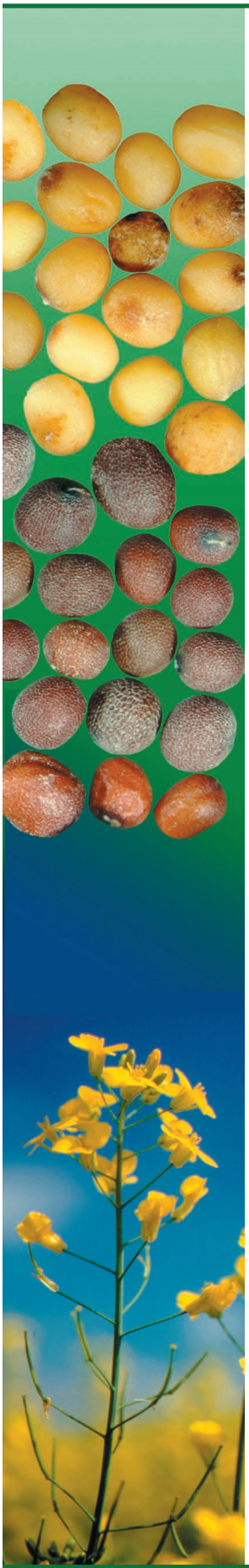

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Canada

Quality of western Canadian mustard 2003

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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 2003. The data were obtained from analyses of harvest survey samples collected by the Canadian Grain Commission (CGC).

Summary

Both the oriental and brown mustard 2003 survey samples had lower average fixed oils but similar protein contents compared to 2002 values. Top grade oriental mustard had an oil content of 39.2%, a decrease of 1.4% from the 2002 value of 40.6%. Top grade brown mustard samples had an oil content of 38.3%, a 0.5% decrease from the 2002 value. Oriental and brown mustard samples decreased very slightly in protein content to 28.1% and 27.2% respectively in 2003. The average glucosinolate content of the 2003 oriental and brown mustard samples increased noticeably from the values in 2002. Compared to 2002, the yellow mustard survey samples were 1.6% lower in fixed oil at 28.1% and 0.1% higher in protein content at 34.1%. When compared to the ten-year means, all three types of mustard seed were significantly lower in average fixed oil content but higher in average protein content.

Weather and production review

Weather review

Temperature and precipitation patterns for the 2003 western Canadian growing season can be found on the PFRA web site
(http://www.agr.gc.ca/pfra/drought/maps/td03_08e.pdf).
Of particular note this growing season was that both day and night temperatures were extremely high for long periods of time. Most mustard growing regions received some moisture in the spring; however, July and August were very hot and dry, bringing about an early harvest. The Weather and Crop Surveillance department of the Canadian Wheat Board provided the detailed weather review of the 2003 crop year
(http://www.cwb.ca/en/growing/weather/crop_issues.jsp).

Seeding

A combination of rains during the 2002 harvest and normal to above normal winter precipitation greatly improved the soil moisture situation in western Canada for the spring seeding season. The wetter than normal precipitation pattern continued through the month of April and into early May in Saskatchewan and Alberta. The precipitation received during that period, 125% to 175% of the normal amounts, delayed seeding progress. The spring precipitation was accompanied by cooler than normal

temperatures, which slowed planting progress as well. Temperatures recovered by May 15 and seeding advanced rapidly in the western prairies. Manitoba and parts of eastern Saskatchewan did not experience planting delays, due to drier and warmer weather in the first half of May. This allowed farmers to plant most oilseed crops before May 15 in the eastern growing region. Overall planting progress was 10 days to two weeks behind normal for the prairies. Planting of all grains and oilseeds in western Canada advanced rapidly during the second half of May and was complete by the first week in June. Germination and emergence of crops were very good, but some patches of severe frost in northern Saskatchewan and Alberta meant that some crops needed reseeding.

