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Quality of western Canadian mustard 2022

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Summary

In 2022, the mean oil content of No. 1 oriental, brown and yellow mustard (35.5%, 33.0% and 25.4%, respectively) was lower than each corresponding 10-year mean (Figures 5, 6, and 7). In contrast, the mean protein content of No.1 oriental, brown and yellow mustard (30.3%, 31.2% and 35.3%, respectively) was much higher than each corresponding 10-year mean (Figures 5, 6 and 7). Total glucosinolate content of No. 1 oriental mustard was 143 micromoles per gram (µmol/g) of seeds, 143 µmol/g of seeds for No. 1 brown mustard and 150 µmol/g of seeds for No. 1 yellow mustard. These values are higher than the 10-year means of 119 µmol/g of seeds (oriental) and 108 µmol/g of seeds (brown) (Figure 8). It should be noted that a 10-year mean for total glucosinolate in yellow mustard is not calculated since there are no historical data. However the 2022 total glucosinolate content was higher than that observed in 2021 and 2020. Oil, protein and total glucosinolates are reported on a dry matter basis in this report.

Introduction

This report presents data on the quality of oriental (*Brassica juncea*), brown (*Brassica juncea*), and yellow (*Sinapis alba*) mustard seed grown in western Canada in 2022 (Figure 1). Samples of mustard submitted to the Harvest Sample Program were analysed by the Oilseeds Program for quality traits, including oil, protein, total glucosinolate content, and fatty acid composition.

Figure 1 Mustard seed grown in western Canada

Oriental mustard (*Brassica juncea*)

Brown mustard (*Brassica juncea*)

Yellow mustard (*Sinapis alba*)

Weather and production review

Weather

The growing season began with below normal temperatures in April and May over the entire mustard growing region. In Manitoba, extreme cold temperatures were associated with large amounts of snow which left fields unable to drain and dry properly. Moreover, heavy rains in May caused overland flooding in Manitoba and some parts of eastern Saskatchewan. This saturated fields and further delayed the start of seeding by about a month. In contrast, Alberta experienced extreme drought at the end of May and western Saskatchewan experienced abnormally dry to severe drought conditions also at this time (Figure 2). The dry conditions allowed an early start to seeding in southern Alberta, with approximately 18% completed by May 3. In Saskatchewan, however, seeding was just beginning in the first week of May. For both provinces, the seeding of mustard was complete by the end of May.

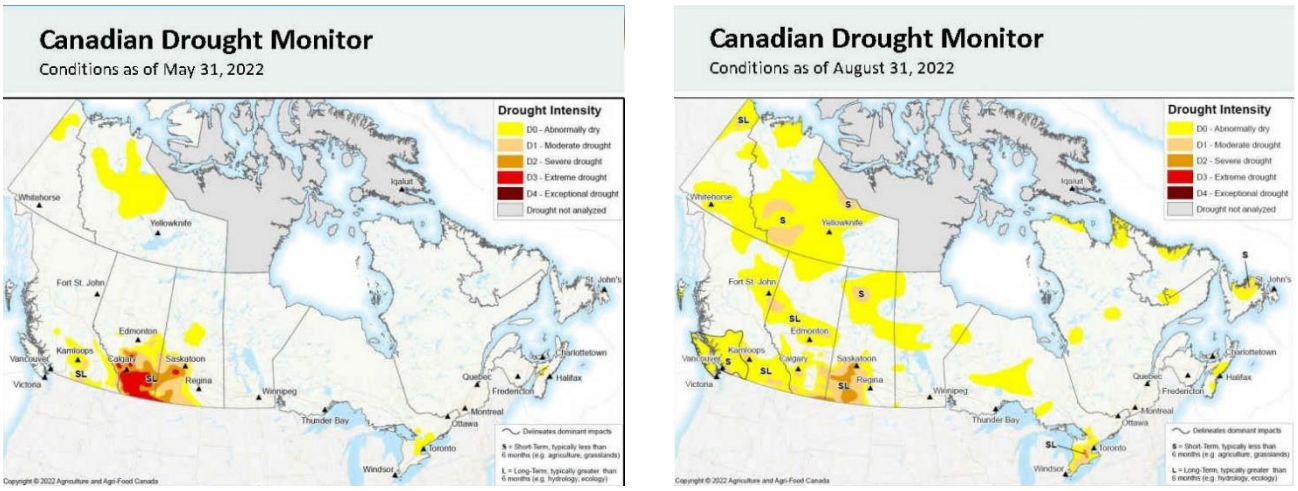
Across Alberta, the abundant rain in June sustained most of the crop throughout the entire growing season as July had variable precipitation and there was almost no rain in August (Figure 2). In southwestern Saskatchewan, most of the area received very little moisture during the growing season with crops experiencing drought-like conditions. July and August were warmer than normal over the prairies. In Alberta, even though there was a once-in-50 years heat wave with a significant number of days over 30°C in August, approximately 45% of the mustard crops were rated as being in good to excellent condition by the end of August.

