



Canadian Grain
Commission

Commission canadienne
des grains

ISSN 1498-9905



Quality of western Canadian mustard 2013

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Acknowledgements

The Canadian Grain Commission acknowledges the cooperation of mustard producers, grain handling offices, and seed handling plants in western Canada for supplying samples of mustard harvested in 2013. The Canadian Grain Commission recognizes Industry Services grain inspectors for grading samples from the harvest survey and Grain Research Laboratory staff for conducting the analyses and preparing the report.

Introduction

This report presents information on the oil, protein and glucosinolate content and the fatty acid composition of oriental (*Brassica juncea*), brown (*Brassica juncea*) and yellow (*Sinapis alba*) mustard grown in western Canada in 2013 (Figure 1). The data was obtained from analyses of harvest survey samples collected by the Canadian Grain Commission.

Figure 1 – Mustard crops grown in Canada



Summary

Mean fixed oil content for the top grade of all types of mustard in the 2013 harvest was higher than the 10-year mean (2003-12): oriental (44.9% versus 41.9%); brown (39.5% versus 39.1%); and yellow (32.3% versus 30.2%) (Figures 2, 3 and 4). Mean crude protein for the top grade of all types of mustard was: oriental (24.2% versus 26.6%); brown (26.3% versus 26.8%); and yellow (29.5% versus 31.8%), compared to the 10-year mean for each crop (Figures 2, 3 and 4). Glucosinolate content in the top grade of oriental mustard was 108 micromoles per gram, 18 micromoles per gram lower than the 10-year mean. Meanwhile, glucosinolate content in the top grade of brown mustard was 96 micromoles per gram, 13 micromoles per gram lower than the 10-year mean (Figure 5).

Weather and production review

Weather review

The 2013 growing season was a good year for mustard quality and production. In the spring, there were initial concerns during seeding time because of a delayed snow melt and cool, wet conditions. Although seeding started in some places in early May it was not completed until mid-June. In spite of late seeding, near favourable weather conditions during the rest of the summer allowed the crop in Alberta and Saskatchewan to mature without undue stress. Warm and dry conditions from mid-August until September allowed the crop to be harvested in good condition. By the middle of September, three-quarters of the mustard crop in Saskatchewan was harvested, and by the first week in October the harvest was essentially completed (Saskatchewan Crop Reports - <http://www.agriculture.gov.sk.ca/crop-report>).

Temperature and precipitation patterns for the 2013 western Canadian growing season can be found on the Agriculture and Agri-Food Canada web site (<http://www4.agr.gc.ca/DW-GS/historical-historiques.aspx?lang=eng>).

Production and grade information

As shown in Table 1, mustard seed production increased by approximately 30% from 2012 to 154.5 thousand metric tonnes. The increase was a result in more hectares seeded and higher yields per hectare. Yield was approximately 1,045 kilograms per hectare (Statistics Canada), which is higher than last year's yield of 880 kilograms per hectare and above the 10-year average of 896 kilograms per hectare.

About 44% of production in Saskatchewan was estimated to be yellow mustard, followed by 41% brown and 15% oriental mustard, according to Saskatchewan's 2013 Specialty Crop Report (<http://www.agriculture.gov.sk.ca/Default.aspx?DN=57e075f3-2dfe-420b-9c65-a027fb1ee61c>). Saskatchewan accounted for 74% of western Canada's total seeded area and nearly 76% of mustard production, while Alberta accounted for most of the remaining seeded area and production (Table 1).

Seventy percent of samples from the harvest survey graded No. 1, in contrast to 62% in 2012 and 72%, the 10-year mean (2003-12). Growing and harvest conditions throughout the prairies produced a mustard crop with only some visible damage. Conspicuous admixtures from weed seeds and foreign material were the major factors that lowered the grades of samples from the harvest survey.