Growing conditions

Moisture conditions began to deteriorate in the second half of June in the northern and central areas of Saskatchewan. The dryness, combined with above normal temperatures, resulted in stress to crops. The rest of the region received timely rainfall throughout June, but total amounts for the month were below normal over most of the prairie region. Although the crop was rated in mostly good to excellent condition in mid-June, the lack of sub-soil moisture was a major concern. These concerns were well founded, as hot and dry conditions dominated the weather on the prairies from mid-June to late August. The southern prairies received less than 50% of the normal precipitation in July and August, while the northern areas received less than 75% of the normal precipitation. Timely rains in northern Alberta and northwestern Saskatchewan over the summer months helped maintain crop potential. Temperatures were warmer than normal during the months of July and August, which increased stress to all crops. August temperatures were 2 to 5 degrees Celsius above normal across western Canada. The warmer than normal temperatures caused yield reductions in all crops, dropping above average production potential back to average to slightly-below-average in most regions. Timely rains limited yield losses in northern growing areas of Alberta. The warm, dry weather during the summer months was ideal for grasshoppers, which resulted in significant damage to crops throughout the prairie region. The environmental conditions did keep plant diseases in check, with leaf and head diseases reported at the lowest levels in a decade. Crop development was boosted by the warmer than normal temperatures, with most crops reaching maturity by the end of July in the eastern prairies. Crops in western areas were not mature until the middle of August, while northern Alberta and the Peace River region were delayed until the end of the month.

Harvest conditions

The harvest began the first week of August on the eastern prairies and was underway in all areas except northern Alberta by the middle of the month. Rainfall during August and September was well below normal, which resulted in a rapid harvest pace. The majority of the crop was harvested by the first week of September, with most of the unfinished harvest located in northern Alberta and Saskatchewan. Cool, rainy conditions in the

northern areas slowed the harvest in the middle of September, but the return of warm, dry conditions by the end of the month allowed the harvest to proceed rapidly.

Production and grade information

As shown in Table 1, mustard seed production for 2003 increased by 47% to 226.1 thousand metric tonnes due to increases in seeded area. About 47% of western Canadian mustard production was estimated to be the yellow type, followed by 35% brown and 18% oriental mustard. Saskatchewan accounted for 80% of western Canada's total seeded acreage and production of mustard. According to Saskatchewan Agriculture and Food, the 2003 Saskatchewan yield of 600 lb/acre (273 kg/acre) was 26% below the ten-year (1993-2002) average of 810 lb/acre (368 kg/acre) but 15% above the 2002 yield of 521 lb/acre (237 kg/acre). Mustard seed is traditionally grown in the drier, southern part of the prairies, which experienced some of the most severe drought conditions in 2003. Detailed information on production factors and yields for Saskatchewan crop districts can be found at:

http://www.agr.gov.sk.ca/DOCS/crops/special_crops/production_information specialtycroprpt.asp

Over 80% of the 2003 Saskatchewan mustard crop graded No. 1 Canada, compared to just 44% in 2002 and 77% for the 1993–2002 period. The early mustard harvest produced a sound seed with minimal visible damage or discoloration. In 2003, mustard samples that were downgraded to Sample Grade were due to presence of admixture rather than damaged seed. Compared to 2002, there were notably fewer yellow mustard samples in the lower grades.

Table 1 – Seeded area and production for western Canadian mustard

Region	Seeded area[1] 2003	Seeded area[2] 2002	Production[1] 2003	Production[2] 2002	Mean production 1993-2002
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	10.1	12.1	10.4	10.0	4.4
Saskatchewan	273.1	242.8	176.9	125.2	188.6
Alberta	56.6	34.4	38.8	19.1	32.9
Western Canada	**339.8**	**289.3**	**226.1**	**154.3**	**225.9**

[1] *Field Crop Reporting Series No. 8,* December 5, 2003; Statistics Canada
[2] *Field Crop Reporting Series No.8*, revised estimates for 1993-2002

Harvest survey samples

The 278 samples for the 2003 mustard survey included 106 yellow mustard, 90 brown mustard and 82 oriental mustard. Over 81% of the 2003 harvest survey samples came from Saskatchewan.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2003 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 glucosinolate contents of oriental and brown mustard are expressed as µmoles/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 µmoles of allyl glucosinolate (sinigrin) to mg/g of allyl isothiocyanate. Composite samples were tested for fatty acid composition.

Quality of western Canadian mustard 2003

The Grain Research Laboratory (GRL) long-term harvest survey results show that hot, dry growing conditions tend to produce an oilseed crop with lower oil contents and iodine values, but higher protein contents. Research also shows that glucosinolate levels increase when *Brassica* crops are grown under hot, dry conditions. The three mustard crops grown in western Canada in 2003 showed the general characteristics of a crop grown under heat and drought stress.