In Saskatchewan, the mustard harvest began in the second half of August and finished at the end of September (Figure 4). The pace of harvest differed, however, with geography and weather conditions. In southwestern Saskatchewan, the mustard crop was harvested more than 2 weeks earlier than crops in the southeastern area of the province. There were reports that the mustard harvest extended into October in other parts of the prairies.

More detailed information can be found at :
Saskatchewan crop reports
Alberta crop reports
Walter Dyck's reports

Information on the temperature and precipitation patterns from the 2022 growing season in western Canada can be obtained from Agriculture and Agri-Food Canada.

Figure 2 Drought intensity in Canada on May 31 and August 31, 2022



Source: Agriculture and Agri-Food Canada

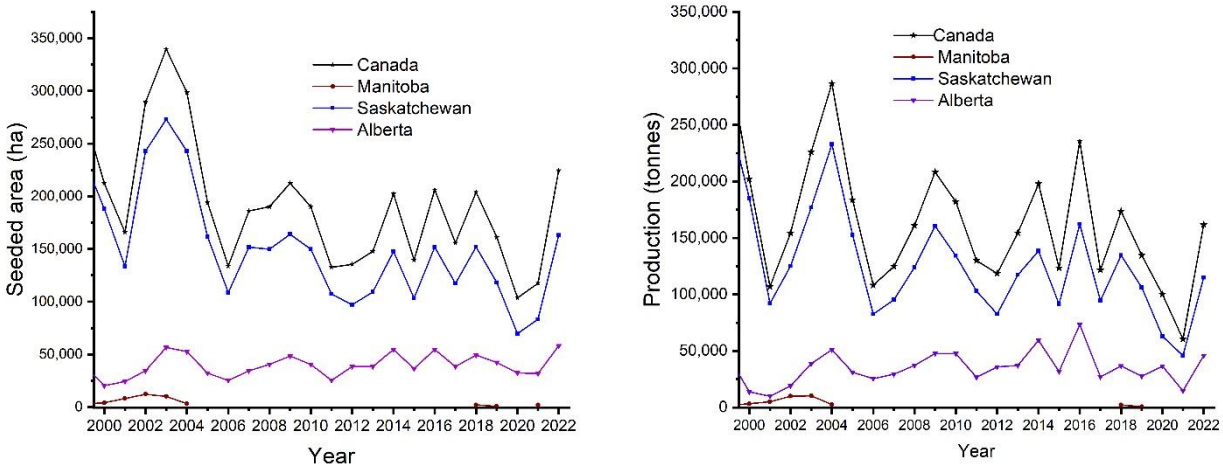
Production and grade information

In 2022, the production of mustard seed was 161,781 tonnes, much higher than the 2021 production (49,955 tonnes), the 5-year (2017 to 2021) mean of 115,711 tonnes and the 10-year (2012 to 2021) mean of 158,060 tonnes (Figure 3). The increase this year was due to the significant increase in hectares (ha) seeded with mustard (224,500 ha in 2022 versus 124,700 ha in 2021) (Figure 3) and an increase in the total yield, with 740 kilograms per hectare (kg/ha) produced in 2022 compared to 548 kg/ha in 2021. The 2022 yield was 717 kg/ha (426 kg/ha in 2021) in Saskatchewan and 801 kg/ha (458 kg/ha in 2021) in Alberta. These yields are an improvement compared to last year but still lower than the 5-year means (833 kg/ha in Saskatchewan and 758 kg/ha in Alberta) and much lower than the 10-year means (916 kg/ha in Saskatchewan and 912 kg/ha in Alberta). Saskatchewan accounted for 72.6% of western Canada's total area seeded with mustard and 71.1% of mustard production while most of the remaining seeded area and production was in Alberta (Figure 3).