Table 1 – Seeded area and production for western Canadian mustard¹

Region	Seeded area	Seeded area	Production	Production	Mean production
	2013	2012	2013	2012	2003-12
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	n/a	n/a	n/a	n/a	1.3
Saskatchewan	109.3	97.1	117.3	82.7	134.5
Alberta	38.5	38.4	37.2	35.9	37.2
Western Canada	147.8	133.5	154.5	118.6	173.0

¹ Statistics Canada. Table 001-0010 - Estimated areas, yield, production and average farm price of principal field crops, in metric units.

<http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010010&paSer=&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid>

Harvest survey samples

This year's survey included 308 samples, compared to 269 in 2012. The survey included 192 yellow, 73 brown and 43 oriental mustard samples. Overall, 67.2% of the samples came from Saskatchewan, followed by 31.5% from Alberta and 1.3% from Manitoba.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2013 to the Canadian Grain Commission. The individual samples were cleaned to remove dockage and graded by Canadian Grain Commission inspectors Chapter 12 of the Official Grain Grading Guide was used. (<http://www.grainscanada.gc.ca/oggg-gocg/2013/12/oggg-gocg-12-eng.htm>)

Oil, protein, and glucosinolate content was determined on all individual whole-seed samples using a FOSS NIRSystems 6500 scanning near infra-red spectrometer, which was calibrated to and verified against the appropriate listed reference methods. 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, 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 No. 2, No. 3, No. 4 and Sample grades by western Canada and by type. Composites were also prepared for the most common mustard varieties.

Effects of weather on quality

The mustard crop grown in western Canada in 2013 showed the general characteristics of a crop maturing under cooler than normal conditions for the western prairies. The Grain Research Laboratory's long-term harvest survey results show that cool growing conditions tend to produce an oilseed crop with higher oil but lower protein content. Research also shows that 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 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 fixed oil content (44.9%) in Oriental Mustard, No. 1 Canada was higher than the mean in 2012 (41.4%) (Figure 2). Meanwhile, mean crude protein content (24.2%) was lower than the 2012 mean (26.4%) (Figure 2). Fixed oil content in samples of Oriental Mustard, No. 1 Canada from producers ranged from 39.4 to 49.1%, whereas protein content ranged from 20.8 to 28.7% (Table 2).

Mean fixed oil content (39.5%) in Brown Mustard, No. 1 Canada was higher than the mean in 2012 (36.7%). Meanwhile, mean crude protein content (26.3%) was lower than the 2012 mean (27.6%) (Figure 3). Fixed oil content in samples of Brown Mustard, No. 1 Canada from producers ranged from 35.1 to 43.7% while the protein content ranged from 21.2 to 30.2% (Table 2).

Glucosinolate content in Oriental Mustard, No.1 Canada was 108 micromoles per gram, a decrease from the value in 2012 (117 micromoles per gram) (Figure 5). The value for Brown Mustard, No.1 Canada (96 micromoles per gram) was also lower than the value for 2012 (105 micromoles per gram) (Figure 5). Glucosinolate content in samples of Oriental Mustard, No. 1 Canada from producers ranged from 90 to 137 micromoles per gram. Glucosinolate content in samples of Brown Mustard, No. 1 Canada from producers ranged from 78 to 119 micromoles per gram (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 (22.2%) and Brown Mustard, No.1 Canada (23.4%) were similar to 2012 values (21.4% and 23.5% respectively for 2012). (<http://www.grainscanada.gc.ca/mustard-moutarde/harvest-recolte/2012/hqm12-qrm12-eng.htm>). These values for oriental and brown mustard are typical of *Brassica juncea* condiment mustards. Two oriental mustard varieties, Forge and Cutlass, are compared. Forge had

higher oleic acid values (C18:1) than Cutlass (24.7% versus 20.2%), and higher linoleic acid values (C18:2) (21.9% versus 20.4%), but lower erucic acid content (C22:1) (19.6% versus 24.0%).