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 2003 quality data with the previous years' surveys is provided in Table 4. The means and standard deviations of the 2003 analytical data by grade and province can be found at

http://grainscanada.gc.ca/Quality/grlreports/Mustard/mustardmenu-e.htm

Quality of oriental and brown mustard

The average fixed oil content of the 2003 No. 1 Canada oriental mustard decreased 1.4% to 39.2% while the average protein content decreased by 0.3% to 28.1%. The fixed oil contents of No. 1 Canada oriental mustard from producers in western Canada ranged from 34.3% to 44.4%. The protein content of No. 1 Canada oriental mustard from producers in western Canada ranged from 23.9% to 32.6%.

The average fixed oil content of No. 1 Canada brown mustard decreased 0.5% to 38.3% while the average protein content decreased only 0.1% to 27.2%. The fixed oil content of No. 1 Canada brown mustard from producers in western Canada ranged from 33.9% to 41.8%. The protein content of No. 1 Canada brown mustard from producers in western Canada ranged from 23.6% to 31.9%.

In 2003, the average glucosinolate contents for both oriental mustard (142 µmol/g) and brown mustard (113 µmol/g) increased significantly. The glucosinolate contents of No. 1 Canada oriental mustard from producers in western Canada ranged from 110 to 171 µmol/g. The glucosinolate contents of No. 1 Canada brown mustard from producers in western Canada ranged from 98 to 132 µmol/g. The provincial and grade differences are detailed in the statistical tables for oriental and brown mustard:

http://grainscanada.gc.ca/Quality/grlreports/Mustard/mustardmenu-e.htm.

Fatty acid compositions for the oriental and brown mustard composites are provided in Table 3. The 2003 erucic acid levels decreased 1.3% and 0.6% respectively for No. 1 Canada oriental and brown mustards. The mean 2003 erucic acid values of 20.7% and 22.6% for oriental and brown mustards are still typical of *Brassica juncea* condiment mustards. The oriental mustard varieties Forge and Cutlass showed varietal differences in oleic (C18:1), linoleic (C18:2), and erucic acid (C22:1) content.

The total saturated fatty acids for the No. 1 Canada oriental and brown mustard samples increased by 0.4% and 0.2% respectively to produce means of 6.5% and 6.4%. In addition, the 2003 mustard composites also had decreased levels of linolenic acid and increased levels of oleic acid. This was a general trend that all western Canadian oilseed crops exhibited in the 2003 surveys. Of particular note this growing season was that both day and night temperatures were extremely high for long periods of time. This likely caused the oilseed plants to reduce the amount of unsaturation in the oil. One needs to remember that 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 iodine value, an indicator of oil unsaturation, will be lower in most 2003 oilseed samples.

Quality of yellow mustard

The yellow mustard had the characteristically lower oil content and higher protein content than oriental and brown mustards. For No. 1 Canada yellow mustard, the average fixed oil content decreased 1.6% to 28.1% while average protein content increased 0.1% to 34.1% (Table 4). The fixed oil contents of No. 1 Canada yellow mustard from producers in western Canada ranged from 24.4% to 32.7%. The protein content of No. 1 Canada yellow mustard from producers in western Canada ranged from 29.1% to 39.9%. Regional and grade differences in seed quality are detailed at: http://grainscanada.gc.ca/Quality/grlreports/Mustard/mustardmenu-e.htm

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 2003 No. 1 Canada yellow mustard seed had a mean erucic acid content of 35.7% compared to the 36.7% in 2002. Total saturated fatty acids, at 5.3%, were higher than the 5.1% in 2002.

Acknowledgements

The CGC acknowledges the cooperation of mustard producers, grain handling offices, and seed handling plants in western Canada for supplying the samples of mustard harvested in 2003, and the Weather and Crop Surveillance department of the Canadian Wheat Board for providing the review of the 2003 growing season. The CGC recognizes Industry Services grain inspectors for grading the mustard harvest survey samples and GRL staff for conducting the analyses and preparing the report. Seed images on cover courtesy of Grain Biology, Grain Research Laboratory, Canadian Grain Commission, Winnipeg MB.

