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Quality of western Canadian mustard 2009

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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 2009. The data were obtained from analyses of harvest survey samples collected by the Canadian Grain Commission (CGC).

Summary

Compared to 2008 means, all three types of mustard seed were significantly higher in fixed oil content and lower in crude protein content. Top grade oriental mustard had a fixed oil content of 43.4%, an increase of 1.4% from the 2008 value of 42.0%. Top grade brown mustard samples had a fixed oil content of 40.1%, a 1.2% increase from the 2008 value of 38.9%. Oriental and brown mustard samples had average protein contents of 26.4% and 27.1%, a decrease of 0.7% and 0.4% from the 2008 values. Compared to 2008 values, the average glucosinolate content of the 2009 oriental and brown mustard samples decreased 6 and 1 micromoles per gram respectively. Compared to 2008, the yellow mustard survey samples were 1.1% higher in fixed oil at 31.2% and 1.2% lower in protein content at 30.8%.

Weather and production review

Weather review

Temperature and precipitation patterns for the 2009 western Canadian growing season can be found on the PFRA web site (http://www.agr.gc.ca/pfra/drought/mapscc_e.htm). The prairie provinces experienced a cooler than normal growing period. The western growing regions of the prairies did experience some drought conditions but the cooler temperatures mitigated some of the potential damage to the crops.

Seeding

Western Canada experienced a cool start to the growing season in 2009. Cool soil temperatures delayed planting and seed germination. Dry soil conditions in parts of Alberta and west central Saskatchewan also caused delays as some farmers waited for some moisture before seeding. Moderate amounts of rain fell in the southern and eastern prairies during late May and early June to improve crop conditions.

Growing conditions

Below normal precipitation during June for the western Prairie region reduced crop production expectations, however, timely rains in July helped to improve crop conditions. Temperatures during the summer months of June, July and August were significantly below normal which delayed overall crop development. By the end of June growth was two to three weeks behind normal. According to the Saskatchewan Ministry of Agriculture weekly Crop Reports (<http://www.agriculture.gov.sk.ca/Crop-Report>) by the middle of July 78% of the oilseed crops were behind in development. While the cool temperatures slowed crop development it did allow the crops to move through the reproductive stage without significant stress. The cool temperatures in the summer months slowed crop development to the point that the average first fall frost would have caused serious crop damage.

Harvest conditions

The extremely warm temperatures and dry conditions reported in September helped the late maturing crops to mature without damaging crop quality. The warm temperatures allowed the harvest of the mustard crop to begin in a significant way by the first week of September. Good harvest conditions continued throughout September so that by October 5th 87% of the mustard crop in Saskatchewan was harvested. The warm, dry weather conditions, however, did not continue into the remainder of October. Cooler than normal temperatures combined with rain and snow during the month slowed the harvest until a warmer than normal November allowed the harvest to resume.

The Weather and Crop Surveillance department of the Canadian Wheat Board provided the majority of the detailed weather review for the 2009 crop year.

Production and grade information

As shown in Table 1, mustard seed production for 2009 increased by 29% to 208.3 thousand metric tonnes as a result of increased planted area and higher than average yields. About 53% of the Saskatchewan mustard production was estimated to be the yellow type, followed by 23% brown and 24% oriental (and non-specified) mustard. Approximately 70% of the Alberta mustard is the yellow type. Saskatchewan accounted for 77% of western Canada's total seeded acreage and production of mustard. According to *Saskatchewan Ministry of Agriculture 2009 Specialty Crop Report*, the 2009 Saskatchewan yield of 885 lb/acre (401 kg/acre) was above the ten-year (1999-2008) average of 741 lb/acre (336 kg/acre) and 15% above the 2008 yield of 770 lb/acre (349 kg/acre). Detailed information on production factors and yields for Saskatchewan crop districts can be found at: http://www.agriculture.gov.sk.ca/Specialty_Crop_Report. Saskatchewan's 2009 Specialty Crop Reports estimated 87% of the 2009 Saskatchewan mustard crop graded No. 1 Canada, compared to 83% in 2008 and 73% for the 10-year provincial average. The good harvest conditions throughout the prairies produced a mustard crop with little visible damage. Compared to the 2008 CGC survey results there were notably fewer mustard samples in the lower grades.

Table 1 – Seeded area and production for western Canadian mustard

Region	Seeded area ¹	Seeded area ²	Production ¹	Production ²	Mean production ²
	2009	2008	2009	2008	1999-2008
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	n/a	n/a	n/a	n/a	3.3
Saskatchewan	163.9	149.7	160.6	123.9	151.7
Alberta	48.5	44.5	47.7	37.1	29.7
Western Canada	212.4	194.2	208.3	161.0	184.8

¹ *Field Crop Reporting Series No. 8*, December 2009; Statistics Canada

² Small Area Data 1976-2008 Statistics Canada, Agriculture Division, Crop Section

Harvest survey samples

The 322 samples from the 2009 mustard survey included 148 yellow mustard, 65 brown mustard and 109 oriental mustard. Approximately 85% of the 2009 harvest survey samples came from Saskatchewan.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2009 to the CGC. The individual samples were cleaned to remove dockage and graded by the CGC's Industry Services Division.

