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Corn: Canada's third most valuable crop

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Corn: Canada's third most valuable crop

By Marie-Andrée Hamel and Erik Dorff

Corn for grain: the world's top cereal crop

When it comes to cereal crop production around the world, corn is king. This may come as a surprise to many. Anyone who has ever seen the endless seas of golden wheat on the Canadian Prairies might think that this lynchpin of Canadian agriculture is the number one cereal crop.

Photograph depicts a summer cornfield in Almonte Ontario.
Photo: Stewart Wells

The same might be thought of rice and the landscape of paddies stretching as far as the eye can see across Asia. But instead, the most produced cereal crop worldwide is actually corn (also known as maize), a cereal native to the Americas. It outstrips both rice and wheat in terms of global production (Table 1).

Table 1
World and Canadian production of major grains and oilseeds, 2011

Commodity	World	Canada	Share of total	World position
	metric tonnes		percent	rank
Maize	885,289,935	10,688,700	1.2	11
Rice, paddy	722,559,584	…	…	…
Wheat	701,395,334	25,261,400	3.6	7
Soybeans	262,037,569	4,246,300	1.6	7
Barley	133,049,075	7,755,700	5.8	7
Canola	62,546,641	14,164,500	22.6	1
Sorghum	58,583,460	…	…	…
Millet	27,226,548	…	…	…
Oats	22,676,189	2,997,100	13.2	2
Rye	13,162,017	194,700	1.5	10

Source: Food and Agriculture Organization of the United Nations.

Maize or corn for grain[1] is the number one cereal crop worldwide with 885.3 million tonnes produced in 2011 according to the FAO[2]. The top producer was the United States with 313.9 million tonnes or 35.5% of global production. The U.S. was followed by China which produced 192.8 million tonnes (21.8% of world production). Canada placed 11th in world production of corn with 10.7 million tonnes of grain corn produced in 2011 (Table 2).

1. Grain corn is grown for the corn kernels which are ground to produce both human food and animal feed, in addition to being used as industrial feedstock.
2. Food and Agriculture Organization of the United Nations.

Table 2
Top grain corn producing nations, 2011

Rank	Country	Production	Share of world production
		metric tonnes	percent
	World	885,289,935	100.0
1	United States of America	313,948,610	35.5
2	China, mainland	192,781,000	21.8
3	Brazil	55,660,415	6.3
4	Argentina	23,799,830	2.7
5	Ukraine	22,837,900	2.6
6	India	21,760,000	2.5
7	Mexico	17,635,417	2.0
8	Indonesia	17,629,033	2.0
9	France	15,913,300	1.8
10	Romania	11,717,591	1.3
11	Canada	10,688,700	1.2
12	South Africa	10,360,000	1.2
13	Italy	9,752,592	1.1
14	Nigeria	9,180,270	1.0
15	Hungary	7,992,000	0.9
16	Philippines	6,971,221	0.8
17	Russian Federation	6,962,440	0.8
18	Egypt	6,876,473	0.8
19	Serbia	6,479,564	0.7
20	Ethiopia	6,069,413	0.7

Source: Food and Agriculture Organization of the United Nations, data accessed February 13, 2014.

In Canada, over 32,300 farms reported planting 1.63 million hectares of corn (corn for grain, corn for silage and sweet corn) according to the 2011 Census of Agriculture. The value of farm cash receipts for grain corn alone reached $2.08 billion in 2011, ranking it as the third most valuable crop in Canada, after canola and wheat.[3]

