



Canadian Grain
Commission

Commission canadienne
des grains

ISSN 1498-9905



Quality of western Canadian mustard

2017

Bert Siemens
Chemist, Oilseeds

Contact: Bert Siemens
Chemist, Oilseeds Services
Tel : 204-984-6991
Email: bert.siemens@grainscanada.gc.ca
Fax : 204-983-0724

Grain Research Laboratory
Canadian Grain Commission
1404-303 Main Street
Winnipeg MB R3C 3G8
www.grainscanada.gc.ca



Canada

Table of contents

Introduction	3
Summary	3
Weather and production review	4
Weather review	4
Production and grade information	4
Harvest samples	5
Effects of weather on quality	6
Quality of Domestic Mustard Seed: Oriental and Brown	6
Quality of Domestic Mustard Seed: Yellow	7

Tables

Table 1 – Seeded area and production for western Canadian mustard	5
Table 2 – Quality of 2017 western Canadian mustard	8
Table 3 – Fatty acid composition of 2017 western Canadian mustard	9
Table 4 – Chlorophyll content and DGR in 2017 western Canadian mustard	10

Figures

Figure 1 – Mustard crops grown in Canada	3
Figure 2 – Oriental Mustard, No.1 Canada Oil and protein content of harvest samples, 2007-17	11
Figure 3 – Brown Mustard, No.1 Canada Oil and protein content of harvest samples, 2007-17	11
Figure 4 – Yellow Mustard, No.1 Canada Oil and protein content of harvest samples, 2007-17	12
Figure 5 – Oriental and Brown Mustard, No.1 Canada Total glucosinolate content of harvest samples, 2007-17.....	12
Figure 6 – Oriental and Brown Mustard, No.1 Canada Chlorophyll content of harvest samples, 2009-17	13

Acknowledgements

The Canadian Grain Commission thanks mustard producers, grain handling offices, and seed handling plants in western Canada for supplying samples of mustard harvested in 2017. 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 2017 (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 2017 harvest was lower than last year and the 10-year average (Figures 2, 3 and 4) at 40.5, 35.9 and 27.1% while the mean protein for the top grade oriental, brown and yellow mustard was higher at 27.5, 29.3 and 34.5%, respectively. Total glucosinolate content in the top grade mustard was 118 micromoles per gram ($\mu\text{mole/g}$) for oriental and 108 $\mu\text{mole/g}$ for brown, which is similar to the 10-year average of 120 $\mu\text{mole/g}$ for oriental and 107 $\mu\text{mole/g}$ for brown mustard (Figure 5). Oil, protein and glucosinolates are reported on a dry matter basis.

Weather and production review

Weather review

The hot and dry growing conditions in 2017 had an adverse effect on mustard development in most of the growing regions of southern Saskatchewan and Alberta. The season began with good soil moisture and seeding was nearly 80% complete by the last week in May. The crop developed well in May and June because of timely rains and warmer than average temperatures but by July and August the hot, dry condition were affecting the normal development of the crop. Harvest began in mid-August and conditions were dry enough that by the first week in September was nearly 60% complete. Harvest was generally finished by the end of September. (Saskatchewan Crop Reports - <http://www.agriculture.gov.sk.ca/crop-report>) and Olds Products 2017 Crop Reports <http://www.oldsproducts.com/2017-crop-reports>).

Temperature and precipitation patterns for the 2017 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 2017 decreased dramatically by approximately 52% from 2016 to 121.6 thousand metric tonnes. The decrease was a result of fewer hectares seeded along with a decrease in yield. Yield was approximately 800 kilograms per hectare (Statistics Canada), which is lower than last year's yield of 1170 kilograms per hectare and the 10-year average of 961 kilograms per hectare.

About 41% of mustard production in Saskatchewan was estimated to be yellow, 25% brown and 34% oriental according to Saskatchewan's 2017 Specialty Crop Report (<http://publications.gov.sk.ca/documents/20/105205-Specialty%20Crop%20Report%202017.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 68% of samples were graded No. 1, in contrast to 52% in 2016 and 69% for the 10-year average (2007-16). Growing and harvest conditions produced a mustard crop with some visible damage particularly in Brown mustard. In Yellow mustard, however, conspicuous admixtures from weed seeds and foreign material were major factors in lowering the grades of samples received in 2017.