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://grainscanada.gc.ca/oilseeds-oleagineux/method-methode/omtm-mmao-eng.htm>.

The glucosinolate contents of oriental and brown mustard are expressed as μ moles/g of allyl glucosinolate and mg/g of allyl isothiocyanate on a whole-seed, dry moisture basis. A molar mass of 99.16 g/mole for allyl isothiocyanate is used to convert μ moles of allyl glucosinolate (sinigrin) to mg/g of allyl isothiocyanate. Composite samples were tested for fatty acid composition.

Quality of western Canadian mustard – 2009

The three mustard crops grown in western Canada in 2009 showed the general characteristics of a crop grown under generally cooler and wetter than normal conditions. 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. Because mustard processors generally prefer lower fixed oils, the quality of the 2009 mustard crop might be considered less than ideal for some end-users.

The oil, protein, and glucosinolate contents for yellow, brown and oriental mustard are summarized by grade in Table 2. The fatty acid compositions of the mustard oils are detailed in Table 3. A comparison of the 2009 quality data with the previous years' surveys is provided in Table 4.

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

In 2009, the average fixed oil content of the Oriental Mustard, No.1 Canada samples increased 1.4% to 43.4% while the average crude protein content decreased by 0.7% to 26.4%. The fixed oil contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 37.2% to 49.5%. The protein content of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 21.8% to 32.4%.

In 2009, the average fixed oil content of Brown Mustard, No. 1 Canada samples increased 1.2% to 40.1% while the average crude protein content decreased by 0.4% to 27.1%. The fixed oil content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 34.6% to 43.4%. The protein content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.6% to 31.3%.

In 2009, the average glucosinolate contents for Oriental Mustard, No.1 Canada samples decreased by 6 $\mu\text{mol/g}$ to 118 $\mu\text{mol/g}$ while Brown Mustard, No.1 Canada samples decreased by 1 $\mu\text{mol/g}$ to 112 $\mu\text{mol/g}$. The glucosinolate contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 73 to 147 $\mu\text{mol/g}$. The glucosinolate contents of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 93 to 141 $\mu\text{mol/g}$.

Fatty acid compositions for the oriental and brown mustard composites are provided in Table 3. The 2009 average erucic acid (C22:1) level decreased by 1.1% for Oriental Mustard, No.1 Canada samples while Brown Mustard, No.1 Canada samples decreased slightly by 0.3%. The average 2009 erucic acid values of 21.7% and 23.5% 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, No.1 Canada composites were 5.9% and 5.8% respectively; similar to last year's values. The 2009 mustard composites had slight change in the level of linolenic acid and oleic acid and as a result, the iodine value (an indicator of oil unsaturation) increased slightly in 2009 mustard samples to 118 and 119 units for oriental and brown mustard respectively.

The plant's objective in making the oil unsaturated is to give a more liquid (*i.e.* unsaturated) oil at lower temperatures. To do this, the plants have evolved mechanisms in the form of enzyme systems that are more active in making the oil unsaturated when the weather is cool and less active when it is hot. The cool temperatures during the growing season in 2009 resulted in shifts in the overall fatty acid profiles.

Quality of Domestic Mustard Seed, Canada, Yellow

The yellow mustard had the characteristically lower oil content and higher protein content than oriental and brown mustards. For Yellow Mustard, No. 1 Canada samples, the average fixed oil content increased 1.1% to 31.2% while average crude protein content decreased 1.2% to 30.8% (Table 4). The fixed oil contents of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 26.5% to 36.6%. The crude protein content of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 25.2% to 37.9%.

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 (C18:3) acid compared to the oriental and brown mustard oils. The oil from the 2009 Yellow Mustard, No.1 Canada seed had a mean erucic acid content of 35.7% compared to the 36.1% in 2008. Total saturated fatty acids, at 5.1%, were slightly higher than the 4.9% in 2008.

