



Canadian Grain Commission
Commission canadienne
des grains

ISSN 1498-9905



Quality of western Canadian mustard 2015

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Canada

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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 2015. 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 2015 (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 fixed oil content for the top grade for oriental mustard in the 2015 harvest was higher than the 10-year average (43.2% versus 42.3%); while for brown and yellow mustard it was lower: brown (37.4% versus 38.8%); yellow (29.5% versus 30.5%) (Figures 2, 3 and 4). Conversely the mean crude protein for the top grade oriental mustard was lower than the 10-year average (25.3 versus 26.2%) while for brown and yellow it was higher: brown (27.7% versus 26.9%), yellow (32.3% versus 31.3%) (Figures 2, 3 and 4). Total glucosinolate content in the top grade mustard was 127 micromoles for oriental and 112 micromoles per gram for brown, which was higher than the 10-year average of 122 micromoles per gram for oriental and 107 micromoles per gram for brown mustard (Figure 5).

Weather and production review

Weather review

The 2015 growing season for mustard started positive with good subsoil moisture and an early spring. Seeding began end of April and by the first week in May one third of the crop was seeded in Saskatchewan. Early development was slow in the due to cold weather and frosts in the later part of May. Conditions continued to be unfavourable up until mid-July with low precipitation and above average temperatures. Timely rains from mid-July and into August allowed the crop to develop and mature.

Although there were some delays in some regions due to re-growth following the mid-summer rains the harvest began at the end of August and was complete by the second week of October (Saskatchewan Crop Reports -

<http://www.agriculture.gov.sk.ca/crop-report>) and Olds Products 2015 Crop Reports (<http://www.oldsproducts.com/olds-products/2015-crop-reports>).

Temperature and precipitation patterns for the 2015 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.aspx?lang=eng&jsEnabled=true>).

Production and grade information

As shown in Table 1, mustard seed production decreased by approximately 38% from 2014 to 123.4 thousand metric tonnes. The decrease was a result of fewer hectares seeded combined with a decrease in yield. Yield was approximately 930 kilograms per hectare (Statistics Canada), which is lower than last year's yield of 1010 kilograms per hectare but close to the 10-year average of 933 kilograms per hectare.

About 47% of mustard production in Saskatchewan was estimated to be yellow, 29% brown and 24% oriental according to Saskatchewan's 2015 Specialty Crop Report. Saskatchewan accounted for 74% of western Canada's total seeded area and nearly 74% of mustard production, while Alberta accounted for most of the remaining seeded area and production (Table 1).

This year 58% of samples were graded No. 1, in contrast to 73% in 2014 and 73% for the 10-year mean (2005-14). Growing and harvest conditions throughout the Prairies produced a mustard crop with some visible damage. However, conspicuous admixtures from weed seeds and foreign material were major factors in lowering the grades of samples received in 2015.

Table 1 – Seeded area and production for western Canadian mustard¹

| Region | Seeded area | Seeded area | Production | Production | Mean production |
|-----------------------|-------------------|--------------|-----------------|--------------|-----------------|
| | 2015 | 2014 | 2015 | 2014 | 2005-14 |
| | thousand hectares | | thousand tonnes | | thousand tonnes |
| Manitoba | n/a | n/a | n/a | n/a | n/a |
| Saskatchewan | 103.2 | 147.7 | 91.5 | 138.6 | 119.1 |
| Alberta | 36.4 | 54.6 | 31.9 | 59.4 | 37.8 |
| Western Canada | 139.6 | 202.3 | 123.4 | 198.0 | 156.9 |

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 samples

This year's Harvest Sample Program included 367 samples, compared to 387 in 2014. This included 234 yellow, 50 brown and 83 oriental mustard samples. Overall, 68% of the samples came from Saskatchewan, followed by 30% from Alberta and 2% from Manitoba.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2015 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, protein, and total glucosinolate content was determined on all individual whole-seed samples using a FOSS NIRSystems 6500 scanning near infrared 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, 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 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 2015 showed general characteristics of a crop well matured. 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 lower oil but higher protein content and the converse is true for cool, moist conditions. 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 fixed oil content (43.2%) in Oriental Mustard, No. 1 Canada was higher than the mean in 2014 (42.7%) (Figure 2). Meanwhile, mean crude protein content (25.3%) was similar to the 2014 mean (25.5%) (Figure 2). Fixed oil content in samples of Oriental Mustard, No. 1 Canada from producers ranged from 36.9 to 53.7%, whereas protein content ranged from 19.3 to 31.7% (Table 2).

