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Quality of Canadian oilseed-type soybeans

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Summary

In 2016 the average oil content for Soybean, No. 1 and No. 2 grades combined, was 21.7% on a dry matter basis (Table 2). This was very similar to last year's average of 21.5% and to the 5-year average (2011-15) of 21.5%. The average protein content for Soybean, No. 1 and No. 2 grades was 40.1%, which was higher than last year's (39.6%) and the 5-year average (39.4%). The oil and protein content averages for No. 1 and No. 2 grades combined varied between eastern and western provinces. Manitoba had an oil content of 20.9% and a protein content of 38.6%, whereas Saskatchewan had an oil content of 20.2% and a protein content of 39.7%. Ontario had an oil content of 22.1% and a protein content of 40.8%. Québec had an oil content of 19.9% and a protein content of 40.3%. Prince Edward Island and New Brunswick had an oil content and protein content of 21.5%, 21.4% and 39.6% and 38.4% respectively.

Acknowledgments

The Grain Research Laboratory acknowledges the cooperation of the soybean producers, grain handling offices, and oilseed crushing plants in eastern and western Canada for supplying the samples of newly harvested soybean. The assistance of the Industry Services Division of the Canadian Grain Commission in grading producer samples is also acknowledged. The technical assistance of the Oilseeds staff, Grain Research Laboratory is recognized.

Introduction

Canadian soybean growing area has expanded over the last couple of years. Soybean is now a crop grown countrywide from the Maritimes to the western provinces (Figure 1).

This harvest survey report is based on 371 samples of oilseed type soybean (previously described as non-food grade), more than what was received in 2015 (225) and in 2014 (346). Samples were from Manitoba (73), Ontario (211), Québec (62), Saskatchewan (10), Prince Edwards Island (8) and New-Brunswick (7). Of the submitted samples, 20.5% were graded as Soybean, No. 1 Canada; 77.4% were graded as Soybean, No. 2 Canada, 1.6% were graded as Soybean, No. 3 Canada and 0.5% were graded Soybean, No. 4 Canada.

Quality data (oil, protein, free fatty acid, chlorophyll and fatty acid composition) are based on the means of Soybean, No. 1 and No. 2 Canada grades combined for all oilseed-type samples received from the Maritimes (New Brunswick and Prince Edward Island), eastern Canada (Ontario and Québec), and western Canada (Manitoba and Saskatchewan). Alberta was not included as no samples were received from Alberta this year (Tables 2 and 3). In addition, results for all combined grades for each province are provided for comparison (Tables 3 and 4). Table 4 presents last year's (2015) quality data for a comparison to this year's harvest.