Table 2 – Quality of 2009 western Canadian mustard

Grade	No. of samples	Oil content ¹	Protein content ²	Glucosinolate content ³	
		%	%	µmol/g	mg/g
Domestic Mustard Seed, Canada, Oriental					
No. 1	98	43.4	26.4	118	11.7
No. 2	5	44.7	24.6	115	11.4
No. 3	3	44.0	26.8	130	12.9
No. 4	3	44.4	25.8	115	11.4
Sample	0				
Domestic Mustard Seed, Canada, Brown					
No. 1	62	40.1	27.1	112	11.1
No. 2	1	40.1	26.8	108	10.7
No. 3	0				
No. 4	0				
Sample	2	39.0	27.2	103	10.2
Domestic Mustard Seed, Canada, Yellow					
No. 1	114	31.2	30.8	—	—
No. 2	11	31.7	30.8	—	—
No. 3	8	33.4	28.4	—	—
No. 4	9	33.1	29.5	—	—
Sample	6	31.4	29.7	—	—

¹ Dry matter basis

² % N x 6.25; dry matter basis

³ Allyl glucosinolate (µmoles/g) and allyl isothiocyanate (mg/g); dry matter basis

Table 3a – Fatty acid composition of 2009 western Canadian mustard

Category	No. of samples	Fatty acid composition (%) ¹								
		C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C20:2
Domestic Mustard Seed, Canada, Oriental										
No. 1										
Saskatchewan	90	2.8	0.1	1.5	21.7	21.9	12.4	0.9	12.4	1.1
Alberta	5	2.9	0.1	1.5	22.9	23.4	12.6	0.8	11.6	1.1
No. 2	5	2.8	0.1	1.6	23.0	21.9	12.3	0.9	12.4	1.1
No. 3	3	2.7	0.1	1.3	18.4	20.5	13.4	0.8	12.5	1.2
No. 4	3	2.7	0.1	1.4	20.5	21.3	12.5	0.9	12.5	1.1
Sample	0									
Cutlass, No. 1	40	2.8	0.1	1.4	20.2	21.0	12.6	0.9	12.7	1.1
Forge, No. 1	38	2.9	0.1	1.6	23.5	23.0	12.3	0.9	11.8	1.1
Domestic Mustard Seed, Canada, Brown										
No. 1										
Manitoba	4	2.9	0.2	1.5	20.7	20.9	13.1	0.9	12.6	1.0
Saskatchewan	57	2.9	0.2	1.3	19.6	20.2	13.7	0.9	12.9	1.1
Alberta	1	2.8	0.2	1.2	19.0	19.7	14.5	0.8	13.0	1.3
No. 2	1	2.8	0.2	1.5	20.4	21.2	14.2	0.9	12.2	1.1
No. 3	0									
No. 4	0									
Sample	2	2.9	0.2	1.4	18.9	21.3	13.9	0.9	12.2	1.2
Centennial, No. 1	23	2.9	0.2	1.3	19.3	20.0	13.9	0.9	13.1	1.2
Common, No. 1	10	3.0	0.2	1.4	19.9	20.3	13.5	0.9	12.9	1.1
Duchess, No. 1	12	2.9	0.2	1.5	20.9	20.9	13.0	0.9	12.5	1.0
Domestic Mustard Seed, Canada, Yellow										
No. 1										
Manitoba	5	2.6	0.2	1.1	26.1	9.3	10.1	0.7	11.3	0.3
Saskatchewan	82	2.6	0.2	1.0	24.4	9.1	10.9	0.7	11.2	0.3
Alberta	25	2.6	0.1	1.0	24.3	8.9	10.6	0.7	11.3	0.3
No. 2	11	2.6	0.1	1.0	24.5	9.1	11.0	0.7	11.0	0.3
No. 3	8	2.6	0.2	1.1	25.0	9.0	10.9	0.7	11.2	0.3
No. 4	9	2.6	0.1	1.0	24.3	8.8	10.8	0.6	10.9	0.3
Sample	6	2.7	0.2	1.0	24.2	9.3	10.8	0.7	11.1	0.3
AC Pennant, No. 1	15	2.6	0.1	1.0	24.2	9.1	10.4	0.7	11.0	0.3
Ace, No. 1	7	2.6	0.1	1.0	22.8	9.0	10.4	0.6	10.7	0.3
Andante, No. 1	56	2.6	0.2	1.0	24.8	9.1	10.9	0.7	11.3	0.3

¹ Percentage of total fatty acids including: palmitic (C16:0), palmitoleic (C16:1), stearic (C18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3), arachidic (C20:0), eicosenoic (C20:1), eicosadienoic (C20:2), behenic (C22:0), erucic (C22:1), docosadienoic (C22:2), lignoceric (C24:0), and nervonic (C24:1)

