



Canadian Grain
Commission

Commission canadienne
des grains

ISSN 1498-9905



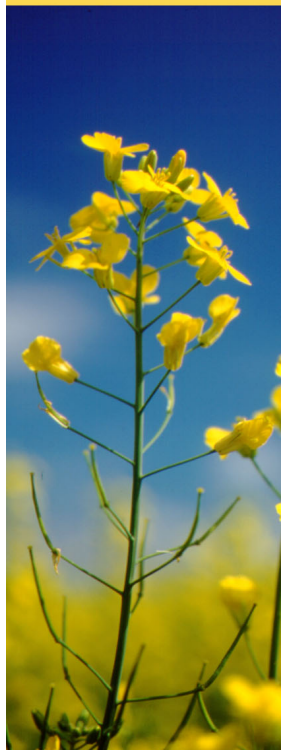
Quality of western Canadian mustard

2018

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Canada 

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Acknowledgements

The Canadian Grain Commission thanks mustard producers and grain handling plants in western Canada for supplying samples of mustard harvested in 2018. 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.

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 2018 (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 2018 harvest was lower than the 10-year average (Figures 2, 3 and 4) at 38.8, 35.2 and 27.3% while the mean protein for the top grade oriental, brown and yellow mustard was higher at 29.2, 30.0 and 34.7%, respectively. Total glucosinolate content in the top grade mustard was 126 micromoles per gram ($\mu\text{mole/g}$) for oriental and 111 $\mu\text{mole/g}$ for brown, which is higher than the 10-year average of 117 $\mu\text{mole/g}$ for oriental and 106 $\mu\text{mole/g}$ for brown mustard (Figure 5). Oil, protein and glucosinolates are reported on a dry matter basis.

Weather and production review

Weather review

The warm and dry growing conditions in 2018 had an undesirable effect on mustard development in most of the mustard growing regions of southern Saskatchewan and Alberta. Seeding progressed well starting in the second week in May and was nearly complete by the end of the month. While moisture levels varied considerably throughout the region most areas suffered because of the lack of rain. The warm/dry conditions during most of the growing season affect many aspects of plant development including germination of the seed and stress during flowering.

Warm and dry conditions in mid-August allowed the harvest to begin early so by the first week in September it was nearly 50% complete. Rain, snow and cool weather slowed the harvest till drier conditions prevailed in mid-October. Harvest was finished by the end of October. (Saskatchewan Crop Reports - <http://www.publications.gov.sk.ca/deplist.cfm?d=20&c=6060>) and Olds Products 2018 Crop Reports (<http://www.oldsproducts.com/olds-products/2018-crop-reports>).

Temperature and precipitation patterns for the 2018 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 2018 increased dramatically by approximately 43% from 2017 to 173.6 thousand metric tonnes. The increase was a result of more hectares seeded along with a slight increase in yield. Yield was approximately 880 kilograms per hectare (Statistics Canada), which is higher than last year's yield of 800 kilograms per hectare but lower than the 10-year average of 978 kilograms per hectare.

About 37% of mustard production in Saskatchewan was estimated to be yellow, 40% brown and 23% oriental according to Saskatchewan's 2018 Specialty Crop Report (<http://publications.gov.sk.ca/documents/20/109914-Specialty%20Crop%20Report%202018.pdf>). Saskatchewan accounted for 75% of western Canada's total seeded area and nearly 78% of mustard production while Alberta accounted for most of the remaining seeded area and production (Table 1).

This year 64% of samples were graded No. 1, in contrast to 68% for the 10-year average (2008-17). Growing and harvest conditions produced a mustard crop with some visible damage particularly in all the mustards (Table 4). In Yellow mustard conspicuous admixtures from weed seeds and foreign material were the major factors in lowering the grades of samples received in 2018.

Table 1 – Seeded area and production for western Canadian mustard¹

Region	Seeded area	Seeded area	Production	Production	Mean production
	2018	2017	2018	2017	2008-17
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	2.0	n/a	2.2	n/a	n/a
Saskatchewan	152.0	117.3	134.7	94.5	120.9
Alberta	49.4	38.4	36.7	27.1	42.4
Western Canada	203.4	155.7	173.6	121.6	163.3

¹ 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 238 mustard samples, compared to 279 in 2017. This included 140 yellow, 54 brown and 44 oriental mustard samples. Overall, 69% of the samples came from Saskatchewan, 28% from Alberta followed by 3% from Manitoba.