Figure 1 – Soybean production area in Canada



Weather and production review

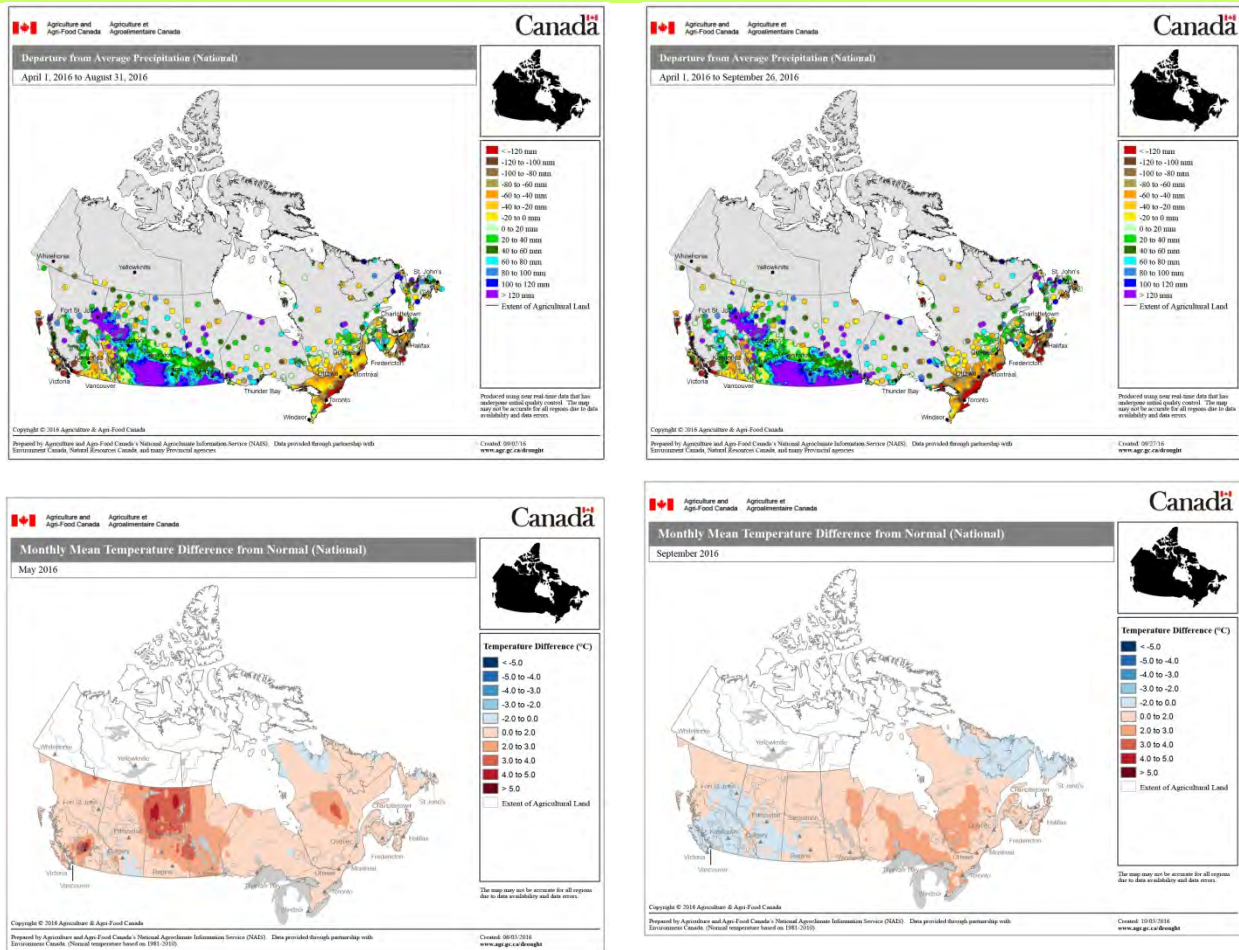
Weather review

2016 was an extreme year for Ontario with very dry conditions in some areas resulting in poor yields or total crop failures (Figure 2). The growing season started with a dry spring. In early June, the OMAFRA crop report stated that the lack of rain caused poor emergence in soybean with some acres having to be reseeded. July remained dry with the soybean crop still struggling; however precipitation in August, particularly in the southwestern part of Ontario, was critical for allowing the crop to develop. The soybean harvest was surprising to a lot of producers who may not have expected the yield that was obtained.

Favourable weather and field conditions in Manitoba allowed for seeding operations in early May. However, frosts in mid-May caused some injuries on emerged soybean plants. The growing season was quite wet in Manitoba (Figure 2) which was a concern for optimal growth of soybean, a warm season crop. Early season precipitation was followed by warmer and drier conditions that helped soybean crop development. In early September, thanks to above average temperatures, the Manitoba soybean crop matured quickly allowing the harvest to begin. However, harvest progress was slowed due to late September rains. During the first half of October, warmer temperatures and minimal rainfall allowed the Manitoba soybean harvest to progress and by October 17, the final Manitoba crop report stated that about 88% of seeded soybeans were harvested. Statistics Canada reported that in 2016, 3.7% of seeded soybean areas in Manitoba had not been harvested.

Thanks to warm, dry weather Saskatchewan producers were able to start seeding early and by the end of May 92% of the soybean crop was seeded. Harvest also started early and by the end of August the Saskatchewan crop report stated that 7% of the soybean crop was combined. Harvest progressed until October 10th when it came to a halt because of heavy rain and snow with 66% of the soybean crop combined. The harvest resumed at the end of October and by the last Saskatchewan crop report 99% of the soybean crop had been harvested.