In 2022, 64.6% of the mustard samples received by the Harvest Sample Program were graded Domestic Mustard Seed No. 1, Canada. This is much higher than what was recorded in 2021 (48.1%) and higher than the 5-year

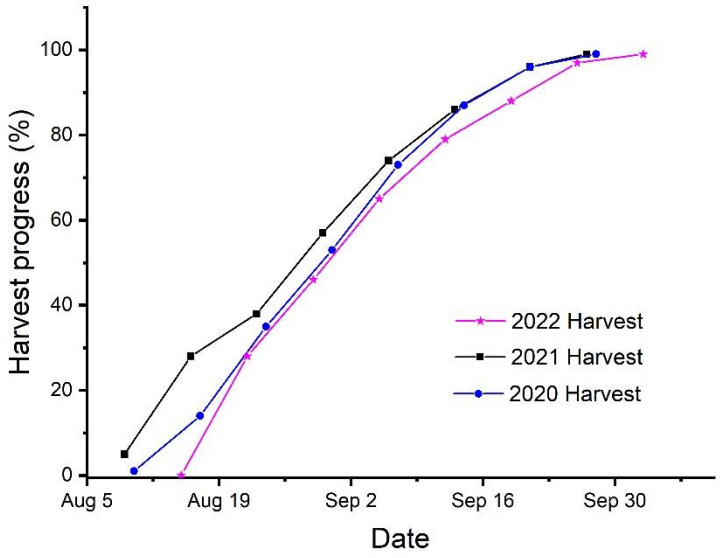
and 10-year means of 61.4% and 62.0%, respectively. The highest percentage of samples graded No. 1 were oriental mustard (79%), followed by brown mustard (70.3%). Samples of yellow mustard had the most damage and only 58.8% of the samples were graded No. 1. For most samples, downgrading was due to the presence of inconspicuous admixture, conspicuous admixture and the presence of other distinctly detrimental seeds. This year, only brown mustard samples showed signs of sprouting.

Figure 3 Seeded area and production of mustard in western Canada from 2000 to 2022[1]



[1] data from Statistics Canada Table 32-10-0359-01 Estimated areas, yield, production, average farm price and total farm value of principal field crops, in metric and imperial units

Figure 4 Mustard harvest progress in Saskatchewan from 2020 to 2022



Harvest samples

In 2022, the Harvest Sample Program received 236 mustard samples from producers and grain companies, more than in 2021 (189), similar to the 5-year mean (240) but lower than the 10-year mean (296). We analysed 136 yellow (122 in 2021), 91 brown (51 in 2021) and only 19 oriental (16 in 2021) mustard samples. Most mustard samples (67.9%) came from Saskatchewan (70% in 2021), 29.3% came from Alberta (27% in 2021) and 2.8% came from Manitoba (3% in 2021). Individual samples were cleaned to remove dockage and were graded by grain inspectors, following Chapter 12 of the Official Grain Grading Guide.

The Canadian Grain Commission used a FOSS NIR Systems 6500 NIR spectrometer, calibrated to and verified against the appropriate listed reference methods, to determine the oil and protein content of all individual whole-seed samples. Total glucosinolate content was determined on individual brown and oriental mustard samples using NIR spectroscopy and all composite samples were analyzed using the high performance liquid chromatography reference method. All oilseed method and test procedures are detailed on our website.

Composite samples were prepared for each province by combining samples of each type graded No. 1 and by combining lower grade samples (No. 2, No. 3, No. 4 and Sample) of each type for western Canada. Variety composites were also prepared by combining the most common mustard varieties using only samples graded No. 1. Composites were analysed for oil, protein, total glucosinolates, and chlorophyll content, as well as fatty acid composition.

Quality of the 2022 mustard crop

The mustard crop grown in western Canada in 2022 had the general characteristics of a well matured crop but showed some stress due to growing conditions that were warm and dry, as well as rain during harvest. Historical data from the Harvest Sample Program indicate that warm and dry growing conditions tend to produce an oilseed crop with higher protein and lower oil content. Scientific literature also suggests that total glucosinolate levels increase in rapeseed when crops are exposed to dry conditions after flowering. We noticed that the total glucosinolate content of the 2022 mustard crop was slightly higher than that in 2021.