Producers and grain companies that routinely handle mustard seed submitted samples of mustard grown in 2018 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 glucosinolate 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.

Effects of weather on quality

The mustard crop grown in western Canada in 2018 showed general characteristics of a crop well matured but somewhat heat stressed. 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 increase when *Brassica* crops are grown under warmer 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 (38.8%) in Oriental Mustard, No. 1 Canada was lower than the mean in 2017 (40.5%) while protein content (29.2%) was higher than the 2017 mean (27.5%) (Figure 2). Oil content in samples of Oriental Mustard, No. 1 Canada ranged from 32.5 to 43.4%, whereas protein content ranged from 22.9 to 32.8% (Table 2).

Mean oil content (35.2%) in Brown Mustard, No. 1 Canada was lower than in 2017 (35.9%) while protein content (30.0%) was higher than the 2017 mean (29.3%) (Figure 3). Oil content in samples of Brown Mustard, No. 1 Canada ranged from 30.1 to 39.3% while the protein content ranged from 26.0 to 33.2% (Table 2).

Total glucosinolate content in Oriental Mustard, No.1 Canada was 126 $\mu\text{mole/g}$, higher than the 2017 value of 118 $\mu\text{mole/g}$ (Figure 5). The value for Brown Mustard, No.1 Canada was slightly higher than the value for 2017, 111 versus 108 $\mu\text{mole/g}$ (Figure 5). Total glucosinolate content in samples of Oriental Mustard, No. 1 Canada ranged from 43 to 152 $\mu\text{mole/g}$ while in Brown Mustard, No. 1 Canada the values ranged from 70 to 136 $\mu\text{mole/g}$ (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 (21.9%) and Brown Mustard, No.1 Canada (23.6%) were slightly lower than the 2017 values of 22.6% and 23.9% respectively (<https://www.grainscanada.gc.ca/mustard-moutarde/harvest-recolte/2017/hqm17-qrm17-1-en.html>). These values for oriental and brown mustard are typical of *Brassica juncea* condiment mustards.

Total saturated fatty acids for Oriental and Brown Mustard, No.1 Canada composites were 6.3 and 6.0% which is slightly higher than last year's values for both types at 6.1 and 5.9%, 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 2017 values for both oriental and brown mustard at 117 and 118 units, respectively.

Chlorophyll content of Oriental and Brown mustard composites is provided in Table 4. Chlorophyll was 1.2 and 2.2 mg/kg for Oriental and Brown Mustard, No. 1 Canada, respectively (Figure 6) which is significantly lower than the long-term average of 1.9 and 3.6 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 2017 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 (27.3%) in Yellow Mustard, No. 1 Canada was similar to the mean values in 2017 (27.1%). The mean protein content (34.7%) were also similar to the 2017 values (34.5%) (Figure 4). Oil content in samples of Yellow Mustard, No. 1 Canada ranged from 22.9 to 32.8% while protein ranged from 27.7 to 40.7%. Protein content for all mustards, but yellow mustard in particular, has been higher than normal for 2017 and 2018 because of very warm and dry conditions during the seed development stage. Yellow mustard protein has seen a 3% 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 34.8%, compared to 34.6% in 2017. Total saturated fatty acids (5.2%) and iodine values (102 units) were similar to the 2017 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 slightly increased levels of chlorophyll, as high as 3.0 mg/kg for Sample grade. Chlorophyll content for No. 1 Canada was lower than the long-term mean of 0.9 mg/kg.

