



Canadian Grain Commission
Commission canadienne
des grains



Quality of western Canadian mustard 2011

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Introduction

This report presents information on the oil, protein and glucosinolate contents and the fatty acid composition of oriental (*Brassica juncea*), brown (*Brassica juncea*) and yellow (*Sinapis alba*) mustard grown in western Canada in 2011 (Figure 1). The data were obtained from analyses of harvest survey samples collected by the Canadian Grain Commission (CGC).

Figure 1 – Mustard crops grown in Canada



Summary

Top grade oriental, brown and yellow mustard in 2011 had a fixed oil content of 43.5%, 38.8% and 31.6% compared to the 10-year averages (2001-2010) of 41.7%, 39.4% and 30.1% respectively. Crude protein for the top grade oriental, brown and yellow mustard was 25.2%, 26.9% and 30.6% compared to the ten-year averages of 26.6%, 26.7% and 32.3%, respectively. Compared to the 10-year averages the glucosinolate content of the 2011 top grade oriental mustard decreased 17 micrograms per gram ($\mu\text{mole/g}$) to 113 $\mu\text{mole/g}$ while brown mustard had a decreased of 10 $\mu\text{mole/g}$ in glucosinolate content to 100 $\mu\text{mole/g}$.

Weather and production review

Weather review

The 2011 growing season was a challenging year for many producers. Concerns due to excess moisture conditions were prevalent in the early spring, as soils were saturated from the heavy rains that fell in 2010. Cool weather in April and May along with heavy rains flooding areas of the southern regions of the prairies led to the delay of seeding. Temperatures during May were below normal in the southern regions. The weather during July and August was almost the opposite of spring conditions with south-eastern regions turning dry and warm while the western areas of the Prairies (the primary mustard growing region) were slightly cooler than normal. Warm dry conditions in September allowed the harvest to progress ahead of normal and by the first week in October 99% of the mustard in Saskatchewan was harvested (Saskatchewan Crop Report October 6, 2011).

Temperature and precipitation patterns for the 2011 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>).

For more detailed information of this year's growing season read the 'Growing season in review' by the Weather and Crop Surveillance department of the Canadian Wheat Board. (<http://www.cwb.ca/public/en/farmers/grain/crop/>).

Production and grade information

As shown in Table 1, mustard seed production for 2011 decreased by approximately 33% to 124.8 thousand metric tonnes as a result of decreased planted area. The average yield for 2011 was approximately 1,000 kg/hectare (Statistic Canada) (<http://www.statcan.gc.ca/pub/22-002-x/22-002-x2011008-eng.pdf>) which is similar to last year's average and above the ten-year average of 830 kg/hectare. About 33% of the Saskatchewan mustard production was estimated to be the yellow type, followed by 38% brown and 29% oriental (and non-specified) mustard. Approximately 80% of the Alberta mustard was the yellow type. Saskatchewan accounted for 77% of western Canada's total seeded area and 83% of the production of mustard. The growing and harvest conditions throughout the prairies produced a mustard crop with only some visible damage. In the 2011 CGC survey 72% of the mustard was in the top grade compared to 70% in 2010 and 71% for the 10-year period (2001-2010). Conspicuous admixtures from weed seeds and foreign material were the major factors that lowered the grades of the harvest survey samples in 2011.

Table 1 – Seeded area and production for western Canadian mustard

Region	Seeded area ¹	Seeded area ²	Production ¹	Production ²	Mean production ²
	2011	2010	2011	2010	2001-2010
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	n/a	n/a	n/a	n/a	2.6
Saskatchewan	107.3	149.7	103.2	134.3	140.3
Alberta	20.2	44.5	21.6	52.5	33.7
Western Canada	127.5	194.2	124.8	186.8	176.6

¹ November Estimates of Production of Principal Field Crops, Catalogue no. 22-002-X, vol. 90 no. 8 Released December 6, 2011; Statistics Canada

² Small Area Data 1976-2010 Statistics Canada, Agriculture Division, Crop Section

Harvest survey samples

This year's survey included 188 sample as compared to 196 in 2010 and 322 in 2009. This year's survey included only 98 yellow mustard, 35 brown mustard and 55 oriental mustard. Approximately 75% of the 2011 harvest survey samples came from Saskatchewan, followed by 24.5% and 0.5% from Alberta and Manitoba, respectively.