Figure 2 – National maps showing environmental growing conditions – precipitation (departure from average) and temperature (monthly mean difference from normal)



Source:

Ontario crop report: <http://www.omafra.gov.on.ca/english/crops/field/reports/index.html>

Manitoba crop report: <http://www.gov.mb.ca/agriculture/crops/seasonal-reports/crop-report-archive/>

Saskatchewan crop report: <http://www.agriculture.gov.sk.ca/Crop-Report>

Canada weather maps: <http://www5.agr.gc.ca/DW-GS/historical-historiques.aspx?lang=eng&jsEnabled=true>

Production and grade information

Seeded area and production data for 2016 and 2015 are presented in Table 1. In 2016 the seeded soybean area in Manitoba increased by 15.3% but decreased in Saskatchewan by 12.6% and in Ontario by 10.5%. Since 2007 soybean production in Canada has been steadily increasing (Figure 3). This year's production increased by 1.4% compared to last year; from 6.37 million tonnes to 6.46 million tonnes (Table 1) and increased in all provinces except in Ontario, Canada's biggest soybean production area. The increase in production was 21.4% in Manitoba, 3.9% in Québec and 11.3% in Saskatchewan (Table 1). The production increase was due to an increase in seeded area in Manitoba (15.3%) and noticeable yield increase compared to 2015 (3.4%, 3,000 Kg/ha in 2016

versus 2,900 Kg/ha in 2015). The highest yield increase was observed in Saskatchewan, 22.7% (from 1,700 Kg/ha in 2015 to 2,000 Kg/ha in 2016, followed by Manitoba 10.7% (2,800 Kg/ha in 2016 versus 2,500 Kg/ha in 2015). No yield increase was observed in Québec (3,200 Kg/ha in 2015 & 2016) and in Ontario (3,100 Kg/ha in 2015 & 2016).

Figure 3 – Historic soybean production data in Canada, 2000 to 2016

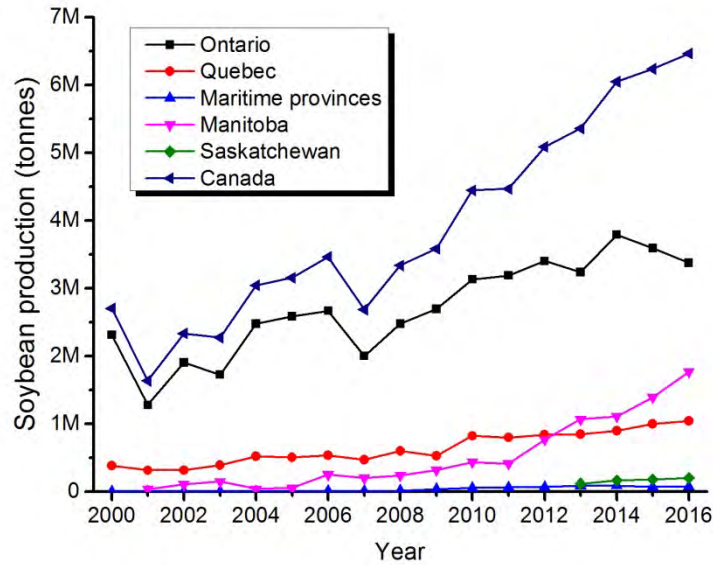


Table 1 - Seeded area and production for eastern and western Canadian soybean¹

Province	Seeded area		Production ¹		5-Year average production
	2016	2015	2016	2015	2011-15
	Hectares		Tonnes		Tonnes
Manitoba	661,700	560,500	1,769,000	1,390,700	950,100
Saskatchewan	97,100	109,300	202,500	179,600	153,767
Western Canada	758,800	669,800	1,971,500	1,570,300	1,042,360
Ontario	1,096,700	1,185,700	3,374,700	3,728,500	3,469,960
Québec	325,000	315,000	1,040,000	1,000,000	877,600
Eastern Canada²	1,421,700	1,500,700	3,374,700	3,728,500	3,469,960
Prince Edward Island	21,400	21,900	49,000	47,200	53,120
New Brunswick	6,100	5,300	14,700	12,200	11,340
Nova Scotia	4,500	4,500	49,000	47,200	53,120
Maritimes	32,000	31,700	76,500	72,200	76,360
Total Canada	2,212,500	2,202,200	6,462,700	6,371,000	5,466,280

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>).