Table 2 – Quality of 2018 western Canadian mustard

Grade	No. of samples	Oil content % ¹			Protein content % ²			Glucosinolate content $\mu\text{mole/g}$ ³		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
Domestic Mustard Seed, Canada, Oriental										
No. 1 - W. Canada	32	38.8	32.5	43.4	29.2	22.9	32.8	126	43	152
Saskatchewan	26	39.2	35.0	43.4	29.0	22.9	31.7	125	43	152
Alberta	6	37.1	32.5	40.6	30.0	26.3	32.8	133	125	142
No. 2	5	40.2	36.2	42.1	28.0	25.2	30.3	129	123	141
No. 3	3	38.9	37.0	40.3	29.2	27.0	31.2	127	122	133
No. 4	2	37.4	35.9	38.9	30.8	30.1	31.5	135	130	140
Sample	2	39.6	38.6	40.6	27.6	26.9	28.2	126	123	129
Cutlass, No.1	20	38.8	35.0	43.4	29.3	24.5	32.0	122	43	140
Forge, No. 1	11	37.9	32.5	43.4	29.4	22.9	32.8	131	108	142
Domestic Mustard Seed, Canada, Brown										
No. 1 - W. Canada	46	35.2	31.0	39.3	30.0	26.0	33.2	111	70	128
Manitoba	1	36.9	-	-	27.8	-	-	70	-	-
Saskatchewan	43	35.2	31.0	39.3	30.0	26.0	33.2	112	88	128
Alberta	2	35.0	33.3	36.3	30.9	29.2	32.2	108	104	112
No. 2	6	34.5	33.3	39.0	30.7	24.9	31.8	116	104	123
No. 3	1	33.4	-	-	31.5	-	-	123	-	-
Sample	1	36.4	-	-	28.1	-	-	98	-	-
Centennial Br., No. 1	20	35.0	31.0	39.3	30.0	26.0	33.2	112	70	128
Domestic Mustard Seed, Canada, Yellow										
No. 1 - W. Canada	74	27.3	22.9	32.8	34.7	27.7	40.7	—	—	—
Saskatchewan	38	27.3	23.3	32.4	34.6	27.9	38.9	—	—	—
Alberta	36	27.3	22.9	32.8	34.7	27.7	40.7	—	—	—
No. 2	19	26.3	23.0	31.0	36.0	29.3	39.1	—	—	—
No. 3	13	27.5	22.5	31.7	34.3	28.5	40.4	—	—	—
No. 4	23	29.6	24.2	34.7	32.4	24.7	38.3	—	—	—
Sample	11	26.7	22.9	32.3	34.8	28.9	38.7	—	—	—
Andante, No. 1	58	27.1	22.9	32.6	35.0	27.9	40.7	—	—	—

¹ Dry matter basis² % N x 6.25; dry matter basis³ Total glucosinolates ($\mu\text{mole/g}$); dry matter basis - ISO 9167-3:2007 (Glucose Release).

Table 3 – Fatty acid composition of 2018 western Canadian mustard

Category	No. of samples	Fatty acid composition (%) ¹					Saturated fatty acids ²	Iodine value
		C18:0	C18:1	C18:2	C18:3	C22:1		
Domestic Mustard Seed, Canada, Oriental								
No. 1 - W. Canada	32	1.5	22.3	22.3	11.5	21.9	6.3	117
Saskatchewan	26	1.5	22.2	22.1	11.5	22.0	6.3	117
Alberta	6	1.5	22.3	23.1	11.3	21.3	6.4	117
No. 2	5	1.5	21.3	21.9	12.4	22.3	6.1	118
No. 3	3	1.3	19.6	21.1	12.6	24.0	5.9	117
No. 4	2	1.3	19.1	21.4	12.6	24.6	5.8	118
Sample	2	1.5	22.8	23.0	11.6	20.8	6.2	118
Cutlass, No.1	20	1.5	20.9	21.6	11.7	23.5	6.2	116
Forge, No. 1	11	1.6	25.0	24.2	11.0	18.6	6.5	118
Domestic Mustard Seed, Canada, Brown								
No. 1 - W. Canada	46	1.2	19.6	20.7	13.3	23.6	6.0	118
Manitoba	1	1.1	19.0	21.2	13.1	24.0	5.9	119
Saskatchewan	43	1.2	19.6	20.7	13.3	23.6	6.0	118
Alberta	2	1.2	19.6	20.3	13.4	23.9	5.9	118
No. 2	6	1.2	19.7	20.9	13.3	23.6	6.0	119
No. 3	1	1.1	20.0	21.1	12.6	24.0	6.0	118
Sample	1	1.3	20.3	20.2	14.2	22.5	5.9	120
Centennial Br., No.1	20	1.2	19.6	20.8	13.4	23.6	6.0	119
Domestic Mustard Seed, Canada, Yellow								
No. 1 - W. Canada	74	1.0	25.2	9.6	10.6	34.8	5.2	102
Saskatchewan	38	1.0	24.9	9.7	10.7	35.0	5.2	103
Alberta	36	1.0	25.6	9.6	10.4	34.7	5.2	102
No. 2	19	1.0	25.7	9.8	10.6	34.3	5.2	103
No. 3	13	1.0	25.4	9.6	10.9	34.3	5.2	103
No. 4	23	1.0	25.4	9.6	10.7	34.6	5.2	102
Sample	11	1.0	25.7	9.9	10.9	33.8	5.2	103
Andante, No. 1	58	1.0	25.4	9.6	10.6	34.6	5.2	102