Table 1: Seeded area and production for western Canadian mustard¹

Region	Seeded area	Seeded area	Production	Production	Mean production
	2017	2016	2017	2016	2007-16
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba ²	n/a	n/a	n/a	n/a	n/a
Saskatchewan	117.3	157.8	94.5	162.3	133.7
Alberta	38.4	54.5	27.1	73.3	41.2
Western Canada	155.7	212.3	121.6	235.6	174.9

¹ Statistics Canada. Table 001-0010 - Estimated areas, yield, and production of principal field crops, in metric units. <http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=10017>

² Data for Manitoba not available.

Harvest samples

This year's Harvest Sample Program included 279 mustard samples, compared to 344 in 2016. This included 175 yellow, 62 brown and 42 oriental mustard samples. Overall, 66% of the samples came from Saskatchewan followed by 34% from Alberta. Less than 1% came from Manitoba.

Producers and grain companies that routinely handle mustard seed submitted samples of mustard grown in 2017 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 content 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 2017 showed general characteristics of a crop well matured but somewhat 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 is especially noticed in yellow mustard. 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 (40.5%) in Oriental Mustard, No. 1 Canada was lower than the mean in 2016 (42.4%) while, protein content (27.5%) was higher than the 2016 mean (25.8%) (Figure 2). Oil content in samples of Oriental Mustard, No. 1 Canada ranged from 35.5 to 49.8%, whereas protein content ranged from 21.7 to 32.3% (Table 2).

Mean oil content (35.9%) in Brown Mustard, No. 1 Canada was lower than in 2016 (37.0%) while protein content (29.3%) was higher than the 2016 mean (28.0%) (Figure 3). Oil content in samples of Brown Mustard, No. 1 Canada ranged from 29.2 to 40.8% while the protein content ranged from 24.8 to 33.5% (Table 2).

Total glucosinolate content in Oriental Mustard, No.1 Canada was 118 $\mu\text{mole/g}$, a similar value to 2016 at 117 $\mu\text{mole/g}$ (Figure 5). The value for Brown Mustard, No.1 Canada was also similar to the value for 2016, 108 versus 106 $\mu\text{mole/g}$ (Figure 5). Total glucosinolate content in samples of Oriental Mustard, No. 1 Canada ranged from 84 to 161 $\mu\text{mole/g}$ while in Brown Mustard, No. 1 Canada the values ranged from 82 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 (22.6%) and Brown Mustard, No.1 Canada (23.9%) were similar to the 2016 values of 21.9% and 23.8% respectively (<https://www.grainscanada.gc.ca/mustard-moutarde/harvest-recolte/2016/hqm16-grm16-1-en.htm>). 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 6.1 and 5.9% which was similar to last year's values for both types at 6.0 and 5.9%, respectively. There were slight changes in the levels of oleic, linoleic and linolenic acid, as a result, the iodine value (an indicator of oil

unsaturation) was slightly lower than the 2016 values for both oriental and brown mustard at 116 and 119 units, respectively.

Chlorophyll content of Oriental and Brown mustard composites is provided in Table 4. Chlorophyll content was 1.2 and 1.7 mg/kg for Oriental and Brown Mustard, No. 1 Canada, respectively (Figure 6) which is significantly lower than the 8-year average of 2.0 and 3.8 mg/kg, respectively. Low chlorophyll is an indicator of well matured seeds. The lower grades in both types had higher levels of chlorophyll.

Quality of Domestic Mustard Seed: Yellow

Oil and protein content for yellow mustard is summarized by grade in Table 2. Comparisons to previous years' data are in Figures 4 and 6.

Yellow mustard has characteristically lower oil content and higher protein content than oriental and brown mustard (Table 2). Mean oil content (27.1%) in Yellow Mustard, No. 1 Canada was lower than the mean in 2016 (30.4%). Meanwhile, mean protein content (34.5%) was higher than in 2016 (30.5%) (Figure 4). Oil content in samples of Yellow Mustard, No. 1 Canada ranged from 22.5 to 32.2% while protein ranged from 28.1 to 40.5%.

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 34.6%, compared to 33.9% in 2016. Total saturated fatty acids (5.3%) and iodine values (103 units) were similar to the 2016 values.

Chlorophyll content of yellow mustard composites is provided in Table 4. Chlorophyll content in Yellow Mustard, No. 1 Canada was 0.7 mg/kg (Figure 6), which corresponds to the low distinctly green seed count (%DGR). The lower grades had slightly increased levels of chlorophyll, as high as 3.3 mg/kg for Sample grade. Chlorophyll content for No. 1 Canada was lower than the 8-year mean of 0.9 mg/kg.