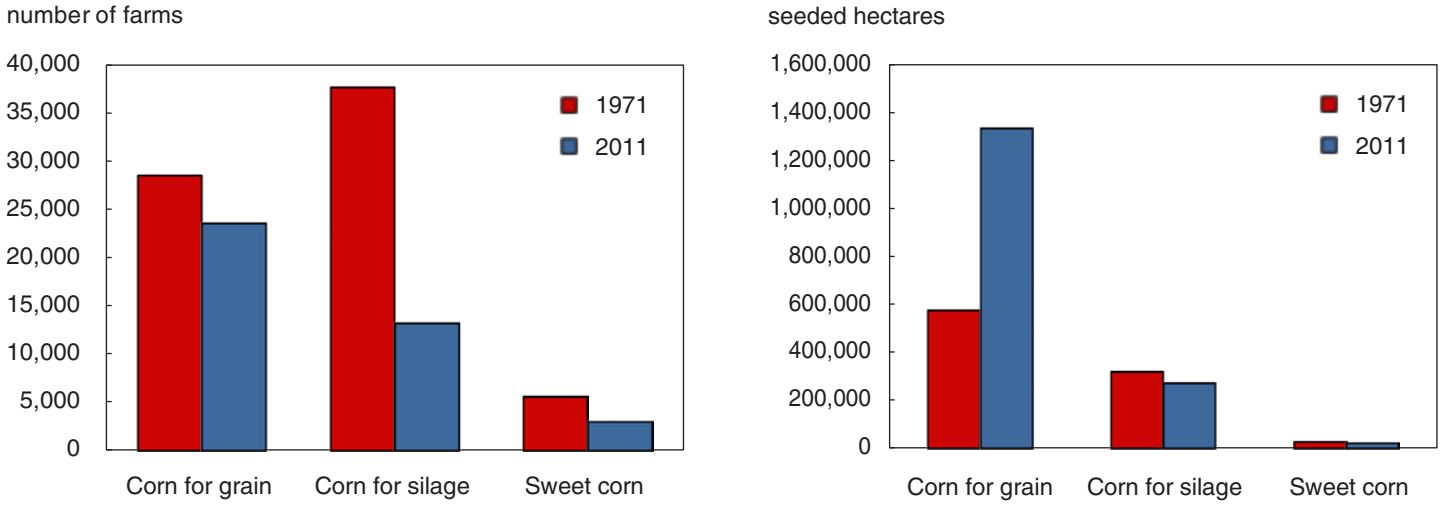
One plant with many specialized varieties

Farmers and corn breeders have developed multiple varieties suited to particular uses and adapted to distinct environments. In Canada, three broad types of corn dominate farmers' fields: corn for grain, corn for silage, and sweet corn. In 2011, 23,472 farms reported growing corn for grain, a 17.7% decrease since 1971. During the same period, the number of farms reporting corn for silage[4] declined by 65.0% to reach 13,184 farms in 2011.The number of farms reporting sweet corn[5] area declined by 46.6% from 1971 to 2,997 farms in 2011.

3. Statistics Canada, CANSIM table 002-0001.
4. Corn for silage is harvested as a whole plant (i.e., the cob, grain, stem and leaves) when still green and is used as feed for ruminant animals, namely dairy and beef cattle, and sheep, as well as pigs and poultry. In general, the harvested plant material is chopped and stored in airless vertical silos, bunker silos, or wrapped bales. The plant material is preserved by a process of bacterial fermentation that produces lactic acid. Of interest is the fact that lactic acid is also used as a preservative in human foods, and it is responsible for the distinctive taste of a variety of products, such as yogurt, sourdough bread, sauerkraut, some pickles, and kimchi.
5. Sweet corn has high sugar content and is the variety known to consumers as corn on the cob, canned corn, and frozen corn.

Chart 1 shows that more than 1.3 million hectares of corn for grain was reported in the 2011 Census of Agriculture, more than double the 573,039 hectares (Chart 1) reported in 1971. The 2011 total represented 81.8% of the total corn area reported.

Chart 1
Corn, number of farms and seeded area by type of corn, Canada, 1971 and 2011