Total saturated fatty acids for both Oriental and Brown Mustard, No.1 Canada composites was 5.8%, which was lower than last year's values of 6.1% and 6.0%, respectively. There were only small changes in the levels of oleic, linoleic and linolenic acid (C:18:3). As a result, the iodine value (an indicator of oil unsaturation) was similar to 2012 values for oriental (118 units) and brown (120 units) mustard.

Chlorophyll content of oriental and brown mustard composites is provided in Table 4. Chlorophyll content was 1.5 and 2.8 milligrams per kilogram for Oriental and Brown Mustard, No. 1 Canada, respectively (Figure 6). The lower grades in both types had higher levels of chlorophyll, ranging from 3.4 to 14.2 milligrams per kilogram. Chlorophyll content for Oriental and Brown Mustard, No. 1 Canada was slightly lower compared to the 4-year mean of 1.9 and 3.5 milligrams per kilogram, respectively (Figure 6).

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 fixed oil content (32.3%) in Yellow Mustard, No. 1 Canada was higher than the mean in 2012 (29.3%). Meanwhile, mean crude protein content (29.5%) was lower than the 2012 mean (31.9%) (Figure 4). Fixed oil content in samples of Yellow Mustard, No. 1 Canada from producers ranged from 27.7 to 36.1% (Table 2). Crude protein content in samples of Yellow Mustard, No. 1 Canada from producers ranged from 25.2 to 34.7% (Table 2).

Fatty acid composition for yellow mustard composites is provided in Table 3. The fixed 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 34.7%, compared to 35.1% in 2012. Total saturated fatty acids (5.1%) and iodine values (103%) were similar to 2012 values.

Chlorophyll content of yellow mustard composites is provided in Table 4. Chlorophyll content in Yellow Mustard, No. 1 Canada was 0.6 milligrams per kilogram (Figure 6), which corresponds to the low distinctly green seed. The lower grades had slightly increased levels of chlorophyll, as high as 1.6 milligrams per kilogram for No. 4 Canada. Chlorophyll content for No. 1 Canada was similar to the 4-year mean of 0.9 milligrams per kilogram.

Table 2 – Quality of 2013 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 (Saskatchewan)	30	44.9	39.4	49.1	24.2	20.8	28.7	108	90	137
No. 2	4	42.7	38.8	46.0	25.8	23.0	28.5	118	108	135
No. 3	2	43.9	42.5	45.3	25.0	23.7	26.2	114	112	116
No. 4	3	42.5	40.5	43.5	25.9	24.4	27.9	121	109	135
Sample	4	41.7	40.6	43.4	26.3	25.0	28.4	119	115	122
Cutlass, No. 1	15	45.5	39.4	49.1	24.1	20.8	27.8	106	90	129
Forge, No. 1	11	45.2	41.0	46.9	23.3	21.5	28.2	107	95	137
Domestic Mustard Seed, Canada, Brown										
No. 1 - W. Canada Saskatchewan	58	39.5	35.1	43.7	26.3	21.2	30.2	96	78	119
Alberta	7	40.0	35.1	43.7	25.7	21.2	30.2	94	78	109
No. 2	4	38.6	33.8	40.6	25.9	23.9	28.6	103	90	126
No. 3	4	39.3	37.6	41.2	26.3	25.6	27.2	94	87	103
No. 4	1	36.1	36.1	36.1	29.0	29.0	29.0	101	101	101
Sample	6	39.0	35.5	43.7	27.5	24.0	30.7	92	87	99
Centennial Br., No. 1	42	38.9	35.1	41.5	26.9	23.9	30.2	97	83	119
Common Br., No. 1	5	40.9	39.6	41.8	25.2	23.3	26.8	94	86	103
Duchess, No. 1	4	40.7	37.7	42.7	25.3	22.9	28.6	93	78	104
Domestic Mustard Seed, Canada, Yellow										
No. 1 - W. Canada Saskatchewan	129	32.3	27.7	36.1	29.5	25.2	34.7	—	—	—
Alberta	67	31.8	27.7	36.1	30.1	25.7	34.7	—	—	—
No. 2	24	30.9	26.5	34.5	31.2	27.1	36.4	—	—	—
No. 3	13	31.5	27.5	35.4	30.1	24.2	34.4	—	—	—
No. 4	17	31.4	29.8	35.3	30.4	27.1	35.1	—	—	—
Sample	9	32.7	26.5	36.1	28.0	24.7	32.1	—	—	—
AC Pennant, No. 1	15	33.3	29.8	36.1	28.7	25.7	31.1	—	—	—
Ace, No. 1	8	34.3	33.4	35.7	27.9	26.8	28.7	—	—	—
Andante, No. 1	83	31.9	28.3	35.5	29.8	25.2	34.7	—	—	—