Table 2: Quality of 2017 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	40.5	35.5	49.8	27.5	21.7	32.3	118	84	161
Saskatchewan	23	41.6	37.6	49.8	26.6	21.7	29.9	112	84	150
Alberta	9	37.7	35.5	42.6	29.9	25.6	32.3	133	111	161
No. 2	5	41.7	39.4	45.1	26.2	24.0	27.8	108	105	134
No. 3	1	37.6	-	-	28.6	-	-	148	-	-
No. 4	1	44.3	-	-	24.9	-	-	111	-	-
Sample	3	42.9	39.9	45.4	25.5	23.2	27.2	102	90	124
Cutlass, No.1	15	41.8	36.6	49.8	26.3	21.7	29.9	108	84	161
Forge, No. 1	15	38.9	35.5	42.6	28.6	23.7	32.2	129	110	150
Domestic Mustard Seed, Canada, Brown										
No. 1 - W. Canada	45	35.9	29.2	40.8	29.3	24.8	33.5	108	82	136
Saskatchewan	43	35.9	29.2	40.8	29.3	24.8	33.5	109	82	136
Alberta	2	35.2	34.5	35.9	28.7	27.7	29.7	104	90	108
No. 2	11	34.3	31.3	39.4	29.9	25.3	32.3	105	101	135
No. 3	3	34.5	32.6	38.0	30.4	26.6	32.3	122	118	131
No. 4	1	36.9	-	-	28.3	-	-	88	-	-
Sample	2	36.8	36.2	37.4	27.8	27.2	28.4	97	93	101
Centennial Br., No. 1	14	34.7	29.2	38.5	30.2	25.3	33.5	112	102	136
Domestic Mustard Seed, Canada, Yellow										
No. 1 - W. Canada	113	27.1	22.5	32.2	34.5	28.1	40.5	—	—	—
Manitoba	1	28.5	-	-	33.8	-	-	—	—	—
Saskatchewan	49	28.1	22.8	32.2	33.0	28.1	39.2	—	—	—
Alberta	63	26.2	22.5	31.4	35.6	29.3	40.5	—	—	—
No. 2	20	29.0	23.4	35.1	32.8	25.6	38.7	—	—	—
No. 3	7	29.6	27.1	34.2	32.0	26.6	34.0	—	—	—
No. 4	23	28.4	24.2	32.3	33.1	27.7	36.8	—	—	—
Sample	12	29.2	24.1	33.9	32.4	27.9	38.9	—	—	—
AC Pennant, No. 1	5	27.0	23.0	30.0	33.8	31.1	38.2	—	—	—
Andante, No. 1	75	26.6	22.5	31.7	34.8	28.1	40.4	—	—	—

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 2017 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	22.5	22.1	11.2	22.6	6.1	116
Saskatchewan	23	1.5	22.5	21.8	11.3	23.1	6.1	116
Alberta	9	1.5	22.7	23.1	11.1	21.2	6.4	117
No. 2	5	1.5	22.6	21.5	11.3	22.2	6.2	116
No. 3	1	1.4	20.6	21.9	11.8	23.3	6.3	117
No. 4	1	1.4	20.0	20.0	13.2	24.2	5.6	118
Sample	3	1.5	22.1	21.5	12.1	22.3	6.0	117
Cutlass, No.1	15	1.4	21.0	20.8	11.1	25.2	6.1	115
Forge, No. 1	15	1.6	24.2	23.7	11.3	19.5	6.3	118
Domestic Mustard Seed, Canada, Brown								
No. 1 - W. Canada	45	1.2	19.3	20.6	13.4	23.9	5.9	119
Saskatchewan	43	1.2	19.3	20.6	13.4	23.9	5.9	119
Alberta	2	1.2	19.4	20.7	13.0	23.8	6.2	118
No. 2	11	1.2	19.1	20.8	13.3	24.0	6.0	119
No. 3	3	1.2	19.3	21.2	12.9	23.7	6.1	118
No. 4	1	1.2	17.3	21.3	14.7	24.3	5.8	122
Sample	2	1.2	19.5	20.2	14.4	23.2	5.6	120
Centennial Br., No.1	14	1.2	19.4	20.8	13.1	24.0	6.0	118
Domestic Mustard Seed, Canada, Yellow								
No. 1 - W. Canada	113	1.0	25.2	10.1	10.6	34.6	5.3	103
Manitoba	1	1.0	27.0	9.9	9.9	33.6	5.2	102
Saskatchewan	49	1.0	25.3	9.8	10.7	34.5	5.3	103
Alberta	63	1.0	25.0	10.3	10.5	34.6	5.3	103
No. 2	20	1.0	25.3	9.6	11.0	34.6	5.2	103
No. 3	7	1.0	24.5	9.6	10.8	35.7	5.2	103
No. 4	23	1.0	24.7	9.9	10.6	35.3	5.3	103
Sample	12	1.0	26.0	10.0	10.7	34.0	5.3	103
AC Pennant, No. 1	5	1.0	25.1	10.4	9.6	35.4	5.5	101
Andante, No. 1	75	1.0	25.0	10.1	10.7	34.7	5.3	103