². In this table eastern Canada represents Ontario plus Québec

Harvest survey samples

For the 2016 soybean survey 371 samples were received, 288 from the East and 83 from the West (Table 2). All harvest survey samples submitted to the Canadian Grain Commission from all locations (Ontario, Québec, Prince Edward Island, New Brunswick, Manitoba and Saskatchewan) were graded by Canadian Grain Commission inspectors according to the Official Grain Grading Guide (<http://www.grainscanada.gc.ca/oggg-gocg/20/oggg-gocg-20-eng.htm>). In the 2016 survey, 99.5% of the submitted samples were in the top 2 grades. Few samples (2.1%) were graded Soybean, No. 3 Canada and lower.

Individual samples were analyzed for oil and protein content using either a FOSS NIRSystems 6500 or a DS2500 near-infrared (NIR) spectrometer, calibrated and verified against the appropriate laboratory reference method. Grade composite samples were analyzed by reference methods for oil, protein, fatty acid composition and free fatty acids. The reference procedures are listed under Oilseeds Methods <http://grainscanada.gc.ca/oilseeds-oleagineux/method-methode/omtm-mmao-eng.htm>.

Due to a low number of samples received from some areas, the data presented in this report for these areas might not reflect the true quality of the crop. The average data presented in this report was weighted using the 2016 provincial production data as reported by Statistics Canada (<http://www5.statcan.gc.ca>).

There are two major types of soybeans grown in Canada: those commonly referred to as oilseed-type (“crush” or non-food grade) beans and food grade beans (used for tofu and other soy products) . This report deals with the oilseed-type soybean samples that are used for the feed or crushing industry. A list of Canadian soybean varieties is provided in *List of Varieties which are Registered in Canada*, Variety Registration Office, Variety Section, Plant Health and Production Division, Canadian Food Inspection Agency (http://www.inspection.gc.ca/active/netapp/regvar/regvar_lookupe.aspx)

Oilseed-type soybeans are grown to produce oil and high-protein meal. Soybean oil is used in salad oil, shortening and margarine products. Defatted soybean meal is used as a protein supplement in livestock rations. Key quality factors for oilseed soybeans are oil content, protein content, and fatty acid composition. Oil and protein content give quantitative estimates of the beans as a source of oil, and of the defatted meal as a source of protein for animal feed. Fatty acid composition provides information about the nutritional, physical and chemical characteristics of the oil extracted from the beans.

Oil and protein content

The average protein content was 40.1% in 2016, slightly higher than what was observed last year (39.6%) and higher than the 5-year average (2011-15) of 39.4%. Samples from the eastern provinces of Canada showed a higher protein content than samples from western Canada (40.6% and 39.3% for eastern Canada and Maritimes versus 38.7% for western Canada). For all grades combined individual producer samples ranged in protein from 29.3% to 43.2%. This protein range was larger than what was observed in 2015 (31.3% to 43.2%). One sample in Ontario graded Soybean No. 2, Canada was particularly low in protein (29.3%) without being high in oil (22.6%). Figure 4 shows the protein content trend since 2000 for Canada and 2008 for eastern (Québec and Ontario) and western Canada (Manitoba and Saskatchewan). The graph shows a decrease in protein content of about 2% between 2000 and 2016. Western averages were consistently lower than eastern averages from 2008 to 2016. Western yearly averages also showed higher yearly variations than eastern averages.