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

Table 3 – Fatty acid composition of 2013 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 (Saskatchewan)	30	1.5	21.9	21.2	12.8	22.2	5.8	118
No. 2	4	1.4	19.8	21.2	13.3	23.5	5.7	119
No. 3	2	1.4	19.5	20.6	13.6	23.9	5.6	119
No. 4	3	1.4	20.0	21.9	13.5	22.8	5.6	120
Sample	4	1.5	22.6	23.5	12.9	19.9	5.9	121
Cutlass, No. 1	15	1.4	20.2	20.4	13.0	24.0	5.7	118
Forge, No. 1	11	1.7	24.7	21.9	12.4	19.6	6.1	118
Domestic Mustard Seed, Canada, Brown								
No. 1 – W. Canada Saskatchewan	58	1.3	19.4	20.4	14.1	23.4	5.8	120
Alberta	7	1.4	20.6	20.5	13.6	22.9	5.9	119
No. 2	4	1.3	19.4	20.3	14.1	23.3	5.9	120
No. 3	4	1.3	19.1	20.1	14.3	23.7	5.7	120
No. 4	1	1.4	16.2	22.4	14.6	23.9	6.1	122
Sample	6	1.4	20.2	21.0	14.0	22.9	5.8	120
Centennial Brown, No. 1	42	1.3	19.1	20.5	14.2	23.6	5.7	120
Common Brown, No. 1	5	1.3	19.4	19.9	14.2	23.6	5.7	120
Duchess, No. 1	4	1.4	19.8	20.6	14.1	23.0	5.9	120
Domestic Mustard Seed, Canada, Yellow								
No. 1 - W. Canada Saskatchewan	129	1.1	25.6	9.1	10.9	34.7	5.1	103
Alberta	67	1.0	25.4	8.9	10.9	35.1	5.0	103
No. 2	24	1.1	25.9	9.2	10.9	34.3	5.1	103
No. 3	13	1.1	26.0	9.4	10.9	34.1	5.2	103
No. 4	17	1.1	26.5	9.2	11.0	33.9	5.1	103
Sample	9	1.1	26.9	9.5	10.8	33.2	5.2	103
AC Pennant, No. 1	15	1.1	25.2	9.0	10.6	35.6	5.1	102
Ace, No. 1	8	1.0	23.6	8.8	10.7	37.5	5.1	102
Andante, No. 1	83	1.1	25.7	9.0	11.1	34.4	5.1	103