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

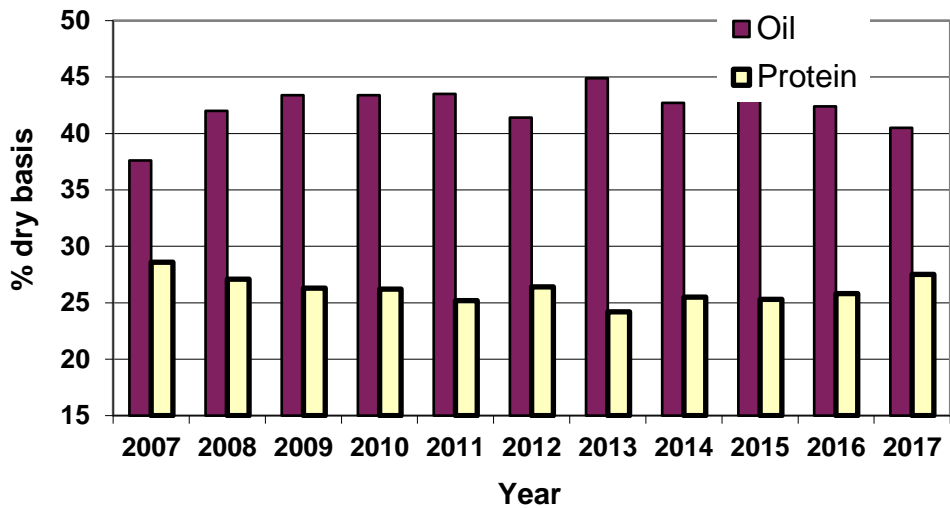
² Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 4: Chlorophyll Content and DGR in 2017 western Canadian mustard

Category	No. of samples	Chlorophyll mg/kg	Distinctly green (%DGR) ¹	%DGR range
Domestic Mustard Seed, Canada, Oriental				
No. 1 - W. Canada	32	1.2	0.13	0.0-1.5
Saskatchewan	23	1.2	0.12	0.0-1.5
Alberta	9	1.4	0.17	0.0-1.5
No. 2	5	0.4	0.00	-
No. 3	1	3.1	0.00	-
No. 4	1	1.6	0.00	-
Sample	3	3.9	0.07	0.0-0.2
Cutlass, No. 1	15	0.6		
Forge, No. 1	15	1.8		
Domestic Mustard Seed, Canada, Brown				
No. 1 - W. Canada	45	1.7	0.05	0.0-1.2
Saskatchewan	43	1.7	0.05	0.0-1.2
Alberta	2	1.1	0.00	-
No. 2	11	2.1	0.00	-
No. 3	3	2.8	0.00	-
No. 4	1	9.9	0.30	-
Sample	2	5.2	0.00	-
Centennial Br., No. 1	14	1.5		
Domestic Mustard Seed, Canada, Yellow				
No. 1 - W. Canada	113	0.7	0.02	0.0-1.4
Manitoba	1	0.7	0.00	-
Saskatchewan	49	0.9	0.04	0.0-1.4
Alberta	63	0.6	0.01	0.0-0.4
No. 2	20	0.8	0.08	0.0-0.8
No. 3	7	2.1	0.00	-
No. 4	23	1.3	0.01	0.0-0.3
Sample	12	3.3	0.00	-
AC Pennant, No. 1	5	0.3		
Andante, No. 1	75	0.8		