The average oil content was 21.7 (Table 2) for soybean graded No. 1 and No. 2 Canada. This average is very similar to the 21.5% observed in 2015 (Table 4) and also to the 5-year average of 21.4%. There was no significant difference between the oil content averages obtained for the various grades (Table 2). Soybean No. 3 Canada averaged 21.4% and soybean No. 4 Canada averaged 23.7% for oil content, however there were only two samples in this grade, which statistically is not very representative. There was however a noticeable difference between the averages of soybean No. 1 and No. 2 Canada from eastern and western provinces, with samples from the east showing higher oil contents than those from the west (22.0% in the east versus 20.8% in the west) (Table 2). All grades combined, individual producer samples ranged from 19.0% to 24.8%, a lesser oil content range than what was observed for the 2015 soybean harvest (17.4% to 25.8%). Figure 5 shows the oil content trend since 2000 for Canada and 2008 for eastern (Québec and Ontario) and western Canada (Manitoba and Saskatchewan). Since 2000, oil content average has increased with the average being about 1.5% higher in 2016 than in 2000. However, a marked difference could be observed between eastern and western averages due to different environmental growing conditions and varietal differences.

Important variations in protein and oil contents in the top 2 grades could be observed among all provinces and between eastern and western provinces (Table 2). While quality parameters can be strongly affected by environmental conditions, the variety of soybean planted and soil fertility can also affect quality. Noticeably there is an inverse relationship between oil and protein content for eastern and western Canada soybean, the higher the oil content and the lower the protein content.

Fatty acid composition

Table 3 shows fatty acid composition for the combined No. 1 and 2 grade composites from the various provinces. This year, the fatty acid composition variation between provinces was reduced compared to last year. Linolenic acid (C18:2), the main fatty acid found in soybean oil, averaged 53.1% and ranged from 52.6 to 55.1% , whereas last years average was 52.8% with a range from 52.0 to 58.8%. Oleic acid, the second most important soybean fatty acid, averaged 22.7% in 2016 and was identical to what was observed in 2015. The other important unsaturated fatty acid, α -linolenic acid (C18:3), averaged 8.2% in 2016 (8.5% in 2015) and ranged from 7.5 to 10.3%. Total saturates averaged 15.3% in Canada varying from 14.6% (Prince Edward Island) to 15.5% (Québec and Saskatchewan).

Iodine value is used to estimate the level of fatty acid unsaturation in oil; the higher the number of double bonds in the oil the higher the iodine value and the level of unsaturation. For 2016 the α -linolenic acid average was slightly higher than last year; this is reflected in the iodine values being very similar to last year, 113.2 units in 2016 versus 133.7 units in 2015. Figure 6 presents the iodine value trend since 2009 for eastern Canada (Québec and Ontario) and western Canada (Manitoba and Saskatchewan) and the overall Canadian averages. The yearly variations are a reflection of the environmental differences which includes geography (temperature and precipitation being very different between eastern and western Canada).

The Canadian averages are weighted by production data. Up until 2015 eastern Canada was growing over twice the amount of soybean than western Canada, therefore Canadian averages were weighted towards eastern averages. In 2016 eastern Canada produced only about 1.7 times more soybean than western Canada. If production keeps increasing in the west the Canadian averages will reflect both production areas equally.

Free fatty acid (FFA) content

Grade composites showed free fatty acid levels averaging 0.12% for composite samples of Soybean, No. 1 Canada and Soybean, No. 2 Canada in 2016 (Table 2). This is similar to what was observed last year (0.09%).

High free fatty acid values are mainly due to seed damage which results from exposure to moisture and oxygen, wet harvesting conditions and improper storage. It has been noted that free fatty acid levels could increase during storage due to storage and environmental conditions.

Figure 4 – Protein content averages of Canadian oilseed type soybean, 2000 to 2016.