Producers, grain companies and elevators that routinely handle mustard seed, submitted samples of mustard grown in 2011 to the CGC. The individual samples were cleaned to remove dockage and graded by the CGC's Industry Services Division based on the Chapter 12 of the Official Grain Grading Guide (<http://www.grainscanada.gc.ca/oggg-gocg/12/oggg-gocg-12-eng.htm>).

The oil, protein, and glucosinolate contents were determined on all individual whole seed samples using a NIRSystems 6500 scanning near infra-red spectrometer calibrated to and verified against the appropriate listed reference methods. The reference procedures are listed on the CGC web site under Oilseeds Methods <http://www.grainscanada.gc.ca/oilseeds-oleagineux/method-methode/omtm-mmao-eng.htm>.

Composite samples were used for oil, protein, glucosinolate and chlorophyll content as well as fatty acid composition analyses. Composites were prepared by combining No. 1 mustard samples by province and type; mustard, No. 2, No. 3, No. 4 and Sample grade by western Canada and by type. Composites were also prepared for the common mustard varieties.

Quality of western Canadian mustard – 2011

The mustard crop grown in western Canada in 2011 showed the general characteristics of a crop grown under a cooler than normal conditions for the western prairies with the possible exception of brown mustard. The Grain Research Laboratory (GRL) long-term harvest survey results show that cool, moist growing conditions tend to produce an oilseed crop with higher oil contents and iodine values, but lower protein contents. Research also shows that glucosinolate levels may decrease when *Brassica* crops are grown under cooler conditions.

The oil, protein, and glucosinolate contents for oriental, brown and yellow mustard are summarized by grade in Table 2. The fatty acid compositions of the mustard oils are detailed in Table 3 and chlorophyll content and distinctly green count (DGR) in Table 4. A comparison of the 2011 quality data with the previous years' surveys are provided in Figures 2 to 5.

Quality of Domestic Mustard Seed, Canada, Oriental and Domestic Mustard Seed, Canada, Brown

Fixed oil, protein and glucosinolate contents are provided in Table 2. In 2011, the fixed oil content of the Oriental Mustard, No.1 Canada samples had similar values of 43.5% when compared to 2010 (Figure 2) while the crude protein content decreased by 1.0% to 25.2%. The fixed oil contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 36.2% to 47.4%. The protein content of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 21.4% to 31.4%.

In 2011, the fixed oil content of Brown Mustard, No. 1 Canada decreased 0.8% from the 2010 results to 38.8% while the crude protein content also decreased to 26.9% from 27.5% (Figure 3). The fixed oil content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 34.3% to 43.1%. The protein content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.4% to 31.3%.

In 2011, the glucosinolate contents for Oriental Mustard, No.1 Canada decreased from 2010 by 10 $\mu\text{mole/g}$ to 113 $\mu\text{mol/g}$ while Brown Mustard, No.1 Canada values decreased by a similar amount to 100 $\mu\text{mole/g}$ (Figure 5). The glucosinolate contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 85 to 148 $\mu\text{mole/g}$. The glucosinolate contents of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 80 to 125 $\mu\text{mol/g}$.

Fatty acid compositions for the oriental and brown mustard composites are provided in Table 3. The 2011 average erucic acid (C22:1) level increased slightly to 21.7% for Oriental Mustard, No.1 Canada from last year while Brown Mustard, No.1 Canada remained the same at 23.4%. These erucic acid values for

oriental and brown mustards are typical of *Brassica juncea* condiment mustards. The oriental mustard variety Forge had higher values in oleic (C18:1), linoleic (C18:2) but lower values in erucic acid content compared to the variety Cutlass.