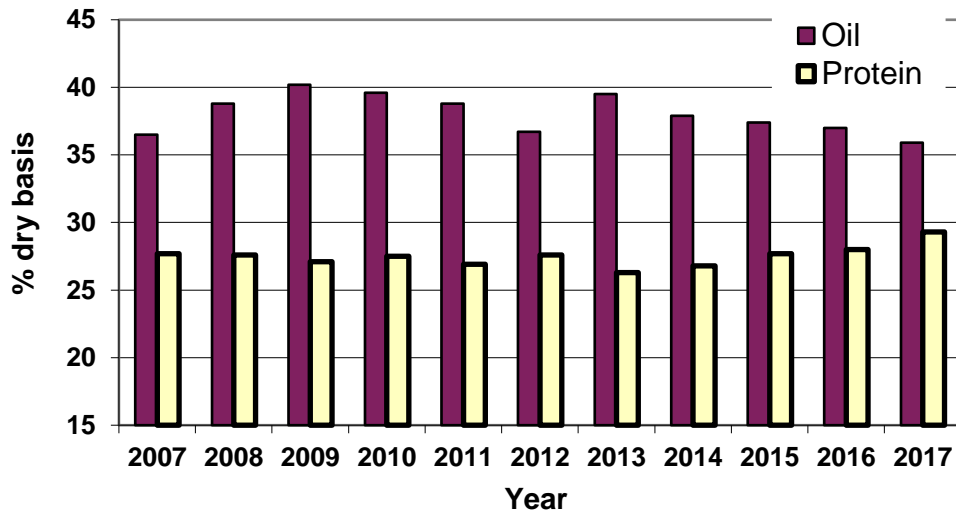
¹ Distinctly green tolerance is applied to crushed seeds which are a distinct green throughout. Pale green or immature seeds are taken into account in the evaluation of colour. The %DGR results are the averages of the individual samples included in the composite.

Figure 2: Oriental Mustard, No.1 Canada
Oil and protein content of harvest samples, 2007-17



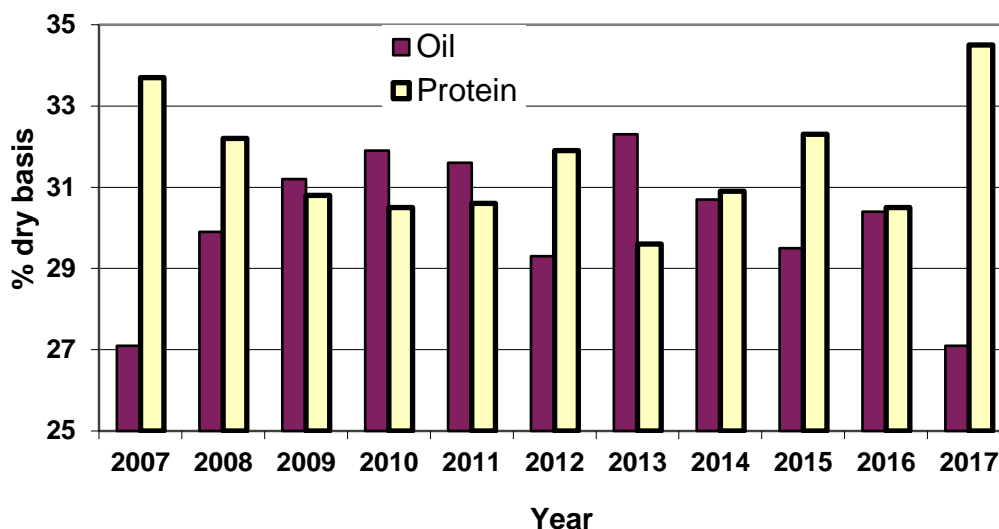
2017 Oil content.....40.5%	2017 Protein content27.5%
2016 Oil content42.4%	2016 Protein content25.8%
2007–16 Mean oil content.....42.5%	2007–16 Mean protein content.....26.1%

Figure 3: Brown Mustard, No.1 Canada
Oil and protein content of harvest samples, 2007-17