Mean fixed oil content (37.4%) in Brown Mustard, No. 1 Canada was lower than the mean in 2014 (37.9%). Meanwhile, mean crude protein content (27.7%) was higher than the 2014 mean (26.8%) (Figure 3). Fixed oil content in samples of Brown Mustard, No. 1 Canada from producers ranged from 34.3 to 42.0% while the protein content ranged from 24.3 to 30.7% (Table 2).

Total glucosinolate content in Oriental Mustard, No.1 Canada was 127 micromoles per gram, a value higher than in 2014 at 109 micromoles per gram (Figure 5). The value for Brown Mustard, No.1 Canada was also higher than the value for 2014, 112 versus 99 micromoles per gram (Figure 5). Total glucosinolate content in samples of Oriental Mustard, No. 1 Canada from producers ranged from 72 to 155 micromoles per gram. Total glucosinolate content in samples of Brown Mustard, No. 1 Canada from producers ranged from 96 to 129 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 (22.3%) and Brown Mustard, No.1 Canada (23.6%) were slightly higher than the 2014 values (21.8% and 23.2% respectively for 2014) (<https://www.grainscanada.gc.ca/mustard-moutarde/harvest-recolte/2014/hqm14-grm14-5-en.htm>). These values for oriental and brown mustard are typical of *Brassica juncea* condiment mustards.

Total saturated fatty acids for both Oriental and Brown Mustard, No.1 Canada composites was 5.9%, which was similar to last year's values of 6.0%. There were only small changes in the levels of oleic, linoleic and linolenic acid (C18:3). As a result, the

iodine value (an indicator of oil unsaturation) was similar to 2014 values for both oriental and brown mustard at 118 and 120 units, respectively.

Chlorophyll content of oriental and brown mustard composites is provided in Table 4. Chlorophyll content was 1.7 and 4.4 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 2.2 to 14.5 milligrams per kilogram.

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 (29.5%) in Yellow Mustard, No. 1 Canada was lower than the mean in 2014 (30.7%). Meanwhile, mean crude protein content (32.3%) was higher than the 2014 mean (30.9%) (Figure 4). Fixed oil content in samples of Yellow Mustard, No. 1 Canada from producers ranged from 23.9 to 34.9% while crude protein ranged from 25.6 to 37.2%.

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 34.8%, compared to 34.3% in 2014. Total saturated fatty acids (5.2%) and iodine values (103 units) were slightly higher than 2014 values.

Chlorophyll content of yellow mustard composites is provided in Table 4. Chlorophyll content in Yellow Mustard, No. 1 Canada was 0.8 milligrams per kilogram (Figure 6), which corresponds to the low distinctly green seed count (%DGR). The lower grades had slightly increased levels of chlorophyll, as high as 3.6 milligrams per kilogram for Sample grade. Chlorophyll content for No. 1 Canada was the same as the 6-year mean of 0.8 milligrams per kilogram.