The total saturated fatty acids for the Oriental and Brown Mustard, No.1 Canada composites were 6.1% and 6.0% respectively; similar to last year's values. The 2011 mustard composites had only slight changes in the levels of oleic, linoleic and linolenic acid and as a result, the iodine value (an indicator of oil unsaturation) were similar to the 2010 mustard samples at 117 and 118 units for oriental and brown mustard.

Chlorophyll content was 1.6 and 3.2 mg/kg for the Oriental and Brown Mustard, No. 1 Canada mustard, respectively (Table 4). The lower grades had increased levels of chlorophyll going as high as 33.6 mg/kg for sample grade.

Quality of Domestic Mustard Seed, Canada, Yellow

The yellow mustard has the characteristically lower oil content and higher protein content than oriental and brown mustards (Table 2). For Yellow Mustard, No. 1 Canada samples in 2011, the fixed oil content decreased slightly from 2010 to 31.6% while crude protein content was similar to the 2010 values at 30.6% (Figure 4). The fixed oil contents of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 26.7% to 34.8%. The crude protein content of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 26.8% to 36.8%.

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 oriental and brown mustard oils (Table 3). The oil from the 2011 Yellow Mustard, No.1 Canada had a mean erucic acid content of 35.6% compared to the 35.2% in 2010. Total saturated fatty acids, at 5.2%, were similar to the value in 2010.

Chlorophyll content in yellow mustard was 0.6 mg/kg for the No. 1 Canada (Table 4) which corresponded to the low DGR. The lower grades had increased levels of chlorophyll going as high as 9.7 mg/kg for sample grade.

Table 2 – Quality of 2011 western Canadian mustard

Grade	No. of samples	Oil content ¹ %	Protein content ² %	Glucosinolate content ³ µmole/g
Domestic Mustard Seed, Canada, Oriental				
No. 1 - Average	46	43.5	25.2	113
Saskatchewan	38	43.3	25.2	114
Alberta	8	44.4	25.2	108
No. 2	1	46.1	23.3	105
No. 4	6	43.7	24.5	114
Sample	2	44.6	23.6	112
Cutlass, No. 1	22	44.0	25.4	109
Forge, No. 1	18	42.6	25.0	116
Domestic Mustard Seed, Canada, Brown				
No. 1 - Average	27	38.8	26.9	100
Manitoba	1	41.5	24.0	87
Saskatchewan	23	38.2	27.4	102
Alberta	3	42.1	24.4	88
No. 2	5	39.0	26.2	101
No. 3	1	40.6	23.9	94
Sample	2	40.7	24.7	89
Centennial Brown, No. 1	6	38.1	27.3	100
Common Brown, No. 1	4	38.7	26.4	100
Duchess, No. 1	5	40.3	25.3	97
Domestic Mustard Seed, Canada, Yellow				
No. 1 - Average	62	31.6	30.6	—
Saskatchewan	33	30.5	31.4	—
Alberta	29	32.8	29.6	—
No. 2	11	31.1	30.3	—
No. 3	4	31.1	32.0	—
No. 4	14	32.4	29.7	—
Sample	7	30.4	30.1	—
AC Pennant, No. 1	10	32.5	29.8	—
Andante, No. 1	23	31.5	30.5	—

¹ Dry matter basis² % N x 6.25; dry matter basis³ Total glucosinolates (µmoles/g); dry matter basis. 2011 results based ISO 9167-3:2007 (Glucose Release). Previous results were based on ISO 9167-1:1992 (HPLC)