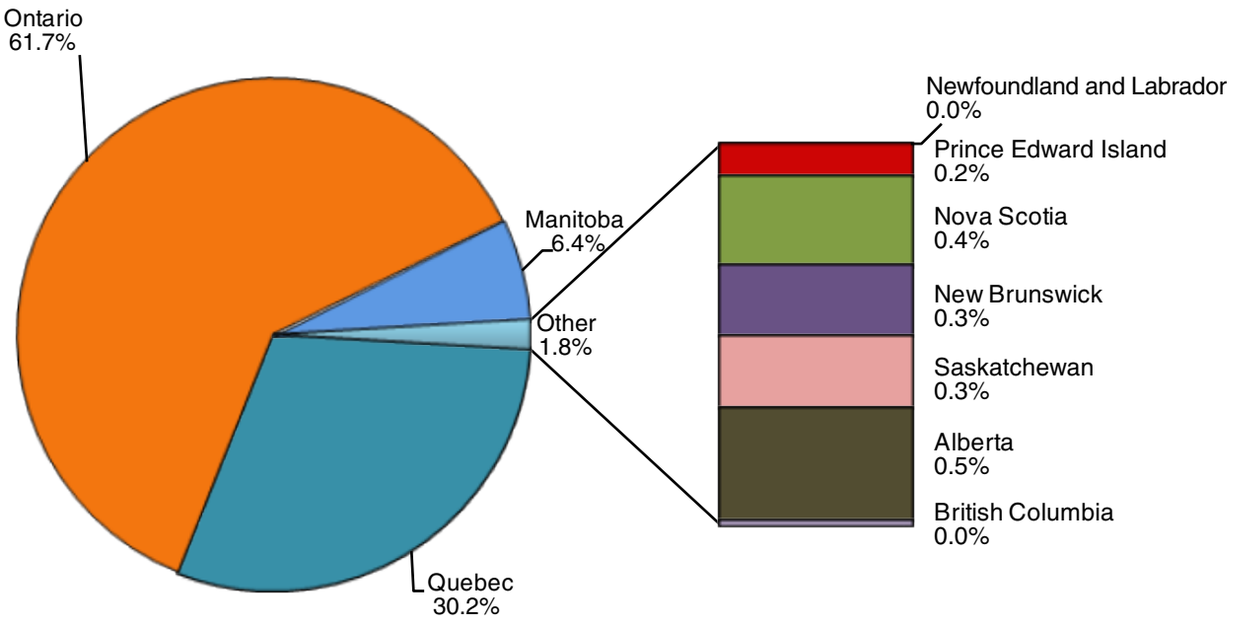
Source: Statistics Canada, Census of Agriculture, 1971 and 2011.

Canadian grain-corn production is located in central Canada

Ontario and Quebec form the backbone of corn for grain production in Canada. According to the Census of Agriculture, Ontario accounted for 61.7% of seeded area in 2011, with Quebec following at 30.2% and Manitoba at 6.4% (Chart 2). While corn for grain is the third largest grain crop in Canada (after wheat and canola), it ranks as the number one crop in Ontario in terms of production[6] and farm cash receipts.

6. Statistics Canada, CANSIM table 001-0010.

Chart 2
Corn for grain seeded area by province, 2011



Source: Statistics Canada, Census of Agriculture, 2011.

Climate is a decisive factor in determining the areas of the country where corn for grain can be a viable crop. In general, the longer and warmer the growing season, the greater the possible harvest. Corn Heat Units (CHUs) are used to measure the average number of summer days that exceed a certain temperature. While corn breeders have developed corn varieties that are adapted to local environmental conditions, the greatest production usually occurs in the warmest regions of the country—primarily in southern, central and eastern Ontario, as well as in southern Quebec—since these areas have the highest CHUs (Map 1). Regions where the growing season is cooler or shorter are more suitable for growing other grains, especially wheat and barley.