Oil, protein and total glucosinolate content

Table 1 contains a summary of the 2022 data for oil, protein and total glucosinolate content in oriental, brown and yellow mustard samples according to grade. Comparisons of the quality of oriental, brown, and yellow mustard from previous years can be found in Figures 5, 6 and 7.

In 2022, samples of oriental mustard graded No. 1 had a mean oil content of 35.5%, higher when compared to 2021 (34.9%) but lower than the 5-year mean (39.1%) and 10-year mean (41.0%). Mean protein content was lower in 2022 (30.3%) when compared to 2021 (31.4%) but much higher than the 5-year mean and 10-year mean (28.5% and 27.0%, respectively) (Figure 5). Oil content ranged from 32.7% to 38.9% (30.4% to 41.8% in 2021) and protein content ranged from 27.3% to 33.2% (26.9% to 34.7% in 2021) (Table 1).

Samples of brown mustard graded No. 1 also had a mean oil content (33.0%) that was higher when compared to 2021 (32.4%) and lower than the 5-year mean and 10-year mean (35.0% and 36.3.0%, respectively). Mean protein content was slightly lower in 2022 (31.2%) compared to 2021 (31.7%) but higher than the 5-year mean and 10-year mean (29.9% and 28.6%, respectively) (Figure 6). Oil content ranged from 27.6% to 40.6% (28.9% to 36.3% in 2021) and protein content ranged from 23.8% to 34.1% (28.6% to 33.5% in 2021) (Table 1).

Yellow mustard is characteristically lower in oil and higher in protein than oriental and brown mustard (Table1). The mean oil content of yellow mustard graded No. 1 was higher in 2022 (25.4%) than in 2021 (25.0%) and lower than the 5-year mean (26.9%) and 10-year mean (28.7%). However, the mean protein content in 2022 (35.2%) was lower than in 2021 (36.6%) and higher than the 5-year mean (34.4%) and the 10-year mean (32.7%) (Figure 7). Oil content ranged from 22.4% to 32.8% (20.8% to 30.6% in 2021) and protein content ranged from 28.5% to 40.1% (30.0% to 42.1% in 2021)(Table 1).

In 2022, the mean total glucosinolate content of No. 1 oriental mustard (143 µmol/g of seeds) was identical to that in 2021. The mean total glucosinolate content of No. 1 brown mustard was higher than in 2021 (143 µmol/g versus 132 µmol/g). As in 2021, the 2022 mean total glucosinolate content of oriental mustard was much higher than the 5-year mean (124 µmol/g) and the 10-year mean (119 µmol/g). An approximately 20 µmol/g increase was also observed when comparing the 5-year mean (112 µmol/g) and 10-year mean (108 µmol/g) to the 2022 mean brown mustard total glucosinolate content. In 2022, the mean total glucosinolate content of the top grade of yellow mustard was 150 µmol/g, higher than in 2021 and 2020 (147 µmol/g and 141 µmol/g, respectively).

In 2022, there was a slight decrease in the mean protein content for brown and yellow mustard compared to 2021. However, the mean protein content in samples of all three types of mustard graded No. 1 in 2022 was higher than the corresponding historical means. The opposite was observed for the oil content, with all 2022 means being lower than the corresponding historical means. Warm and dry conditions during the seed development stage contributed to this increase in protein content. The 2022 mean total glucosinolate content in all types of mustard was also higher than the corresponding historic means. These results are consistent with those reported in the literature, suggesting that hot conditions increase protein content and hot and dry conditions increase total glucosinolate content.

The data on the chlorophyll content of oriental, brown and yellow mustard samples from 2022 is contained in Table 2. For oriental and brown mustard graded No. 1, chlorophyll was 1.4 milligrams per kilograms (mg/kg) and 3.2 mg/kg, respectively (Figure 9). Chlorophyll in yellow mustard graded No. 1 was 0.8 mg/kg (Figure 9 and Table 2). Samples of brown mustard from Manitoba graded No. 1 had the highest mean chlorophyll content (11mg/kg) whereas brown mustard graded No. 2 had a mean chlorophyll content of 5.3 mg/kg. The hot and dry conditions helped the mustard crop mature but in Manitoba the late seeding due to flooding and the shorter growing season likely led to more immature seeds with higher chlorophyll content.