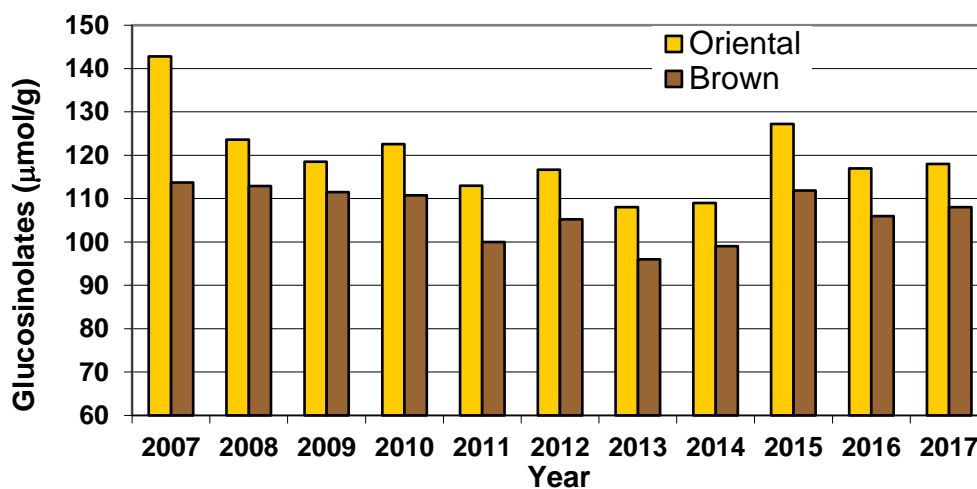
2017 Oil content.....35.9%	2017 Protein content29.3%
2016 Oil content37.0%	2016 Protein content28.0%
2007–16 Mean oil content.....38.2%	2007–16 Mean protein content.....27.3%

**Figure 4: Yellow Mustard, No.1 Canada
Oil and protein content of harvest samples, 2007-17**



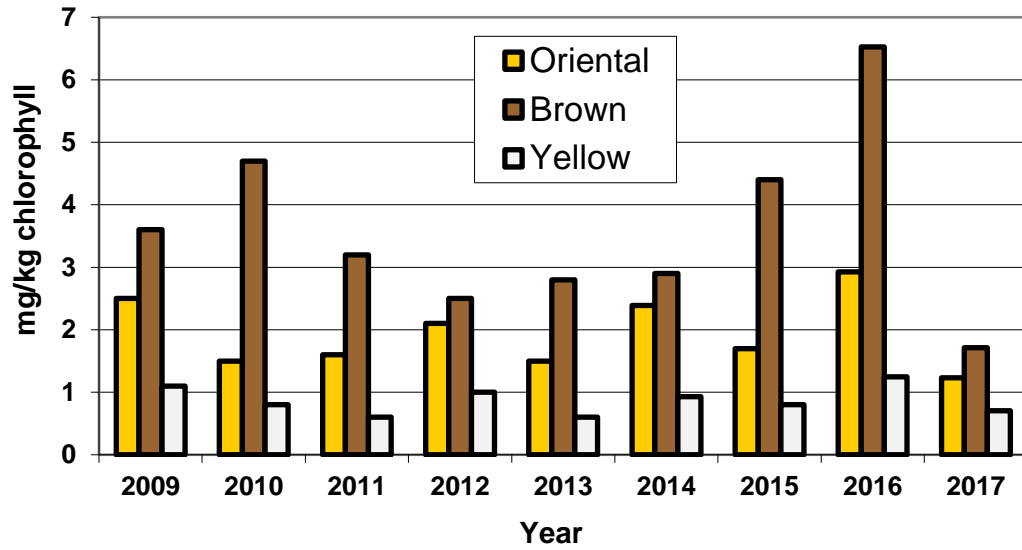
2017 Oil content.....	27.1%	2017 Protein content	34.5%
2016 Oil content	30.4%	2016 Protein content	30.5%
2007–16 Mean oil content.....	30.4%	2007–16 Mean protein content.....	31.3%

**Figure 5: Oriental and Brown Mustard, No.1 Canada
Total glucosinolate content of harvest samples, 2007-17**



2017 Oriental glucosinolate content.....	118 µmole/g	2017 Brown glucosinolate content.....	108 µmole/g
2016 Oriental glucosinolate content.....	117 µmole/g	2016 Brown glucosinolate content.....	106 µmole/g
2007–16 Mean Oriental Glucosinolate content.....	120 µmole/g	2007–16 Mean Brown glucosinolate content.....	107 µmole/g

**Figure 6: Oriental, Brown and Yellow Mustard, No.1 Canada
Chlorophyll content of harvest samples, 2007-17**



2017 Oriental chlorophyll content.....1.2 mg/kg
 2017 Brown chlorophyll content.....1.7 mg/kg
 2017 Yellow chlorophyll content.....0.7 mg/kg

2009–16 Mean Oriental chlorophyll content.....2.0 mg/kg
 2009–16 Mean Brown chlorophyll content.....3.8 mg/kg
 2009–16 Mean Yellow chlorophyll content.....0.9 mg/kg