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

² 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 2018 western Canadian mustard

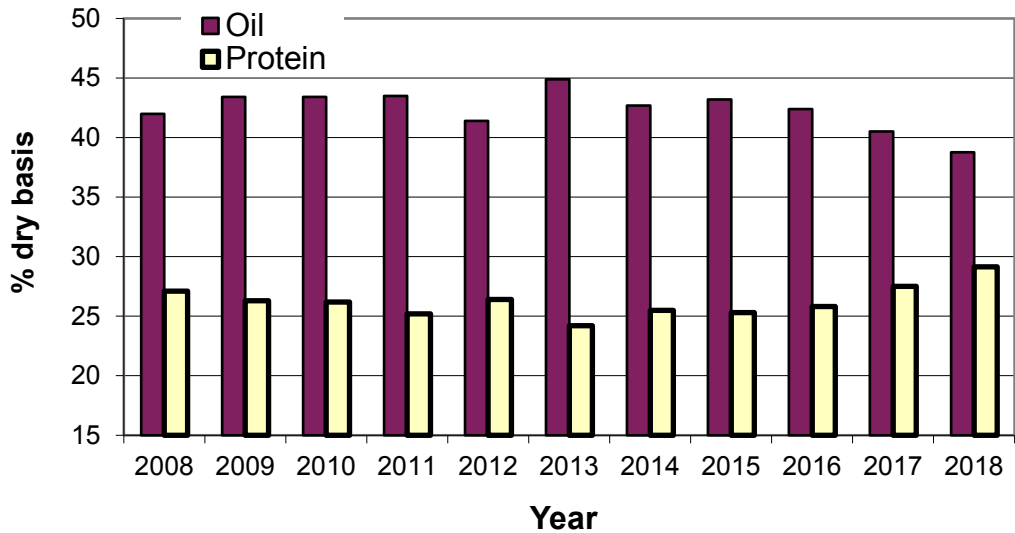
Category	No. of samples	Chlorophyll mg/kg	%DGR ¹	DGR range	FFA ²	Total Damage ³
Domestic Mustard Seed, Canada, Oriental						
No. 1 - W. Canada	32	1.2	0.11	0.0-1.5	0.10	0.3
Saskatchewan	26	0.9	0.07	0.0-1.1	0.09	0.3
Alberta	6	2.4	0.28	0.0-1.5	0.16	0.4
No. 2	5	2.1	0.24	0.0-1.2	0.16	1.7
No. 3	3	1.7	0.00	0.0	0.22	4.0
No. 4	2	2.3	0.10	0.0-0.2	0.14	4.4
Sample	2	2.2	0.00	0.0	0.09	0.6
Cutlass, No. 1	20	1.0			0.09	
Forge, No. 1	11	1.4			0.11	
Domestic Mustard Seed, Canada, Brown						
No. 1 - W. Canada	46	2.2	0.02	0.0-0.3	0.10	0.7
Manitoba	1	1.2	0.00	-	0.10	0.9
Saskatchewan	43	2.3	0.07	0.0-0.3	0.10	0.6
Alberta	2	1.8	0.00	0.0	0.11	1.1
No. 2	6	1.9	0.10	0.0-0.6	0.13	2.3
No. 3	1	0.6	0.00	-	0.07	4.0
Sample	1	4.2	0.00	-	0.12	0.0
Centennial Br., No. 1	20	2.5			0.12	
Domestic Mustard Seed, Canada, Yellow						
No. 1 - W. Canada	74	0.7	0.02	0.0-0.4	0.08	0.4
Saskatchewan	38	0.9	0.03	0.0-0.4	0.07	0.3
Alberta	36	0.4	0.01	0.0-0.1	0.08	0.5
No. 2	19	1.4	0.04	0.0-0.8	0.12	1.0
No. 3	13	1.9	0.27	0.0-3.3	0.08	1.6
No. 4	23	2.4	0.24	0.0-3.0	0.11	1.5
Sample	11	3.0	0.21	0.0-2.3	0.29	2.2
Andante, No. 1	58	0.6			0.08	

¹ 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.

² Free fatty acid content in percentage.