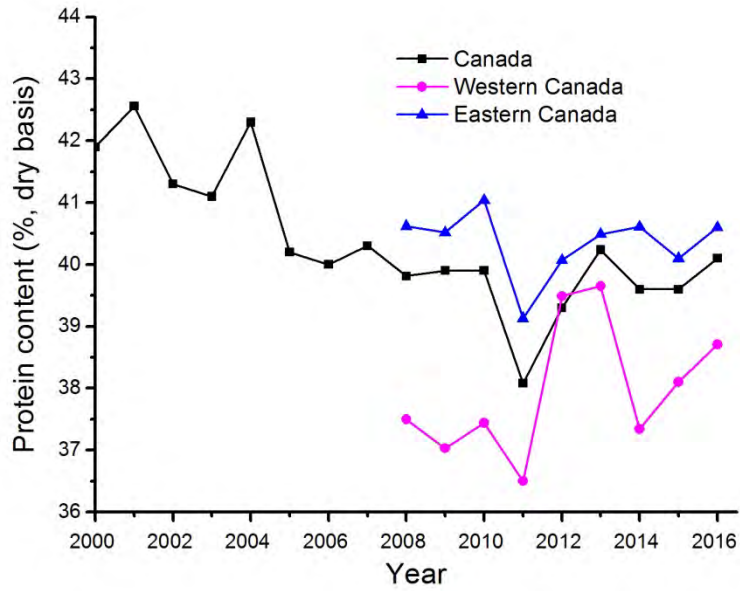


Figure 5 – Oil content averages of Canadian oilseed type soybean, 2000 to 2016

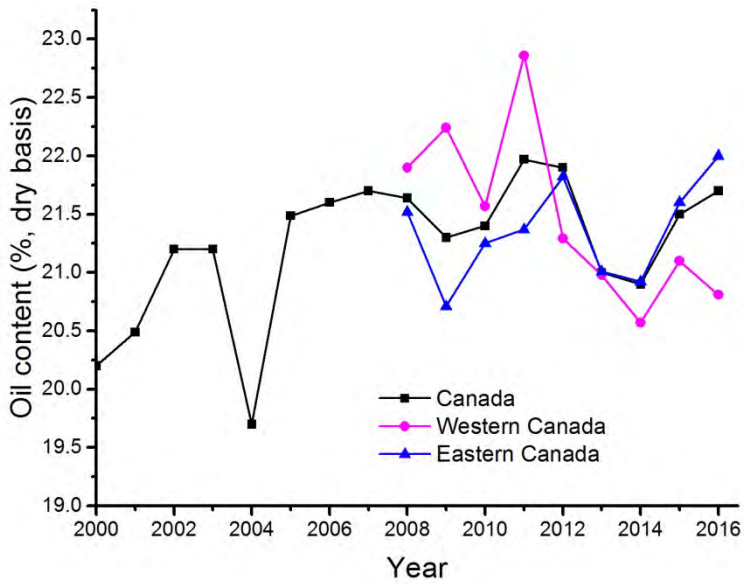


Figure 6 – Iodine value averages of Canadian oilseed type soybean, 2000 to 2016

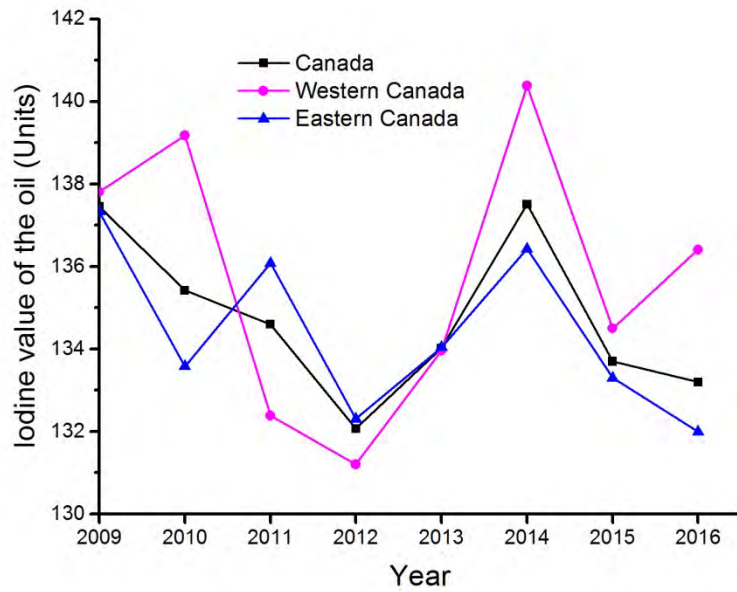


Table 2: Oil, protein and chlorophyll contents and free fatty acid content of the oil of the 2016 soybean survey by province and grade