Table 2 – Quality of 2015 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 | 63 | 43.2 | 36.9 | 53.7 | 25.3 | 19.3 | 31.7 | 127 | 72 | 155 |
| Saskatchewan | 57 | 43.6 | 37.5 | 53.7 | 24.9 | 19.3 | 30.7 | 125 | 72 | 144 |
| Alberta | 6 | 39.0 | 36.9 | 42.4 | 29.5 | 26.2 | 31.7 | 152 | 134 | 155 |
| No. 2 | 15 | 41.2 | 38.4 | 43.5 | 26.8 | 25.0 | 29.2 | 127 | 76 | 149 |
| No. 3 | 2 | 39.1 | 38.4 | 39.8 | 29.3 | 28.8 | 29.8 | 133 | 129 | 137 |
| No. 4 | 2 | 38.6 | 36.4 | 40.7 | 29.6 | 26.9 | 32.2 | 146 | 140 | 151 |
| Sample | 1 | 41.0 | - | - | 25.5 | - | - | 124 | - | - |
| Cutlass, No.1 | 39 | 43.7 | 37.5 | 53.7 | 25.3 | 19.3 | 30.8 | 125 | 72 | 141 |
| Forge, No. 1 | 24 | 42.0 | 36.9 | 46.1 | 25.5 | 21.0 | 31.7 | 129 | 99 | 155 |
| Domestic Mustard Seed, Canada, Brown | | | | | | | | | | |
| No. 1 - W. Canada | 36 | 37.4 | 34.3 | 42.0 | 27.7 | 24.3 | 30.7 | 112 | 96 | 129 |
| Saskatchewan | 30 | 37.1 | 34.3 | 39.8 | 27.9 | 25.4 | 30.7 | 112 | 96 | 129 |
| Alberta | 6 | 38.6 | 34.8 | 42.0 | 26.9 | 24.3 | 28.7 | 110 | 96 | 111 |
| No. 2 | 5 | 34.9 | 33.7 | 35.7 | 30.5 | 29.5 | 32.4 | 126 | 110 | 139 |
| No. 3 | 3 | 37.4 | 33.2 | 42.2 | 27.4 | 23.9 | 30.9 | 110 | 60 | 138 |
| No. 4 | 1 | 35.1 | - | - | 29.5 | - | - | 121 | - | - |
| Sample | 5 | 36.2 | 32.0 | 40.1 | 27.4 | 24.0 | 29.6 | 106 | 91 | 141 |
| Centennial Br., No. 1 | 22 | 37.4 | 34.3 | 42.0 | 27.5 | 24.3 | 30.7 | 115 | 96 | 129 |
| Domestic Mustard Seed, Canada, Yellow | | | | | | | | | | |
| No. 1 - W. Canada | 113 | 29.5 | 23.9 | 34.9 | 32.3 | 25.6 | 37.2 | — | — | — |
| Manitoba | 2 | 29.4 | 26.4 | 32.3 | 32.4 | 28.3 | 36.5 | — | — | — |
| Saskatchewan | 53 | 29.9 | 23.9 | 34.9 | 31.6 | 25.6 | 37.2 | — | — | — |
| Alberta | 58 | 29.1 | 25.4 | 33.4 | 32.9 | 27.4 | 37.0 | — | — | — |
| No. 2 | 49 | 29.3 | 24.7 | 33.0 | 32.7 | 27.7 | 38.5 | — | — | — |
| No. 3 | 23 | 28.8 | 25.3 | 31.7 | 33.2 | 28.7 | 36.6 | — | — | — |
| No. 4 | 30 | 28.3 | 22.7 | 32.7 | 33.6 | 29.1 | 39.3 | — | — | — |
| Sample | 19 | 29.0 | 25.9 | 32.8 | 32.0 | 26.4 | 35.9 | — | — | — |
| AC Pennant, No. 1 | 10 | 30.6 | 27.6 | 33.4 | 30.6 | 27.4 | 34.2 | — | — | — |
| Andante, No. 1 | 77 | 29.3 | 23.9 | 34.9 | 32.2 | 25.6 | 37.2 | — | — | — |