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

Table 3b – Fatty acid composition of 2009 western Canadian mustard

Category	No. of samples	Fatty acid composition (%) ¹					Saturated fatty acids ² %	Iodine value units
		C22:0	C22:1	C22:2	C24:0	C24:1		
Domestic Mustard Seed, Canada, Oriental								
No. 1								
Saskatchewan	90	0.5	21.8	0.4	0.3	1.5	5.9	118
Alberta	5	0.4	19.7	0.4	0.3	1.5	6.0	120
No. 2	5	0.4	20.7	0.4	0.3	1.4	6.0	118
No. 3	3	0.5	25.2	0.5	0.3	1.7	5.6	118
No. 4	3	0.5	23.3	0.4	0.3	1.5	5.7	118
Sample	0							
Cutlass, No. 1	40	0.5	23.6	0.4	0.3	1.5	5.9	117
Forge, No.1	38	0.4	19.5	0.4	0.3	1.4	6.1	119
Domestic Mustard Seed, Canada, Brown								
No. 1								
Manitoba	4	0.5	22.9	0.4	0.3	1.3	6.0	118
Saskatchewan	57	0.4	23.6	0.5	0.3	1.5	5.8	119
Alberta	1	0.4	23.9	0.5	0.3	1.6	5.5	120
No. 2	1	0.4	22.3	0.4	0.2	1.4	5.9	120
No. 3	0							
No. 4	0							
Sample	2	0.4	23.5	0.5	0.3	1.5	5.9	120
Centennial, No. 1	23	0.4	23.7	0.5	0.3	1.5	5.8	119
Common, No. 1	10	0.5	23.4	0.4	0.3	1.4	6.0	118
Duchess, No. 1	12	0.5	22.9	0.4	0.3	1.3	6.0	118
Domestic Mustard Seed, Canada, Yellow								
No. 1								
Manitoba	5	0.5	34.4	0.2	0.3	2.3	5.1	101
Saskatchewan	82	0.5	35.6	0.3	0.3	2.3	5.1	102
Alberta	25	0.5	36.1	0.3	0.3	2.3	5.0	102
No. 2	11	0.5	35.5	0.3	0.3	2.3	5.1	102
No. 3	8	0.5	35.1	0.2	0.3	2.2	5.1	102
No. 4	9	0.5	36.3	0.2	0.3	2.3	5.0	102
Sample	6	0.5	35.6	0.3	0.3	2.3	5.2	102
ACPennant, No. 1	15	0.6	36.3	0.3	0.3	2.3	5.1	101
Ace, No. 1	7	0.6	38.1	0.3	0.3	2.4	5.0	101
Andante, No. 1	56	0.5	34.9	0.2	0.3	2.2	5.1	102

¹ Percentage of total fatty acids including: palmitic (C16:0), palmitoleic (C16:1), stearic (C18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3), arachidic (C20:0), eicosenoic (C20:1), eicosadienoic (C20:2), behenic (C22:0), erucic (C22:1), docosadienoic (C22:2), lignoceric (C24:0), and nervonic (C24:1)

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

Table 4 – Quality of western Canadian mustard from CGC surveys

Year	No. of samples	Oil content ¹	Protein content ²	Glucosinolate content ³	
		%	%	µmol/g	mg/g
Domestic Mustard Seed, No. 1 Canada, Oriental					
2009	98	43.4	26.4	118	11.7
2008	40	42.0	27.1	124	12.3
1999-08	540	41.4	26.9	131	13.0
Domestic Mustard Seed, No. 2 Canada, Oriental					
2009	5	44.7	24.6	115	11.4
2008	6	41.1	28.1	133	13.2
1999-08	99	41.4	27.3	132	13.0
Domestic Mustard Seed, No. 3 Canada, Oriental					
2009	3	44.0	26.8	130	12.9
2008	1	37.9	29.1	138	13.6
1999-08	33	42.1	27.0	129	12.8
Domestic Mustard Seed, No. 1 Canada, Brown					
2009	62	40.1	27.1	112	11.1
2008	73	38.9	27.5	113	11.2
1999-08	635	39.3	26.5	109	10.8
Domestic Mustard Seed, No. 2 Canada, Brown					
2009	1	40.1	26.8	108	10.7
2008	3	41.6	25.1	104	10.3
1999-08	40	38.7	27.0	110	11.0
Domestic Mustard Seed, No. 3 Canada, Brown					
2009	0				
2008	1	40.1	27.6	120	11.9
1999-08	24	38.6	27.0	111	11.0
Domestic Mustard Seed, No. 1 Canada, Yellow					
2009	114	31.2	30.8	—	—
2008	108	30.1	32.0	—	—
1999-08	757	30.0	32.4	—	—
Domestic Mustard Seed, No. 2 Canada, Yellow					
2009	11	31.7	30.8	—	—
2008	21	29.7	32.4	—	—
1999-08	201	30.4	32.2	—	—
Domestic Mustard Seed, No. 3 Canada, Yellow					
2009	8	33.4	28.4	—	—
2008	3	32.3	29.9	—	—
1999-08	84	30.8	31.7	—	—

¹ Dry matter basis² % N x 6.25; dry matter basis³ Allyl glucosinolate(µmoles/g) and allyl isothiocyanate (mg/g); dry matter, seed basis