Map 1
Principal production regions of corn for grain area, Canada, 2011

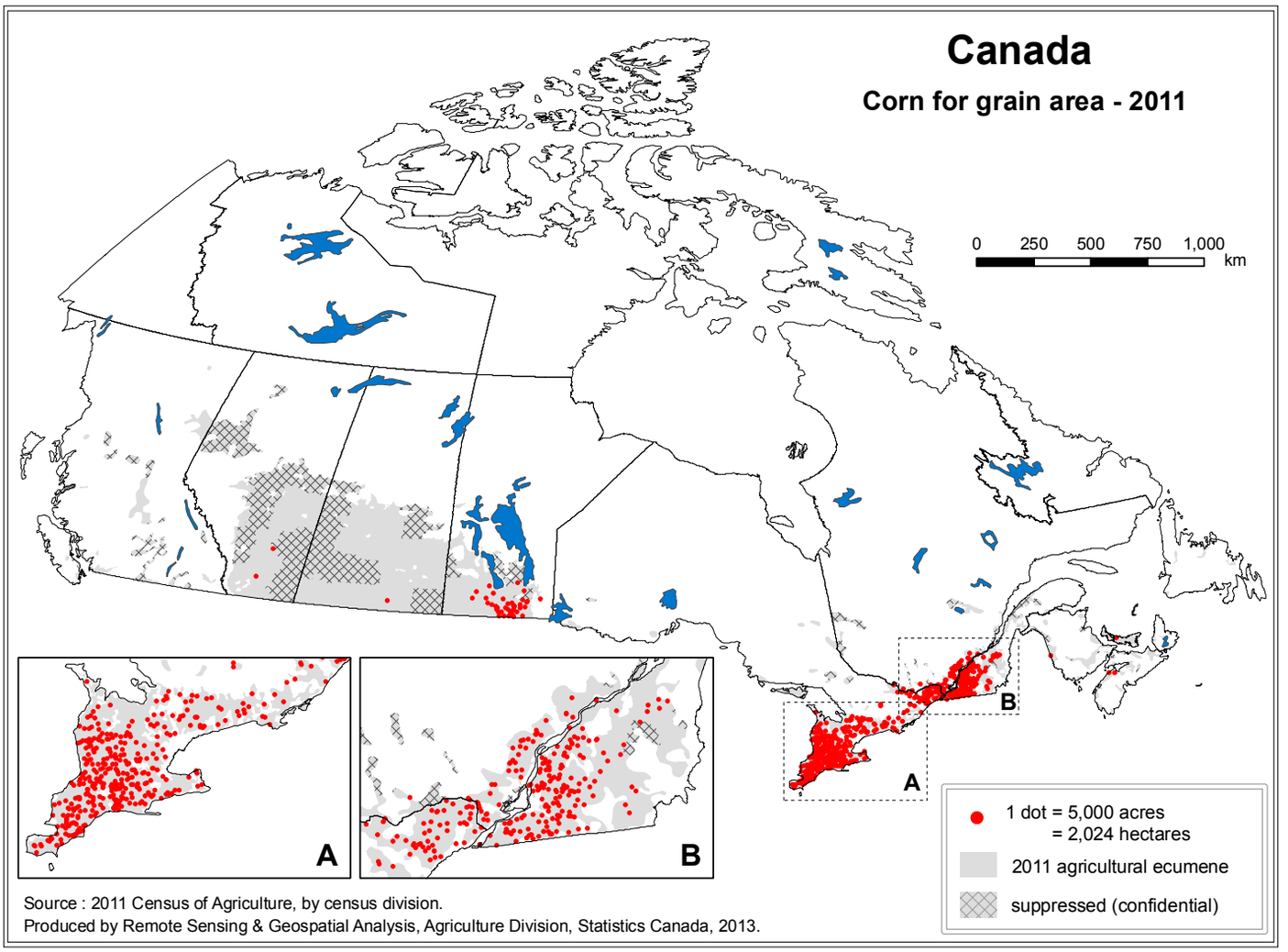


Table 3 shows how corn for grain production changed between 1971 and 2011. At the national level, there were fewer farms reporting corn for grain. However, there were some interesting regional differences. In Ontario, the number of farms reporting corn for grain decreased by almost one-third, while the seeded area increased by 311,272 hectares. The remaining corn for grain farms are producing on a larger scale. The average size per farm more than doubled from 21.3 to 50.8 hectares.

In Quebec, the second largest corn for grain producing province, both the number of farms and the seeded area increased during this period. In 2011, the average corn for grain area per farm was almost five times greater than in 1971. The Quebec average at 65.3 hectares per farm even surpassed Ontario average at 50.8 hectares per farm reporting corn for grain.

In Manitoba, corn for grain acreage increased significantly with the development of earlier maturing varieties which expanded areas suitable for corn production. The largest market for Manitoba corn is livestock feed,

Photo depicts harvested corn for grain.
Photo: Ontario agriculture photo library

followed by processing in the ethanol production plant which opened in 2008. The number of farms reporting corn for grain increased to 713 in 2011 compared to 152 farms in 1971. During the same period, the seeded area jumped by more 20 fold from 3,678 to 85,449 hectares. Average area of 119.8 hectares per farm was almost twice as big as the national average of 56.8 hectares per farm reporting corn for grain (Table 3).