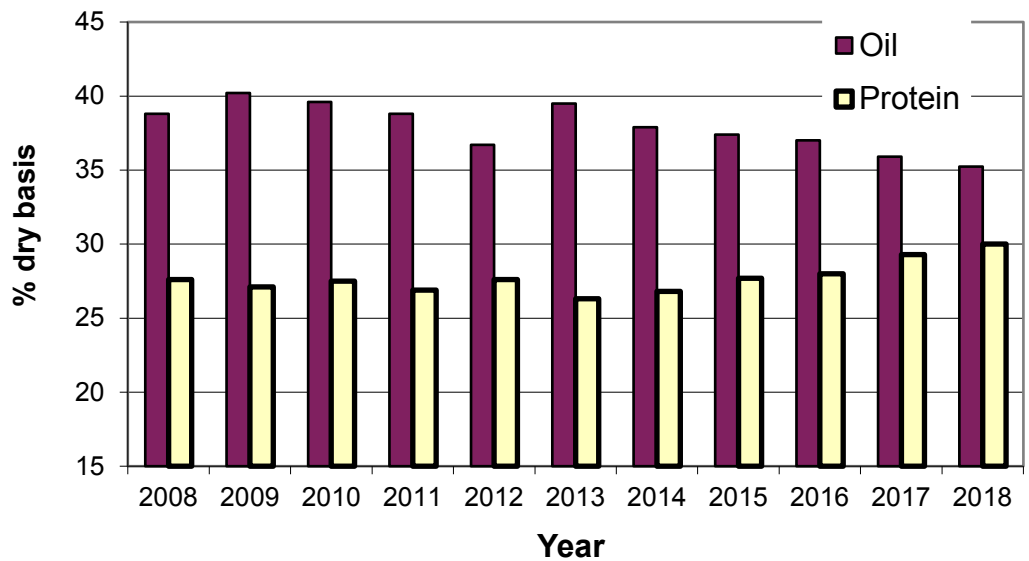
³ Insect damaged, excessively weathered, sprouted, distinctly green, heated or otherwise damaged

**Figure 2 – Oriental Mustard, No.1 Canada
Oil and protein content of harvest samples, 2008-18**



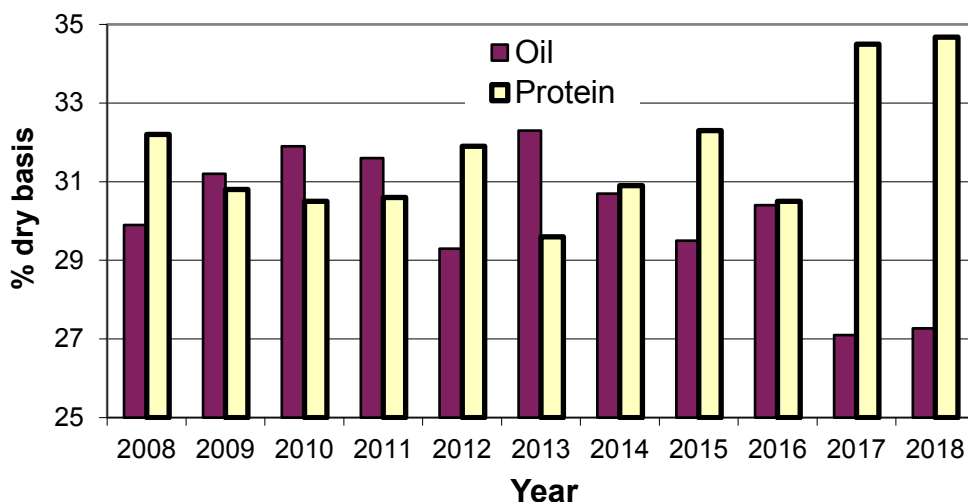
2018 Oil content.....38.8%	2018 Protein content29.2%
2017 Oil content40.5%	2017 Protein content27.5%
2008–17 Mean oil content.....42.7%	2008–17 Mean protein content.....26.0%