Table 2 – Quality of 2003 western Canadian mustard

Grade	Number of samples	Oil content[1]	Protein content[2]	Glucosinolate content[3]	
		%	%	µmol/g	mg/g
Oriental					
No. 1 Canada	54	39.2	28.1	142	14.0
No. 2 Canada	11	39.3	28.9	146	14.5
No. 3 Canada	1	43.1	24.9	127	12.6
No. 4 Canada	8	41.5	27.6	136	13.5
Sample Canada	8	40.3	28.2	135	13.4
Brown					
No. 1 Canada	80	38.3	27.2	113	11.2
No. 2 Canada	1	36.2	28.7	120	11.9
No. 3 Canada	3	35.9	29.5	124	12.3
No. 4 Canada	2	37.4	27.9	115	11.4
Sample Canada	4	36.9	28.0	120	11.9
Yellow					
No. 1 Canada	66	28.1	34.1		
No. 2 Canada	20	29.6	32.7		
No. 3 Canada	4	29.0	33.2		
No. 4 Canada	9	28.4	34.7		
Sample Canada	7	30.4	31.8		

[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 2003 western Canadian mustard

Grade/variety	Number of samples	Fatty acid composition[1]								
		C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C20:2
		%	%	%	%	%	%	%	%	%
Oriental										
No. 1 Canada										
Saskatchewan	43	3.2	0.2	1.6	23.5	23.2	10.8	1.0	12.1	1.0
Alberta	11	3.2	0.2	1.5	22.3	23.4	11.3	0.9	11.7	1.1
No. 2 Canada	11	3.0	0.2	1.5	22.1	23.2	12.4	0.9	11.6	1.1
No. 3 Canada	1	3.0	0.2	1.5	22.0	20.9	11.2	1.0	13.2	1.0
No. 4 Canada	8	2.9	0.2	1.4	20.5	21.6	11.9	0.9	11.4	1.1
Sample Canada	8	3.0	0.2	1.4	20.5	21.9	12.1	0.9	11.9	1.1
Cutlass	13	3.0	0.2	1.5	21.7	22.2	11.7	0.9	12.3	1.1
Forge	15	3.3	0.2	1.6	24.8	24.4	10.5	0.9	11.6	1.0
Brown										
No. 1 Canada										
Manitoba	3	3.1	0.2	1.5	20.1	21.7	13.3	0.9	11.8	1.1
Saskatchewan	64	3.1	0.2	1.4	21.7	21.6	12.0	1.0	12.1	1.0
Alberta	13	3.1	0.2	1.4	21.1	21.5	12.7	1.0	11.8	1.0
No. 2 Canada	1	3.3	0.3	1.4	20.9	23.0	11.6	1.0	11.6	1.0
No. 3 Canada	3	3.2	0.2	1.4	20.5	22.0	12.7	0.9	11.6	1.0
No. 4 Canada	2	3.2	0.2	1.4	21.4	21.8	12.2	0.9	12.1	1.0
Sample Canada	4	3.1	0.2	1.4	20.7	21.6	13.2	1.0	11.6	1.0
Common	50	3.2	0.2	1.5	21.6	21.7	12.1	1.0	12.0	1.0
Duchess	10	3.1	0.2	1.5	21.6	21.4	12.5	1.0	11.9	1.0
Yellow										
No. 1 Canada										
Manitoba	2	2.6	0.2	1.0	25.5	9.5	9.8	0.7	10.5	0.3
Saskatchewan	50	2.7	0.2	1.0	25.2	10.0	9.8	0.7	10.5	0.3
Alberta	14	2.7	0.2	1.0	25.3	9.8	9.7	0.7	10.2	0.3
No. 2 Canada	20	2.7	0.2	1.0	25.0	9.7	10.2	0.7	10.2	0.3
No. 3 Canada	4	2.8	0.2	1.0	24.5	9.8	10.6	0.7	10.2	0.3
No. 4 Canada	9	2.7	0.2	1.0	24.3	9.6	10.8	0.7	10.2	0.3
Sample Canada	7	2.8	0.2	1.1	25.2	10.3	11.2	0.7	10.5	0.3
AC Pennant	17	2.7	0.2	1.0	25.3	10.0	9.4	0.7	10.5	0.3
Ace	3	2.8	0.2	1.1	26.2	10.5	9.9	0.7	10.2	0.3
Tilney	3	2.6	0.2	1.0	26.3	9.9	10.1	0.6	10.0	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), gadoleic (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 2003 western Canadian mustard