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 2015 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 | 63 | 1.5 | 21.8 | 21.5 | 12.5 | 22.3 | 5.9 | 118 |
| Saskatchewan | 57 | 1.5 | 21.9 | 21.4 | 12.4 | 22.3 | 5.9 | 118 |
| Alberta | 6 | 1.4 | 20.8 | 22.1 | 12.6 | 22.7 | 5.9 | 119 |
| No. 2 | 15 | 1.4 | 20.3 | 21.9 | 12.9 | 23.0 | 5.8 | 119 |
| No. 3 | 2 | 1.4 | 20.7 | 22.6 | 12.9 | 22.2 | 5.9 | 120 |
| No. 4 | 2 | 1.3 | 18.9 | 20.9 | 13.4 | 24.2 | 5.7 | 119 |
| Sample | 1 | 1.6 | 24.7 | 24.2 | 12.4 | 18.3 | 6.3 | 120 |
| Cutlass, No.1 | 39 | 1.4 | 20.2 | 20.7 | 12.8 | 23.9 | 5.8 | 118 |
| Forge, No. 1 | 24 | 1.6 | 24.5 | 23.0 | 11.9 | 19.3 | 6.1 | 119 |
| Domestic Mustard Seed, Canada, Brown | | | | | | | | |
| No. 1 - W. Canada | 36 | 1.2 | 18.7 | 21.1 | 13.9 | 23.6 | 5.9 | 120 |
| Saskatchewan | 30 | 1.2 | 18.5 | 21.1 | 14.0 | 23.7 | 5.9 | 120 |
| Alberta | 6 | 1.4 | 19.9 | 21.0 | 13.7 | 23.1 | 6.0 | 119 |
| No. 2 | 5 | 1.2 | 18.5 | 21.2 | 14.0 | 23.8 | 5.9 | 120 |
| No. 3 | 3 | 1.3 | 19.6 | 21.6 | 13.6 | 22.7 | 6.1 | 120 |
| No. 4 | 1 | 1.2 | 16.7 | 21.8 | 14.6 | 24.4 | 5.9 | 122 |
| Sample | 5 | 1.3 | 19.4 | 21.6 | 13.2 | 22.9 | 6.2 | 119 |
| Centennial Br., No.1 | 22 | 1.2 | 18.8 | 20.8 | 14.0 | 23.7 | 5.9 | 120 |
| Domestic Mustard Seed, Canada, Yellow | | | | | | | | |
| No. 1 - W. Canada | 113 | 1.0 | 25.3 | 9.4 | 10.9 | 34.8 | 5.2 | 103 |
| Manitoba | 2 | 1.0 | 25.4 | 9.6 | 10.9 | 34.4 | 5.2 | 103 |
| Saskatchewan | 53 | 1.0 | 25.5 | 9.5 | 10.7 | 34.5 | 5.3 | 103 |
| Alberta | 58 | 1.0 | 25.0 | 9.3 | 11.0 | 35.1 | 5.1 | 103 |
| No. 2 | 49 | 1.0 | 24.9 | 9.4 | 11.2 | 35.0 | 5.2 | 103 |
| No. 3 | 23 | 1.0 | 24.6 | 9.5 | 11.0 | 35.4 | 5.1 | 103 |
| No. 4 | 30 | 1.0 | 25.1 | 9.6 | 10.9 | 34.9 | 5.2 | 103 |
| Sample | 19 | 1.0 | 25.1 | 9.7 | 11.1 | 34.7 | 5.2 | 103 |
| AC Pennant, No. 1 | 10 | 1.0 | 24.8 | 9.3 | 10.6 | 35.5 | 5.2 | 102 |
| Andante, No. 1 | 77 | 1.0 | 25.2 | 9.4 | 11.0 | 34.7 | 5.2 | 103 |