**Figure 3 – Brown Mustard, No.1 Canada
Oil and protein content of harvest samples, 2008-18**



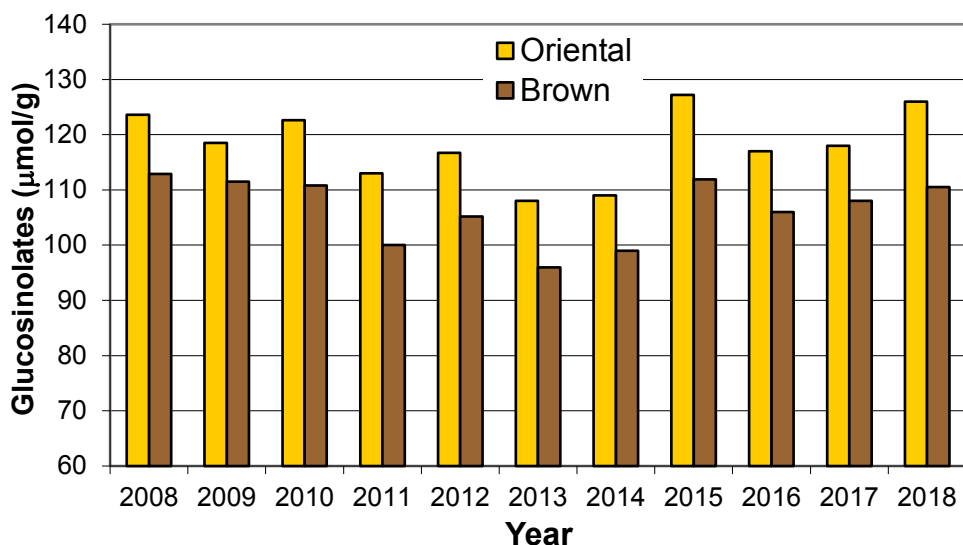
2018 Oil content.....35.2%	2018 Protein content30.0%
2017 Oil content35.9%	2017 Protein content29.3%
2008–17 Mean oil content.....38.2%	2008–17 Mean protein content.....27.3%

**Figure 4 – Yellow Mustard, No.1 Canada
Oil and protein content of harvest samples, 2008-18**



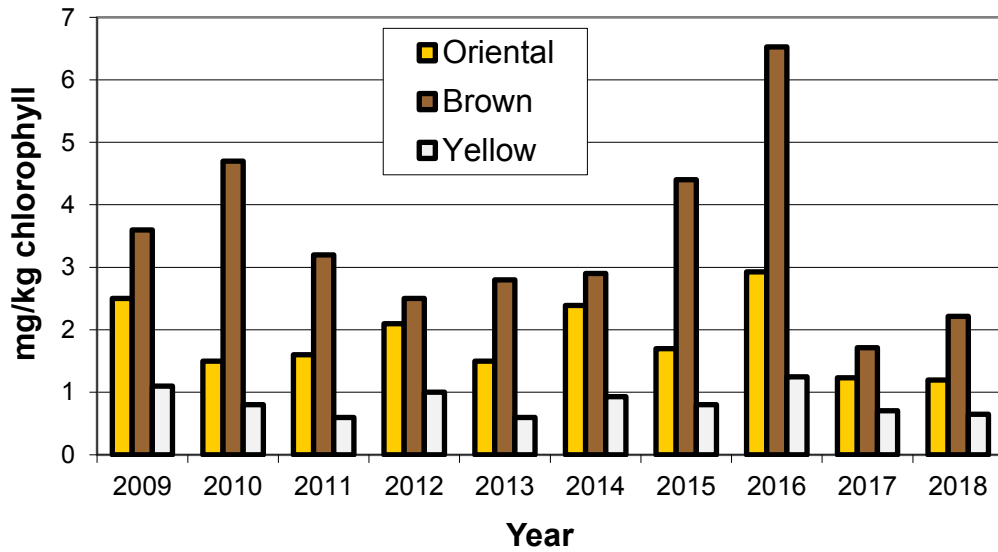
2018 Oil content.....	27.3%	2018 Protein content	34.7%
2017 Oil content	27.1%	2017 Protein content	34.5%
2008–17 Mean oil content.....	30.4%	2008–17 Mean protein content.....	31.4%

**Figure 5 – Oriental and Brown Mustard, No.1 Canada
Total glucosinolate content of harvest samples, 2008-18**



2018 Oriental glucosinolate content.....	126 µmole/g	2018 Brown glucosinolate content.....	111 µmole/g
2017 Oriental glucosinolate content.....	118 µmole/g	2017 Brown glucosinolate content.....	108 µmole/g
2008–17 Mean Oriental Glucosinolate content.....	117 µmole/g	2008–17 Mean Brown glucosinolate content.....	106 µmole/g

Figure 6 – Oriental, Brown and Yellow Mustard, No.1 Canada Chlorophyll content of harvest samples, 2009-18



2018 Oriental chlorophyll content.....1.2 mg/kg
 2018 Brown chlorophyll content..... 2.2 mg/kg
 2018 Yellow chlorophyll content.....0.7 mg/kg

2009–17 Mean Oriental chlorophyll content.....1.9 mg/kg
 2009–17 Mean Brown chlorophyll content.....3.6 mg/kg
 2009–17 Mean Yellow chlorophyll content.....0.9 mg/kg