Fatty acid composition

Table 2 contains the fatty acid composition data for brown, oriental and yellow mustard seed samples received in 2022.

Yellow mustard had more oleic acid (C18:1) and erucic acid (C22:1) than brown and oriental mustard. Concurrently, the amount of linoleic acid (C18:2) and α-linolenic acid (C18:3) was higher in brown and oriental mustard than in yellow mustard. Mean erucic acid content of yellow mustard graded No.1 was 33.5% (34.7% in 2021) while the mean erucic acid content of brown and oriental mustard was 22.3% and 20.7%, respectively (23.9% and 20.3%, respectively, in 2021). This resulted in a higher iodine value for brown mustard (118.8 units in 2022 versus 118.3 units in 2021) and lower iodine values for oriental mustard (116.8 units in 2022 versus 117.3 in 2021) and yellow mustard (101.4 units in 2022 versus 102.7 units in 2021). Mean total saturated fatty acids levels ranged from 5.4% (yellow mustard) to 6.7% (oriental mustard).

There were some varietal differences in the distribution of fatty acids in mustard samples from 2022. The oleic acid content of two oriental mustards, Cutlass (21.1%) and Forge (23.4%), differed by 2.2% and the erucic acid content of Cutlass (22.7%) and Forge (18.6%) differed by 4.1%.

The level of free fatty acid (FFA) content is an indicator of seed stress and oil degradation. In 2022, the mean FFA content of mustard graded No.1 was low (0.06% to 0.13%), but still slightly higher than in 2021 (0.03% to 0.07%). Samples of brown mustard showed sprouting damage and although this was expected to strongly affect the grade (based on FFA content), it generally did not. There was a significant difference between the mean FFA content of oriental mustard graded No. 1 (0.13%) and that graded No. 2 (0.58%). In 2022, brown mustard samples received by the Harvest Sample Program were obtained from southwestern Saskatchewan and southeastern Alberta, where hot and dry conditions prevailed during most of the growing season. The high FFA content observed in the samples may be due to heat stress.

Table 1 Oil, protein and total glucosinolate content of 2022 western Canadian mustard

Grade	Province	Number of samples	Oil content[1] %			Protein content[2] %			Glucosinolate content µmol/g[3]		
			Mean	Min[4]	Max[5]	Mean	Min	Max	Mean	Min	Max
Domestic Mustard Seed, Canada, Oriental											
No. 1	**Canada**	**15**	**35.5**	**32.7**	**38.9**	**30.3**	**27.3**	**33.2**	**143**	**110**	**160**
	Saskatchewan	11	35.6	32.7	38.9	30.3	27.3	33.2	144	113	160
	Alberta	4	35.2	33.4	36.8	30.2	29.8	32.2	142	110	150
No. 2	Canada	2	36.5	29.5	43.5	30.8	25.9	34.9	127	110	144
No. 3	Canada	2	34.6	30.2	41.6	29.9	25.4	33.3	147	124	164
Cutlass, No. 1	Canada	7	36.9	35.3	38.9	29.2	27.3	31.3	134	113	142
Forge, No.1	Canada	7	34.4	32.7	36.8	31.2	29.8	33.2	142	110	160
Domestic Mustard Seed, Canada, Brown											
No. 1	**Canada**	**64**	**33.0**	**33.4**	**35.0**	**31.2**	**29.3**	**30.8**	**143**	**84**	**153**
	Manitoba	3	33.5	33.4	35.0	30.7	29.3	30.8	129	105	138
	Saskatchewan	59	33.0	27.6	40.6	31.3	23.8	34.1	144	84	153
	Alberta	2	34.4	33.8	34.7	30.6	29.6	30.8	125	114	120
No. 2	Canada	18	34.3	30.8	37.0	30.2	26.9	32.8	135	85	146
Sample	Canada	5	33.7	31.3	35.6	31.0	29.6	31.7	132	111	126
Centennial Brown, No.1	Canada	34	33.07	27.6	40.6	31.1	23.8	34.0	135	84	153
Domestic Mustard Seed, Canada, Yellow											
No. 1	**Canada**	**80**	**25.4**	**22.4**	**32.8**	**35.2**	**28.5**	**40.1**	**150**	**NA[6]**	**NA**
	Manitoba	1	32.2	NS[7]	NS	29.0	NS	NS	147	NA	NA
	Saskatchewan	40	25.0	22.4	32.8	35.9	28.5	40.1	151	NA	NA
	Alberta	39	25.7	22.4	30.8	34.7	29.0	39.0	149	NA	NA
No. 2	Canada	26	25.6	23.0	31.4	36.0	30.5	38.8	149	NA	NA
No. 3	Canada	12	24.9	19.8	27.6	36.5	32.7	39.6	147	NA	NA
No. 4	Canada	8	26.0	21.2	31.5	35.2	29.8	40.1	147	NA	NA
Sample	Canada	10	26.6	23.7	32.4	33.9	28.3	37.7	148	NA	NA
Andante, No. 1	Canada	56	25.1	22.4	32.8	35.8	28.5	40.1	151	NA	NA