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

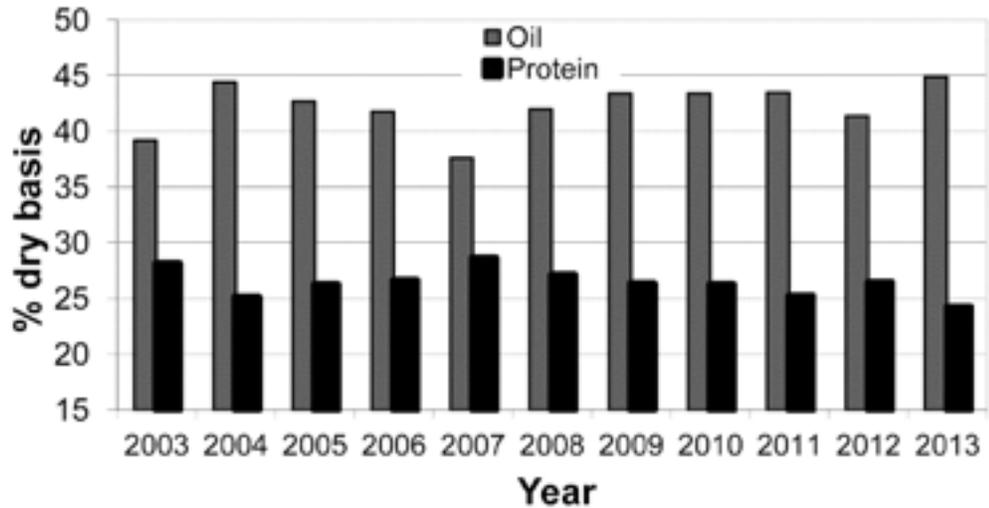
² Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 4 – Chlorophyll Content and DGR in 2013 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 (Saskatchewan)	30	1.5	0.08	0.0-1.2
No. 2	4	3.4	0.16	0.0-0.8
No. 3	2	3.6	0.00	0.0
No. 4	3	3.7	0.00	0.0
Sample	4	4.0	0.00	0.0
Cutlass, No. 1	15	1.3		
Forge, No. 1	11	1.1		
Domestic Mustard Seed, Canada, Brown				
No. 1 - W. Canada Saskatchewan	58	2.8	0.12	0.0-1.5
Alberta	51	2.9	0.13	0.0-1.5
No. 2	7	2.2	0.00	0.0
No. 2	4	6.5	0.25	0.0-1.0
No. 3	4	7.4	0.83	0.0-2.9
No. 4	1	7.8	0.00	0.0
Sample	6	14.2	1.97	0.0-5.4
Centennial Brown, No. 1	42	2.9		
Common Brown, No. 1	5	2.1		
Duchess, No. 1	4	5.9		
Domestic Mustard Seed, Canada, Yellow				
No. 1 - W. Canada Saskatchewan	129	0.6	0.03	0.0-1.4
Alberta	62	0.8	0.05	0.0-1.4
No. 2	67	0.4	0.02	0.0-0.2
No. 2	24	1.3	0.08	0.0-1.0
No. 3	13	0.9	0.14	0.0-1.8
No. 4	17	1.6	0.00	0.0
Sample	9	1.3	0.02	0.0-0.2
AC Pennant, No. 1	15	0.2		
Ace, No. 1	8	0.2		
Andante, No. 1	83	0.4		

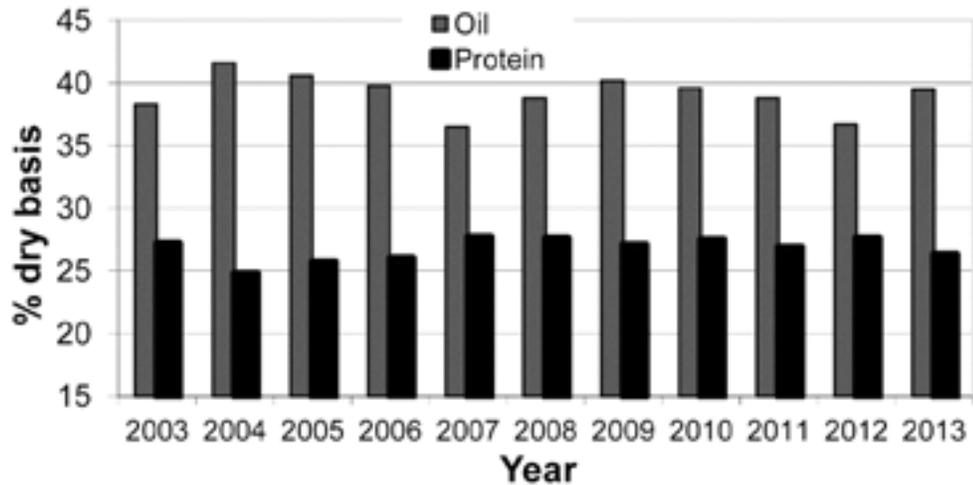
¹ Distinctly green tolerance is applied to crushed seeds which are a distinct green throughout. Pale green or immature seeds are taken into account in the evaluation of colour. The %DGR results are the averages of the individual samples included in the composite.