Province	N	Oil			Protein ¹			Chlorophyll Mg/Kg	Free Fatty Acid ² %, in oil
		Mean	Min	Max	Mean	Min	Max		
Soybean, No. 1 Canada and Soybean No. 2 Canada									
Manitoba	69	20.9	19.2	24.5	38.6	31.9	42.3	0.6	0.13
Saskatchewan	10	20.2	19.0	22.5	39.7	37.2	42.3	0.8	0.11
Alberta	NA								
Western Canada	79	20.8	19.0	24.5	38.7	31.9	42.3	0.6	0.13
Ontario	209	22.1	20.5	24.8	40.8	29.3	43.6	0.3	0.12
Québec	60	21.5	19.9	24.5	40.3	37.1	43.9	0.2	0.13
Eastern Canada	269	22.0	19.9	24.8	40.6	29.3	43.6	0.2	0.12
Prince Edward Island	8	21.5	20.8	23.2	39.6	38.7	42.4	0.4	0.19
New Brunswick	7	21.4	21.0	23.8	38.4	34.4	40.8	0.3	0.18
Maritimes	15	21.5	20.8	23.8	39.3	34.4	42.4	0.4	0.19
Canada	363	21.7	19.0	24.8	40.1	29.3	43.6	0.3	0.12
Soybean, No. 3									
Eastern + Maritimes	2	21.8	19.9	22.1	41.5	40.7	42.3	0.7	0.23
Western	4	21.2	19.9	23.1	37.7	37.0	39.8	0.8	0.13
Canada	6	21.4	19.9	23.1	38.8	37.0	42.3	0.8	0.16
Soybean, No. 4									
Eastern + Maritimes	2	23.7	23.5	24.7	42.0	40.8	42.9	0.7	0.35
Western	NA								
Canada	2	23.7	23.5	24.7	42.0	40.8	42.9	0.7	0.35
Soybean, All grades combined									
Manitoba	73	20.9	19.2	24.5	38.5	31.9	42.3	0.6	0.13
Saskatchewan	10	20.3	19.0	22.5	39.7	37.2	42.3	0.8	0.11
Alberta	NA								
Western Canada	83	20.8	19.0	24.5	38.7	31.9	42.3	0.6	0.13
Ontario	211	22.1	20.5	24.8	40.7	29.3	43.6	0.3	0.12
Québec	62	21.5	19.9	24.5	40.4	37.1	43.9	0.3	0.14
Eastern Canada	273	22.0	19.9	24.8	40.6	29.3	43.9	0.3	0.17
Prince Edward Island	8	21.5	20.8	23.2	39.6	38.7	42.4	0.4	0.19
New Brunswick	7	21.4	21.0	23.8	38.4	34.4	40.8	0.3	0.18
Maritimes	15	21.5	20.8	23.8	39.3	34.4	42.4	0.4	0.19
Canada	371	21.7	19.0	24.8	40.1	29.3	43.9	0.3	0.12

¹ calculated from nitrogen content with N x 6.25

² calculated as % of oleic acid

NA non applicable, no samples

Table 3: Main fatty acid contents and iodine value of the oil of the 2016 soybean survey by province and grade