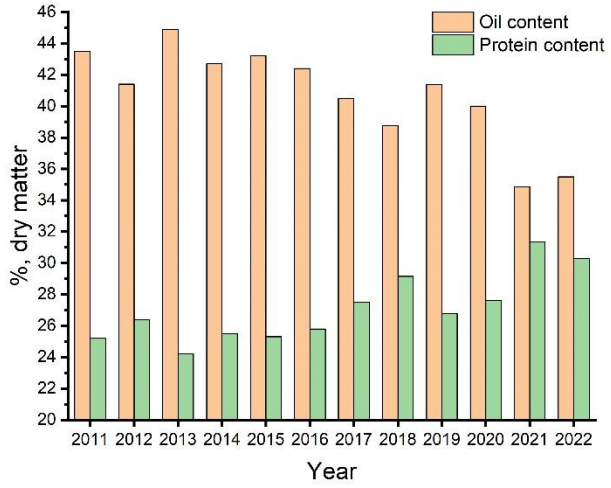
[1] dry matter basis
[2] protein content calculated from nitrogen (N) content using N x 6.25, dry matter basis
[3] µmol/g = micromoles per gram; total glucosinolate content was calculated on a dry matter basis
[4] Min = minimum obtained from the NIR predictions
[5] Max = maximum obtained from the NIR predictions
[6] NA= not available (no NIR models were developed to predict total glucosinolate content in yellow mustard)
[7] NS = non-sufficient (insufficient number of samples to generate a representative sample)

Table 2 Fatty acid composition, chlorophyll content and free fatty acid content of 2022 western Canadian mustard

Grade	Province	Number of samples	Fatty acid composition (%)[1]					Iodine value (units)	Chl[2] (mg/kg)	FFA[3] (%)
			C18:1	C18:2	C18:3	C22:1	Total SFA[4]			
Domestic Mustard Seed, Canada, Oriental										
No. 1	**Canada**	**15**	**22.2**	**23.8**	**11.0**	**20.7**	**6.7**	**116.8**	**1.4**	**0.13**
	Saskatchewan	11	21.8	23.4	11.1	21.3	6.7	116.6	1.6	0.13
	Alberta	4	23.7	25.1	10.7	18.7	6.8	117.7	1.0	0.13
No. 2	Canada	2	21.4	23.7	11.5	21.2	3.6	117.6	1.8	0.58
No. 3	Canada	2	21.4	23.2	11.3	21.4	6.6	116.8	2.7	0.25
Cutlass, No. 1	Canada	7	21.1	22.3	10.9	22.7	6.6	115.1	1.0	0.10
Forge, No.1	Canada	7	23.4	25.4	10.9	18.6	6.9	118.1	1.1	0.17
Domestic Mustard Seed, Canada, Brown										
No. 1	**Canada**	**62**	**20.4**	**21.8**	**13.1**	**22.3**	**6.5**	**118.8**	**3.2**	**0.09**
	Manitoba	3	20.5	22.9	13.7	21.1	6.3	121.3	10.6	0.16
	Saskatchewan	59	20.4	21.7	13.1	22.3	6.5	118.7	2.8	0.08
	Alberta	2	19.6	21.5	12.6	23.6	6.3	117.7	1.9	0.10
No. 2	Canada	18	24.9	23.8	13.6	16.8	7.0	121.7	5.3	0.09
Sample	Canada	5	21.75	21.4	12.2	22.2	6.3	116.9	5.5	0.09
Centennial Brown, No.1	Canada	35	20.4	21.7	13.0	22.4	6.4	118.9	3.0	0.09
Domestic Mustard Seed, Canada, Yellow										
No. 1	**Canada**	**80**	**26.4**	**10.1**	**9.8**	**33.5**	**5.4**	**101.4**	**0.8**	**0.06**
	Manitoba	1	32.5	10.0	9.8	26.9	5.5	102.1	0.6	0.05
	Saskatchewan	40	26.0	10.3	10.3	33.30	5.4	102.4	0.9	0.05
	Alberta	39	26.7	10.0	9.4	33.8	5.4	100.4	0.7	0.07
No. 2	Canada	26	26.7	9.8	9.9	33.5	5.3	101.2	1.3	0.10
No. 3	Canada	12	26.2	10.0	9.8	33.9	5.3	101.2	1.6	0.15
No. 4	Canada	8	25.9	10.2	10.4	33.4	5.3	102.4	2.5	0.13
Sample	Canada	10	27.6	10.7	10.9	31.3	5.3	104.1	4.3	0.19
Andante, No. 1	Canada	56	26.7	10.1	9.8	33.1	5.4	101.3	0.7	0.06