Table 3 – Fatty acid composition of 2011 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 – Average	46	1.6	22.2	21.4	12.2	21.7	6.1	117
Saskatchewan	38	1.6	22.3	21.6	12.1	21.5	6.2	117
Alberta	8	1.5	21.6	20.6	12.6	22.7	5.8	117
No. 2	1	1.5	21.4	19.9	12.2	23.2	6.0	116
No. 4	6	1.5	21.2	21.3	12.5	22.3	6.0	118
Sample	2	1.5	20.9	20.4	12.4	23.0	6.1	116
Cutlass , No. 1	22	1.5	20.7	20.4	12.4	23.5	6.0	116
Forge , No. 1	18	1.6	24.0	22.8	12.1	19.3	6.3	118
Domestic Mustard Seed, Canada, Brown								
No. 1 – Average	27	1.4	19.7	20.3	13.5	23.4	6.0	118
Manitoba	1	1.5	20.9	20.6	13.4	22.7	6.1	118
Saskatchewan	23	1.3	19.4	20.4	13.6	23.6	6.0	119
Alberta	3	1.5	21.7	20.0	13.4	22.4	6.1	118
No. 2	5	1.4	19.4	20.5	13.8	23.4	6.1	119
No. 3	1	1.3	19.6	19.6	13.6	23.4	6.1	118
Sample	2	1.5	20.3	21.4	13.9	22.3	6.2	120
Centennial Brown, No. 1	6	1.3	18.7	20.2	13.8	24.0	6.0	119
Common Brown, No. 1	4	1.4	19.4	20.5	13.4	23.2	6.2	118
Duchess, No. 1	5	1.5	21.3	20.4	13.1	22.6	6.2	118
Domestic Mustard Seed, Canada, Yellow								
No. 1 – Average	62	1.0	24.4	9.3	10.8	35.6	5.2	102
Saskatchewan	33	1.0	24.3	9.6	10.8	35.4	5.3	103
Alberta	29	1.0	24.6	8.9	10.8	35.8	5.2	102
No. 2	7	1.0	24.8	9.6	11.0	34.5	5.3	103
No. 3	10	1.1	25.6	9.5	11.2	34.0	5.2	103
No. 4	8	1.1	25.2	9.4	10.8	34.5	5.3	102
Sample	7	1.1	25.1	9.7	11.2	34.1	5.4	103
AC Pennant, No. 1	10	1.1	25.3	9.1	10.4	35.2	5.3	101
Andante, No. 1	23	1.0	24.3	9.2	11.0	35.5	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)

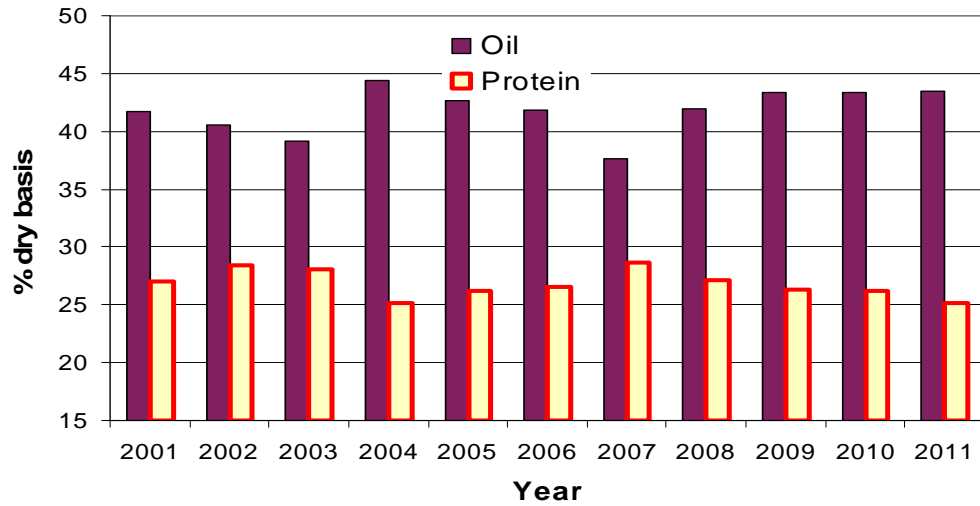
² Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 4 – Chlorophyll Content and DGR in 2011 western Canadian mustard