Table 3
Number of farms and seeded area, Canada and selected provinces, 1971 and 2011

	Number of farms		Seeded area		Average area	
Provinces	**1971**	**2011**	**1971**	**2011**	**1971**	**2011**
	number of farms		hectares		hectares per farm	
Canada	28,535	23,472	573,039	1,334,081	20.1	56.8
Quebec	4,139	6,160	55,817	402,441	13.5	65.3
Ontario	24,040	16,184	511,194	822,465	21.3	50.8
Manitoba	152	713	3,678	85,449	24.2	119.8
Other provinces	204	415	2,351	23,726	11.5	57.2

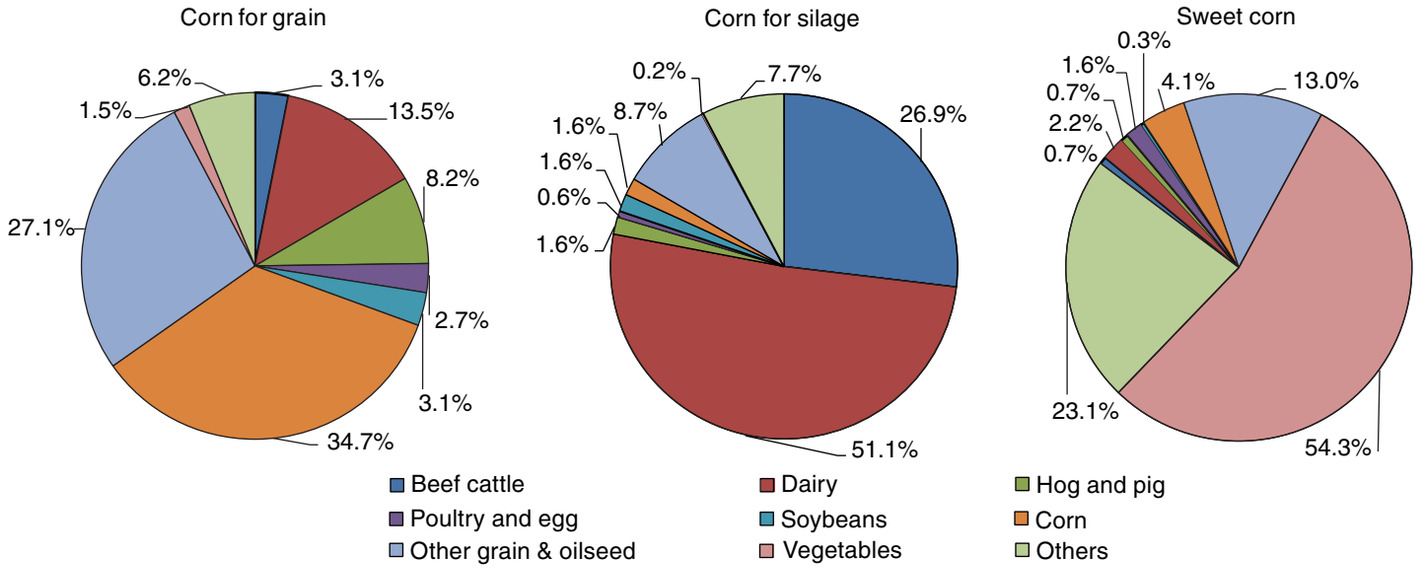
Source: Statistics Canada, Census of Agriculture, 1971 and 2011.

Who's producing corn?

Farms reporting seeded corn were classified using the 2012 North American Industry Classification System. The subsector is determined on the commodity that accounts for 50% or more of the farm production. Chart 3 shows that in 2011 more than one-third of the corn for grain seeded area was on farms specialized in corn production. This was followed closely by other grain and oilseed farms at 27.1% and dairy farms with 13.5% of the corn for grain seeded area.

More than half of the corn for silage was on specialized dairy farms, followed by 26.9% of area on beef cattle farms. Corn for silage is harvested as a whole plant (i.e., the cob, grain, stem and leaves) when still green and is used as feed for ruminant animals such as dairy and beef cattle. As expected, 54.3% of the seeded area of sweet corn was on specialized vegetable farms.