[1] total fatty acids include oleic (C18:1), linoleic (C18:2), α-linolenic (C18:3) and erucic (C22:1)
[2] Chl = chlorophyll, mg/kg = milligrams per kilogram
[3] FFA = free fatty acids
[4] SFA = saturated fatty acids, total SFA are the sum of palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0)

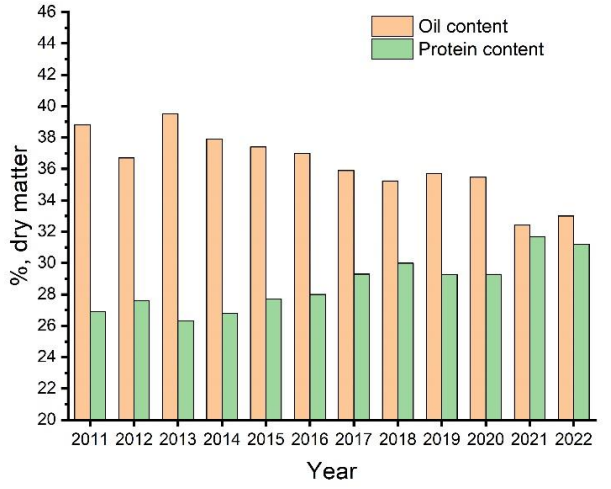
Figure 5 Oil and protein content of oriental Domestic Mustard Seed, No.1 Canada from 2011 to 2022 harvest samples



2022 oil content……..35.5%
2021 oil content ……34.9%
2012 to 2021 mean oil content ……..41.0%

2022 protein content ……30.3%
2021 protein content ……31.4%
2012 to 2021 mean protein content …….27.0%

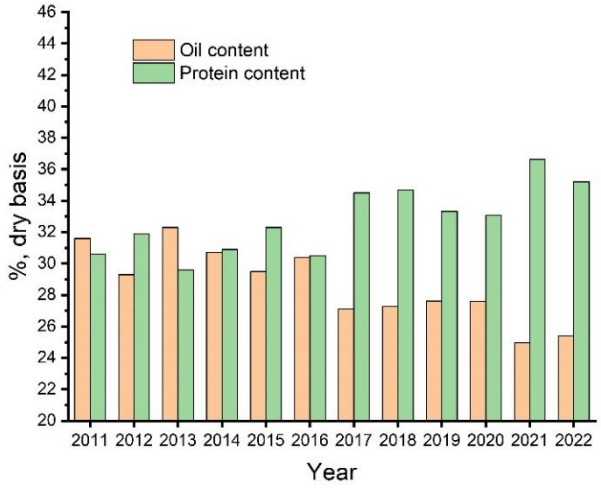
Figure 6 Oil and protein content of brown Domestic Mustard Seed, No.1 Canada from 2011 to 2022 harvest samples