Category	No. of samples	Chlorophyll mg/kg	Distinctly green (%DGR) ¹	%DGR range
Domestic Mustard Seed, Canada, Oriental				
No. 1 – Average	46	1.6	0.06	0.0 - 0.6
Saskatchewan	38	1.9	0.06	0.0 - 0.6
Alberta	8	0.6	0.05	0.0 - 0.4
No. 2	1	0.4	0.00	0.0
No. 4	6	4.8	0.30	0.0 - 0.6
Sample	2	1.9	0.00	0.0
Cutlass, No. 1	22	1.6		
Forge, No. 1	18	2.0		
Domestic Mustard Seed, Canada, Brown				
No. 1 - Average	27	3.2	0.03	0.0 - 0.2
Manitoba	1	9.0	0.00	0.0
Saskatchewan	23	2.7	0.03	0.0 - 0.2
Alberta	3	4.9	0.00	0.0
No. 2	5	9.1	0.40	0.0 - 2.0
No. 3	1	2.0	0.00	0.0
Sample	2	33.6	4.30	0.0 - 8.6
Centennial Brown, No. 1	6	2.7		
Common Brown, No. 1	4	2.3		
Duchess, No. 1	5	3.6		
Domestic Mustard Seed, Canada, Yellow				
No. 1 - Average	62	0.6	0.02	0.0 - 0.6
Saskatchewan	33	0.9	0.04	0.0 - 0.6
Alberta	29	0.4	0.01	0.0 - 0.3
No. 2	11	1.3	0.11	0.0 - 0.6
No. 3	4	4.4	0.00	0.0 - 0.0
No. 4	14	2.8	0.30	0.0 - 3.4
Sample	7	9.7	2.71	0.0 - 18.0
AC Pennant, No. 1	10	0.6		
Andante, No. 1	23	0.5		

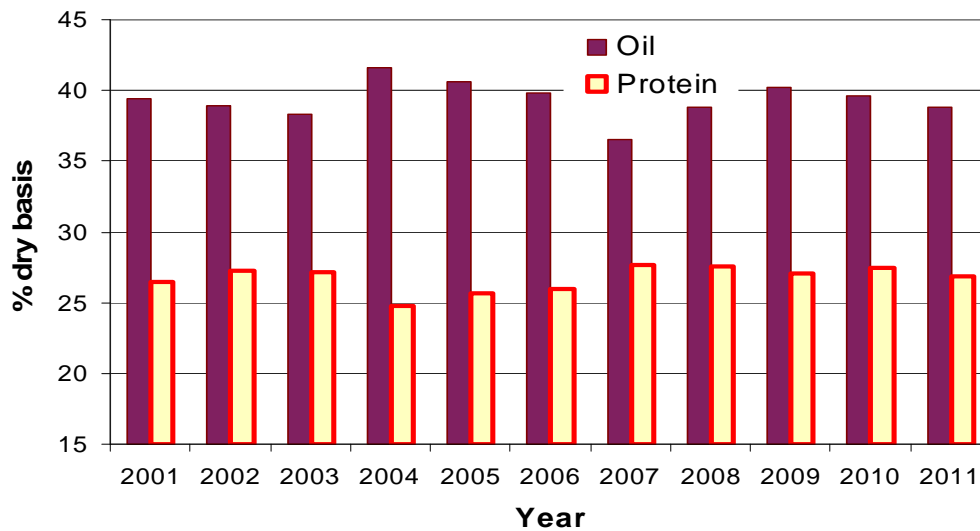
¹ Distinctly green tolerances are applied to crushed seeds which are a distinct green throughout. Pale green or immature seeds are taken into account in the evaluation of colour. The %DGR results are the averages of the individual samples included in the composite.

Figure 2 – Oriental Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2001-2011



