2009–18 Mean Oriental Glucosinolate content.....	118 µmole/g	2009–19 Mean Brown glucosinolate content.....	106 µmole/g

**Figure 6 – Oriental, Brown and Yellow Mustard, No.1 Canada Chlorophyll content of harvest samples, 2009-19**



2019 Oriental chlorophyll content.....	1.1 mg/kg	2009–18 Mean Oriental chlorophyll content.....	1.9 mg/kg
2019 Brown chlorophyll content.....	2.9 mg/kg	2009–18 Mean Brown chlorophyll content.....	3.5 mg/kg
2019 Yellow chlorophyll content.....	0.7 mg/kg	2009–18 Mean Yellow chlorophyll content.....	0.8 mg/kg