Province	N	C16:0	C18:0	C18:1	C18:2	C18:3	SATS ²	Iodine Value ³ Units
%, in oil								
Soybean, No. 1 Canada and Soybean No. 2 Canada								
Manitoba	69	9.9	4.0	21.4	53.7	9.4	14.7	136.3
Saskatchewan	10	10.1	4.5	19.6	53.8	10.3	15.5	137.4
Alberta	NA	NA	NA	NA	NA	NA	NA	NA
Western Canada	79	9.9	4.1	21.2	53.7	9.5	14.8	136.4
Ontario	209	10.4	4.2	23.6	52.6	7.5	15.4	131.5
Québec	60	10.6	4.0	21.9	53.5	8.4	15.5	133.8
Eastern Canada	269	10.5	4.1	23.2	52.8	7.7	15.5	132.0
Prince Edward Island	8	10.1	3.6	21.5	53.8	9.4	14.6	136.6
New Brunswick	7	10.3	3.8	19.6	55.1	9.6	15.0	137.6
Maritimes	15	10.2	3.6	21.1	54.1	9.5	14.7	136.8
Canada	363	10.3	4.1	22.7	53.1	8.2	15.3	133.2
Soybean, No. 3								
Eastern Canada	2	10.5	3.9	22.8	53.0	8.3	15.2	133.2
Western Canada	4	10.4	3.9	18.7	55.4	9.9	15.2	138.3
Canada	6	10.4	3.9	19.9	54.7	9.4	15.2	136.8
Soybean, No. 4								
Eastern Canada	2	10.0	3.9	26.8	50.4	7.1	14.7	129.2
Western Canada	NA							
Canada	2	10.0	3.9	26.8	50.4	7.1	14.7	129.2
Soybean, All grades combined								
Manitoba	73	9.9	4.0	21.3	53.8	9.4	14.8	136.4
Saskatchewan	10	10.0	4.5	19.6	53.8	10.3	15.5	137.4
Alberta	NA							
Western Canada	83	9.9	4.0	21.3	53.8	9.5	14.9	136.5
Ontario	211	10.4	4.15	23.6	52.6	7.5	15.4	131.5
Québec	62	10.6	4.0	22.1	53.4	8.4	15.4	133.6
Eastern Canada	273	10.5	4.1	23.2	52.8	7.7	15.4	132.0
Prince Edward Island	8	10.1	3.6	21.5	53.8	9.4	14.6	136.6
New Brunswick	7	10.3	3.8	19.6	55.1	9.6	15.0	137.6
Maritimes	15	10.2	3.6	21.1	54.1	9.5	14.7	136.8
Canada	371	10.3	4.1	22.7	53.1	8.2	15.3	133.2

² sum of all saturated fatty acid from C12:00 to C24:0

³ Calculated from the fatty acid composition

Table 4: Quality data (oil, protein, iodine value and free fatty acid) of the 2015 soybean survey by province

Province	Oil	Protein ¹	FFA ²	C16:0	C18:0	C18:1	C18:2	C18:3	Iodine Value ³
	%, dry basis			% in the oil					Units
2015 - Soybean, No. 1 Canada and Soybean No. 2 Canada									
Western Canada	21.1	38.1	0.05	10.0	4.0	22.7	52.6	9.0	134.5
Eastern Canada	21.6	40.1	0.10	10.4	4.1	22.7	52.9	8.4	133.3
Canada	21.5	39.6	0.09	10.3	4.1	22.7	52.8	8.5	133.7
2015 - Soybean, All grades combined									
Manitoba	21.2	38.0	0.04	10.0	4.0	23.1	52.4	8.8	134.1
Saskatchewan	20.6	38.4	0.11	10.0	4.4	20.0	54.1	9.9	137.1
Alberta	18.6	39.3	0.03	10.1	4.0	17.1	55.8	11.4	141.4
Western Canada	21.1	38.1	0.05	10.0	4.0	22.7	52.6	9.0	134.5
Ontario	21.7	39.8	0.08	10.4	4.2	22.4	53.1	8.4	133.4
Québec	21.2	41.0	0.21	10.4	3.9	23.8	52.2	8.2	132.7
Prince Edward Island	22.2	35.7	0.15	10.2	3.2	16.6	58.8	9.7	141.8
New Brunswick	20.9	39.5	0.09	10.7	3.7	18.8	55.7	9.5	137.8
Eastern Canada	21.6	40.1	0.11	10.4	4.1	22.6	52.9	8.4	133.4
Canada	21.5	39.6	0.09	10.3	4.1	22.7	52.9	8.5	133.7

¹ calculated from nitrogen content with N x 6.25

² calculated as % of oleic acid

³ calculated from the fatty acid composition

NA non applicable, no sample