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

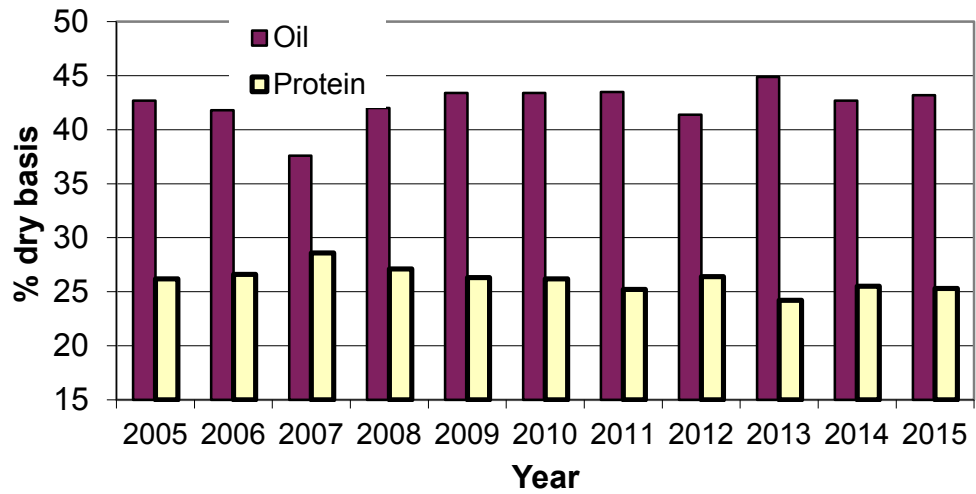
² Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 4 – Chlorophyll Content and DGR in 2015 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 | 63 | 1.7 | 0.18 | 0.0-1.2 |
| Saskatchewan | 57 | 1.7 | 0.17 | 0.0-1.2 |
| Alberta | 6 | 1.3 | 0.23 | 0.0-0.8 |
| No. 2 | 15 | 3.9 | 0.09 | 0.0-0.8 |
| No. 3 | 2 | 2.2 | 0.10 | 0.2 |
| No. 4 | 2 | 2.9 | 0.00 | 0.0 |
| Sample | 1 | 7.3 | 1.20 | - |
| Cutlass, No. 1 | 33 | 1.8 | | |
| Forge, No. 1 | 20 | 1.7 | | |
| Domestic Mustard Seed, Canada, Brown | | | | |
| No. 1 - W. Canada | 36 | 4.4 | 0.10 | 0.0-0.6 |
| Saskatchewan | 30 | 4.4 | 0.11 | 0.0-0.6 |
| Alberta | 6 | 4.7 | 0.03 | 0.0-0.2 |
| No. 2 | 5 | 4.0 | 0.05 | 0.0-0.6 |
| No. 3 | 3 | 2.9 | 0.00 | 0.0 |
| No. 4 | 1 | 14.5 | 1.50 | - |
| Sample | 5 | 5.8 | 0.00 | 0.0 |
| Centennial Br., No. 1 | 38 | 3.7 | | |
| Domestic Mustard Seed, Canada, Yellow | | | | |
| No. 1 - W. Canada | 113 | 0.8 | 0.00 | 0.0-0.1 |
| Manitoba | 2 | 1.7 | 0.00 | 0.0 |
| Saskatchewan | 53 | 1.0 | 0.00 | 0.0-0.1 |
| Alberta | 58 | 0.6 | 0.00 | 0.0-0.1 |
| No. 2 | 49 | 1.1 | 0.04 | 0.0-1.0 |
| No. 3 | 23 | 2.5 | 0.17 | 0.0-3.0 |
| No. 4 | 30 | 1.7 | 0.00 | 0.0 |
| Sample | 19 | 3.6 | 0.00 | 0.0 |
| AC Pennant, No. 1 | 10 | 0.4 | | |
| Andante, No. 1 | 77 | 0.9 | | |

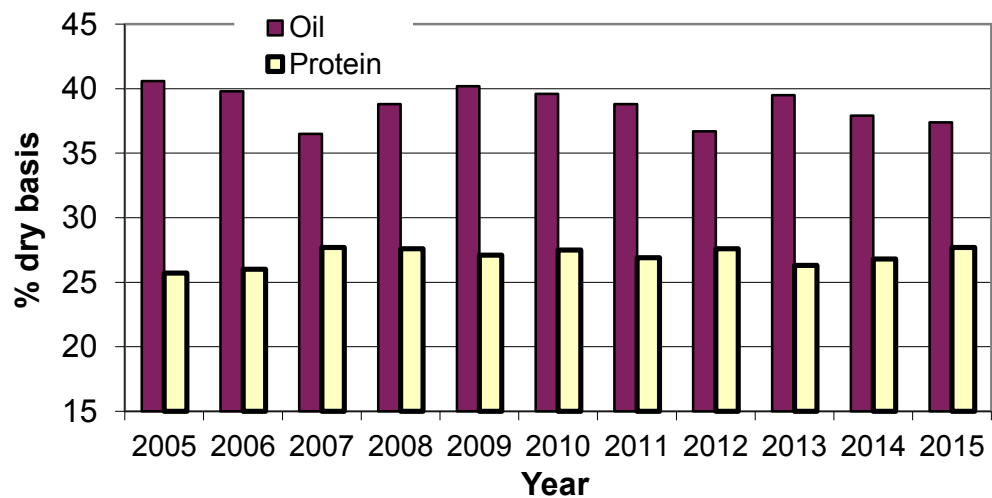
¹ Distinctly green tolerance is applied to crushed seeds which are a distinct green throughout. Pale green or immature seeds are taken into account in the evaluation of colour. The %DGR results are the averages of the individual samples included in the composite.