2022 oil content……..33.0%
2021 oil content ……32.4%
2012 to 2021 mean oil content……..36.3%

2022 protein content ……31.2%
2021 protein content ……31.7%
2012 to 2021 mean protein content…….28.6%

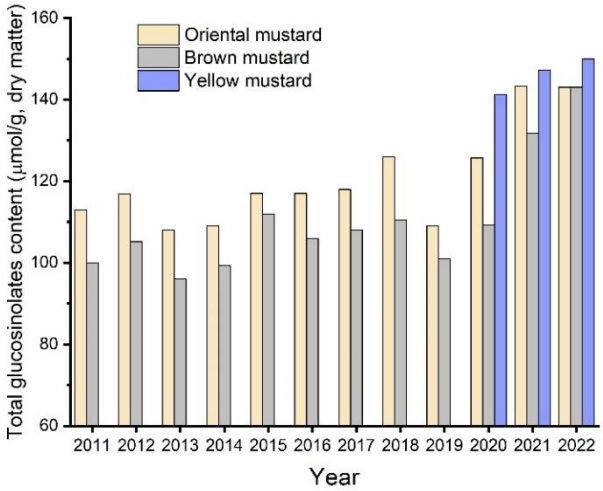
Figure 7 Oil and protein content of yellow Domestic Mustard Seed, No.1 Canada from 2011 to 2022 harvest samples



2022 oil content……..……25.4%
2021 oil content ……..……..25.0%
2012 to 2021 mean oil content…….28.7%

2022 protein content ……..……35.2%
2021 protein content ……..……36.6%
2012 to 2021 mean protein content……32.7%

Figure 8 Total glucosinolate content of oriental, brown and yellow[1] Domestic Mustard Seed, No.1 Canada from 2011 to 2022 harvest samples

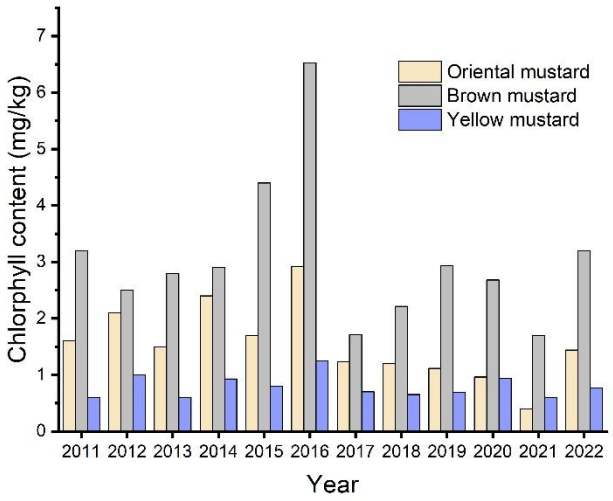


2022 total glucosinolate content: oriental …….143 µmol/g
2021 total glucosinolate content: oriental …….143 µmol/g
2012-2021 mean total glucosinolate: oriental .119 µmol/g
2022 total glucosinolate content: yellow ……..150 µmol/g
2021 total glucosinolate content: yellow ……..147 µmol/g
2020 total glucosinolate content: yellow ……..141 µmol/g

2022 total glucosinolate content: brown ……..143 µmol/g
2021 total glucosinolate content: brown ……..132 µmol/g
2012 to 2021 mean total glucosinolate: brown…108 µmol/g

[1] data from 2020, 2021 and 2022

Figure 9 Chlorophyll content of oriental, brown and yellow Domestic Mustard Seed, No.1 Canada from 2011 to 2022 harvest samples



2022 chlorophyll content: oriental .....1.4 mg/kg
2022 chlorophyll content: brown ..... 3.2 mg/kg
2022 chlorophyll content: yellow .....0.7 mg/kg

2012-2021 mean chlorophyll content: oriental ..... 1.6 mg/kg
2012-2021 mean chlorophyll content: brown .....3.0 mg/kg
2012-2021 mean chlorophyll content: yellow .....0.8 mg/kg

Acknowledgements

We would like to thank the mustard producers and grain handling facilities in western Canada for supplying samples of the 2022 mustard harvest. We also thank the Industry Services division of the Canadian Grain Commission for grading the Harvest Sample Program samples and the Grain Research Laboratory staff for conducting the analyses and preparing this report.