Grade/variety	Number of samples	Fatty acid composition[1]						
		C22:0	C22:1	C22:2	C24:0	C24:1	Saturated fatty acids[2]	Iodine value
		%	%	%	%	%	%	units
Oriental								
No. 1 Canada								
Saskatchewan	43	0.5	20.6	0.4	0.3	1.3	6.5	116
Alberta	11	0.5	21.2	0.5	0.3	1.4	6.6	117
No. 2 Canada	11	0.5	20.9	0.5	0.3	1.5	6.1	120
No. 3 Canada	1	0.5	23.0	0.5	0.3	1.3	6.3	115
No. 4 Canada	8	0.6	24.7	0.5	0.3	1.6	6.0	117
Sample Canada	8	0.5	23.6	0.5	0.3	1.5	6.2	117
Cutlass	13	0.5	22.4	0.5	0.3	1.4	6.3	117
Forge	15	0.5	18.9	0.4	0.3	1.3	6.6	117
Brown								
No. 1 Canada								
Manitoba	3	0.5	23.0	0.4	0.3	1.3	6.3	119
Saskatchewan	64	0.5	22.5	0.4	0.3	1.2	6.4	117
Alberta	13	0.5	22.9	0.5	0.3	1.3	6.3	118
No. 2 Canada	1	0.6	22.6	0.5	0.3	1.3	6.5	117
No. 3 Canada	3	0.6	23.0	0.5	0.3	1.3	6.4	118
No. 4 Canada	2	0.5	22.5	0.4	0.3	1.2	6.4	117
Sample Canada	4	0.5	22.7	0.5	0.3	1.3	6.3	119
Common	50	0.5	22.5	0.4	0.3	1.2	6.4	117
Duchess	10	0.5	22.7	0.4	0.3	1.3	6.3	117
Yellow								
No. 1 Canada								
Manitoba	2	0.6	35.9	0.3	0.3	2.4	5.2	101
Saskatchewan	50	0.6	35.5	0.3	0.3	2.3	5.3	101
Alberta	14	0.6	36.2	0.3	0.3	2.4	5.2	101
No. 2 Canada	20	0.6	36.0	0.3	0.3	2.4	5.2	102
No. 3 Canada	4	0.6	35.9	0.3	0.3	2.4	5.3	103
No. 4 Canada	9	0.6	36.2	0.3	0.3	2.4	5.2	103
Sample Canada	7	0.5	33.7	0.3	0.3	2.2	5.4	104
AC Pennant	17	0.6	35.7	0.3	0.3	2.3	5.3	100
Ace	3	0.6	34.0	0.3	0.3	2.3	5.4	102
Tilney	3	0.6	35.1	0.3	0.3	2.3	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), gadoleic (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	Number of samples	Oil content[1]	Protein content[2]	Glucosinolate content[3]	
		%	%	µmol/g	mg/g
Oriental – No. 1 Canada					
2003	54	39.2	28.1	142	14.0
2002	19	40.6	28.4	133	13.2
1993-2002	651	42.7	26.0	124	12.3
Oriental – No. 2 Canada					
2003	11	39.3	28.9	146	14.5
2002	7	40.8	27.8	135	13.3
1993-2002	55	42.5	26.7	123	12.2
Oriental – No. 3 Canada					
2003	1	43.1	24.9	127	12.6
2002	7	42.6	28.1	130	12.8
1993-2002	37	43.2	25.6	121	12.0
Brown – No. 1 Canada					
2003	80	38.3	27.2	113	11.2
2002	53	38.8	27.3	108	10.7
1993-2002	564	40.2	25.9	103	10.2
Brown – No. 2 Canada					
2003	1	36.2	28.7	120	11.9
2002	2	36.2	29.6	115	11.4
1993-2002	22	37.7	27.8	110	10.9
Brown – No. 3 Canada					
2003	3	35.9	29.5	124	12.3
2002	2	38.2	28.4	119	11.8
1993-2002	65	39.2	26.4	104	10.4
Yellow– No. 1 Canada					
2003	66	28.1	34.1		
2002	41	29.7	34.0		
1993-2002	535	31.2	31.2		
Yellow– No. 2 Canada					
2003	20	29.6	32.7		
2002	19	29.6	34.1		
1993-2002	103	30.8	31.8		
Yellow – No. 3 Canada					
2003	4	29.0	33.2		
2002	15	30.1	33.8		
1993-2002	55	31.9	30.6		

[1] Dry matter basis
[2] % N x 6.25; dry matter basis
[3] Allyl glucosinolate(µmoles/g) and allyl isothiocyanate (mg/g); dry matter, seed basis