Figure 2 – Oriental Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2003-2013



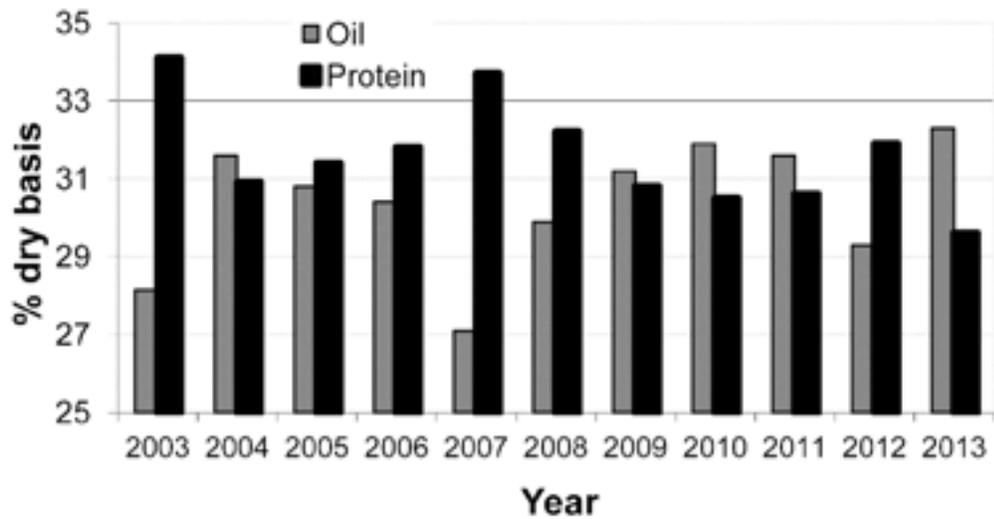
2013 Oil content.....	44.9%	2013 Protein content	24.2%
2012 Oil content	41.4%	2012 Protein content	26.4%
2003-2012 Mean oil content.....	41.9%	2003-12 Mean protein content.....	26.6%

Figure 3 – Brown Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2003-2013



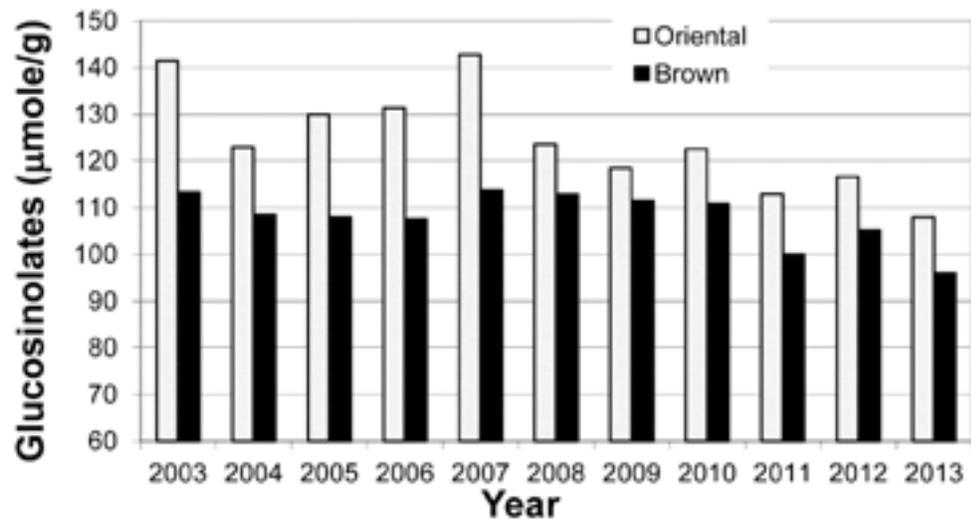
2013 Oil content.....	39.5%	2013 Protein content	26.3%
2012 Oil content	36.7%	2012 Protein content	27.6%
2003-2012 Mean oil content.....	39.1%	2003-2012 Mean protein content.....	26.8%