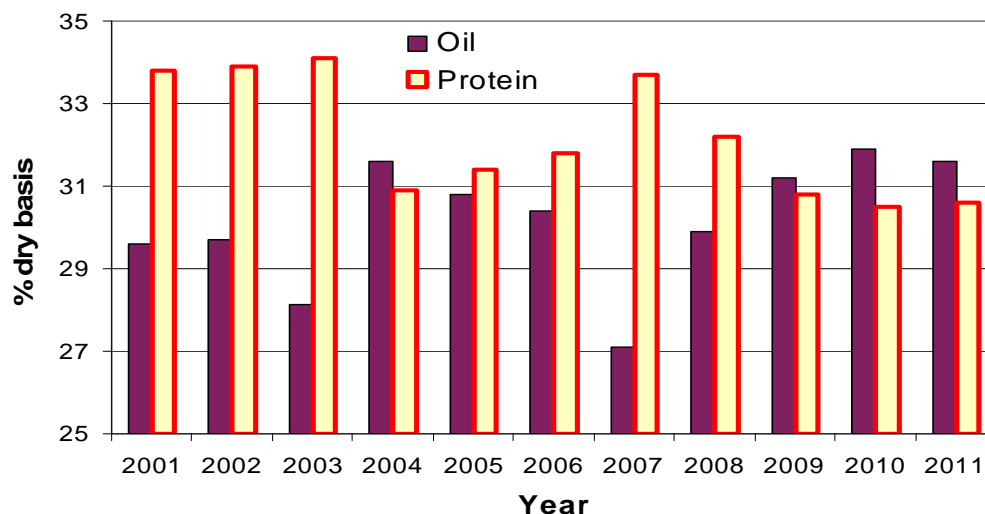
2011 Oil Content.....43.5%	2011 Protein Content25.2%
2010 Oil Content43.4%	2010 Protein Content26.2%
2001–2010 mean Oil Content41.7%	2001–2010 mean Protein Content.....26.6%

Figure 3 – Brown Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2001-2011



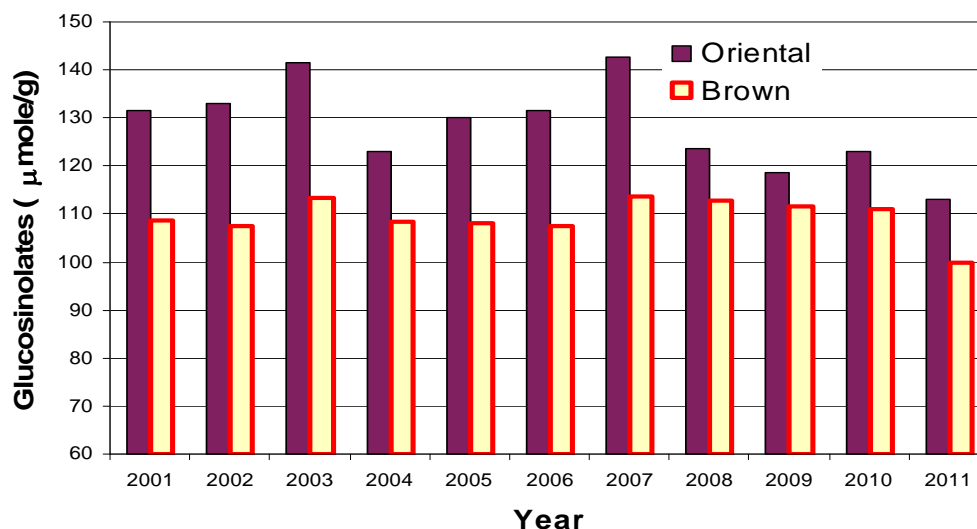
2011 Oil Content.....38.8%	2011 Protein Content26.9%
2010 Oil Content39.6%	2010 Protein Content27.5%
2001–2010 mean Oil Content.....39.4%	2001–2010 mean Protein Content.....26.7%

**Figure 4 – Yellow Mustard, No.1 Canada
Oil and protein content of harvest survey samples, 2001-2011**



2011 Oil Content.....31.6%	2011 Protein Content30.6%
2010 Oil Content31.9%	2010 Protein Content30.5%
2001–2010 mean Oil Content.....30.1%	2001–2010 mean Protein Content....32.3%

**Figure 5 – Oriental and Brown Mustard, No.1 Canada
Glucosinolate content of harvest survey samples, 2001-2011**



2011 Oriental Glucosinolate content.....113 µmole/g	2011 Brown Glucosinolate content.....100 µmole/g
2010 Oriental Glucosinolate content.....123 µmole/g	2010 Brown Glucosinolate content.....111 µmole/g
2001–2010 mean Oriental Glucosinolate content.....130 µmole/g	2001–2010 mean Brown Glucosinolate content.....110 µmole/g