Figure 2 – Oriental Mustard, No.1 Canada
Oil and protein content of harvest samples, 2005-15



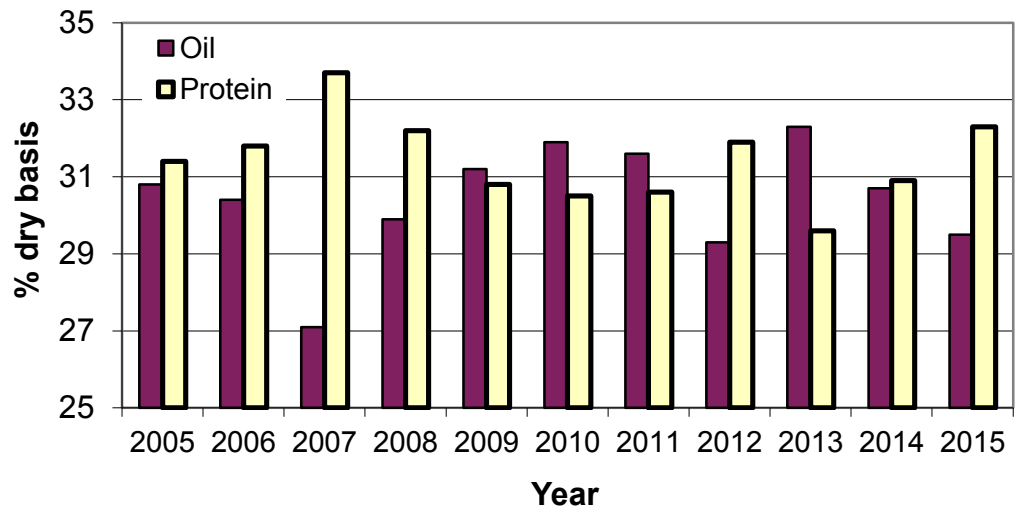
| | | | |
|-------------------------------|-------|-----------------------------------|-------|
| 2015 Oil content..... | 43.2% | 2015 Protein content | 25.3% |
| 2014 Oil content | 42.7% | 2014 Protein content | 25.5% |
| 2005–14 Mean oil content..... | 42.3% | 2005–14 Mean protein content..... | 26.2% |

Figure 3 – Brown Mustard, No.1 Canada
Oil and protein content of harvest samples, 2005-15



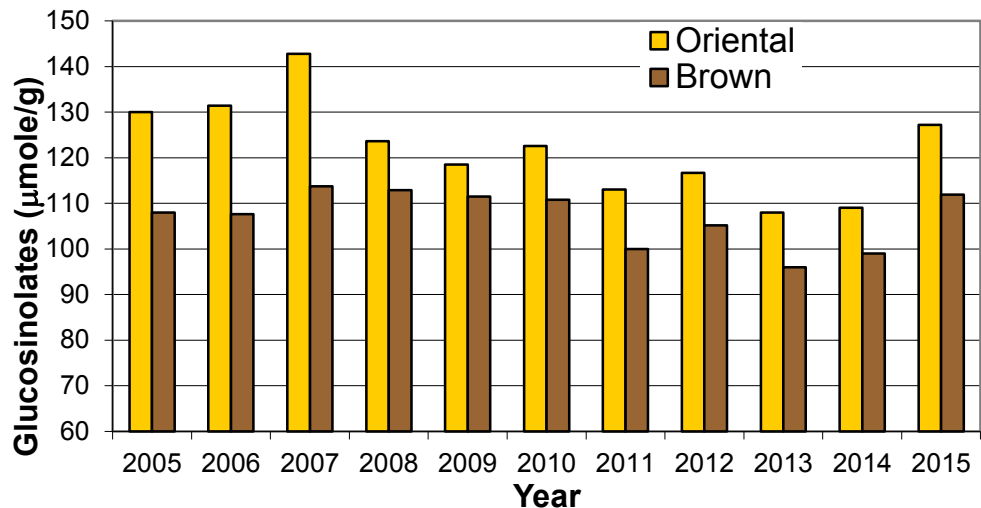
| | | | |
|-------------------------------|-------|-----------------------------------|-------|
| 2015 Oil content..... | 37.4% | 2015 Protein content | 27.7% |
| 2014 Oil content | 37.9% | 2014 Protein content | 26.8% |
| 2005–14 Mean oil content..... | 38.8% | 2005–14 Mean protein content..... | 26.9% |