**Figure 4 – Yellow Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2003-2013**



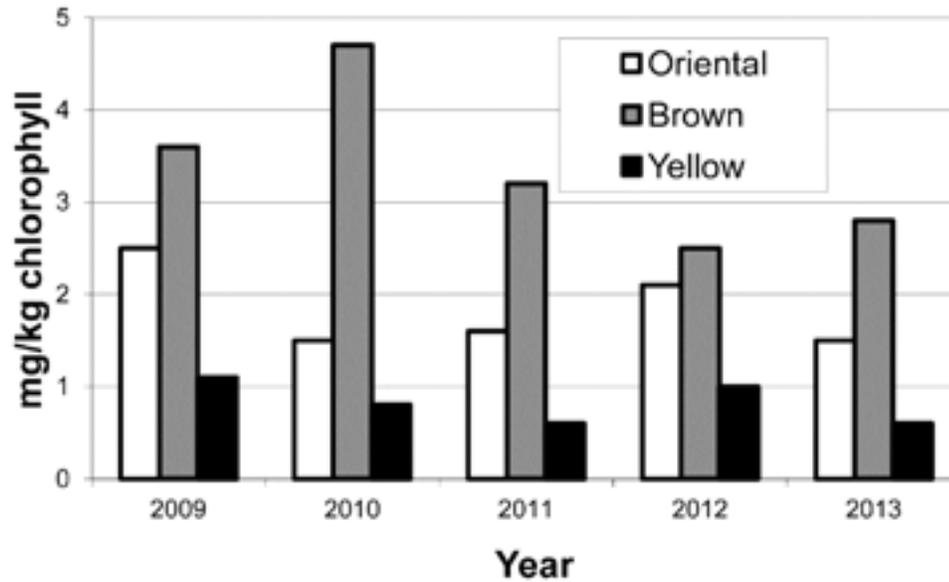
2013 Oil content.....	32.3%	2013 Protein content	29.5%
2012 Oil content	29.3%	2012 Protein content	31.9%
2003-2012 Mean oil content.....	30.2%	2003-12 Mean protein content.....	31.8%

**Figure 5 – Oriental and Brown Mustard, No.1 Canada
Glucosinolate content of harvest survey samples, 2003-2013**



2013 Oriental glucosinolate content.....	108 µmole/g	2013 Brown glucosinolate content.....	96 µmole/g
2012 Oriental glucosinolate content.....	117 µmole/g	2012 Brown glucosinolate content.....	105 µmole/g
2003-2012 Mean Oriental Glucosinolate content.....	126 µmole/g	2003-2012 Mean Brown glucosinolate content.....	109 µmole/g

**Figure 6 – Oriental, Brown and Yellow Mustard, No.1 Canada
Chlorophyll content of harvest survey samples, 2009-2013**



2013 Oriental chlorophyll
content.....1.5 mg/kg
2013 Brown chlorophyll
content.....2.8 mg/kg
2013 Yellow chlorophyll
content.....0.6 mg/kg

2009-2012 Mean Oriental chlorophyll
content.....1.9 mg/kg
2009-2012 Mean Brown chlorophyll
content.....3.5 mg/kg
2009-2012 Mean Yellow chlorophyll
content.....0.9 mg/kg