Figure 4 – Yellow Mustard, No.1 Canada
Oil and protein content of harvest samples, 2005-15



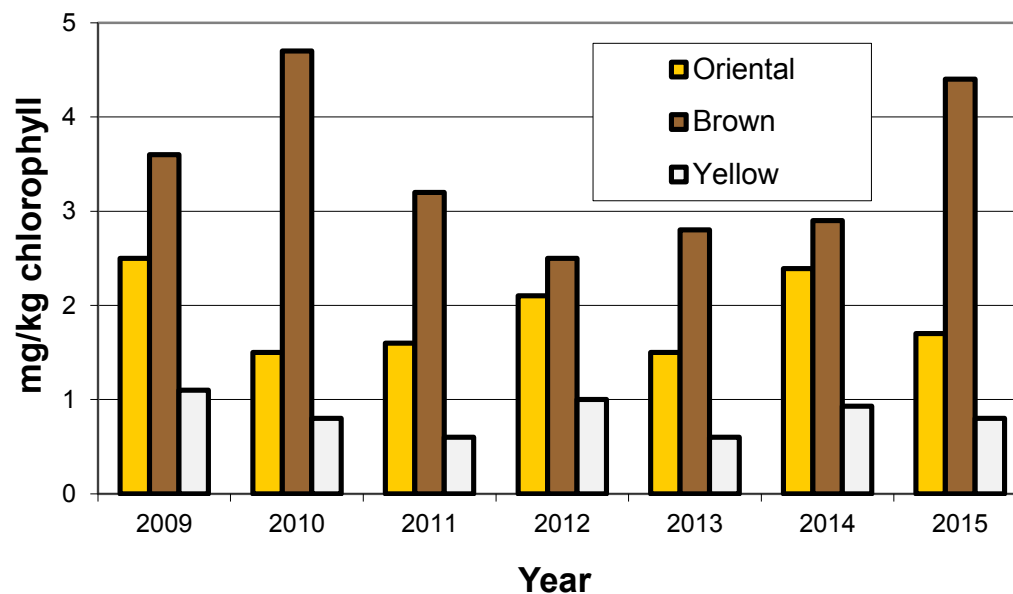
| | | | |
|-------------------------------|-------|-----------------------------------|-------|
| 2015 Oil content..... | 29.5% | 2015 Protein content | 32.3% |
| 2014 Oil content | 30.7% | 2014 Protein content | 30.9% |
| 2005–14 Mean oil content..... | 30.5% | 2005–14 Mean protein content..... | 31.3% |

Figure 5 – Oriental and Brown Mustard, No.1 Canada
Total glucosinolate content of harvest samples, 2005-15



| | | | |
|--|-------------|---|-------------|
| 2015 Oriental glucosinolate content..... | 127 µmole/g | 2015 Brown glucosinolate content..... | 112 µmole/g |
| 2014 Oriental glucosinolate content..... | 109 µmole/g | 2014 Brown glucosinolate content..... | 99 µmole/g |
| 2005–14 Mean Oriental Glucosinolate content..... | 122 µmole/g | 2005–14 Mean Brown glucosinolate content..... | 107 µmole/g |

**Figure 6 – Oriental, Brown and Yellow Mustard, No.1 Canada
Chlorophyll content of harvest samples, 2009-15**



2015 Oriental chlorophyll content.....1.7 mg/kg
 2015 Brown chlorophyll content.....4.4 mg/kg
 2015 Yellow chlorophyll content.....0.8 mg/kg

2009-14 Mean Oriental chlorophyll content.....1.9 mg/kg
 2009-14 Mean Brown chlorophyll content.....3.3 mg/kg
 2009-14 Mean Yellow chlorophyll content.....0.8 mg/kg