Chart 3
Distribution of seeded corn area by variety and farm type, Canada, 2011

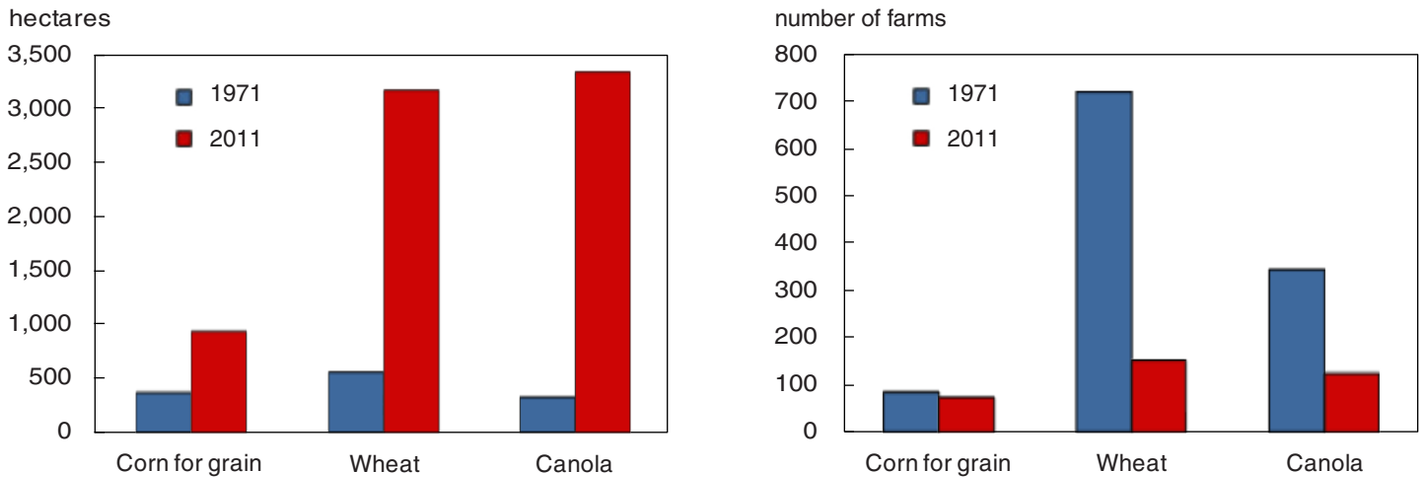


Source: Statistics Canada, Census of Agriculture, 2011.

The structure of the agriculture industry has changed significantly over the last decades. Overall, there are fewer but larger farms contributing to a significant portion of Canadian agriculture production. Corn production was no exception to this trend. The total corn for grain seeded area more than doubled between 1971 and 2011.

The top 5% corn growers also operated on a much larger scale. During this period, their average seeded area almost tripled from 347.2 to 935.0 hectares per farm (Chart 4). Only 2.4% (or 561) of all corn for grain growers were responsible for 20% of all corn seeded area in 2011. For wheat and canola, the proportion of growers responsible for 20% of all seeded area was quite similar with, respectively, 2.4% and 3.0% of all wheat and canola growers. The number of growers responsible for the 5% of all national area declined sharply between 1971 and 2011. The average seeded area of the top 5% wheat producers grew by almost six times, while the top 5% of canola producers increased 10.5 times (Table 4).

Chart 4
Average farm size and number of farms for top 5% of production, Canada, 1971 and 2011



Source: Statistics Canada, Census of Agriculture, 1971 and 2011.

Table 4
Average farm size and number of farms by contribution to total commodity area, Canada, 1971 and 2011

	Corn for grain		Wheat		Canola	
Proportion of national area	**1971**	**2011**	**1971**	**2011**	**1971**	**2011**
			hectares per farm			
Top 5%	347.2	935.9	545.7	3,148.4	316.6	3,318.2
5 to 19%	135.3	408.4	250.3	1,272.4	151.7	1,279.5
Bottom 80%	16.5	46.6	47.6	146.0	37.1	184.2
			number of farms			
Top 5%	82	71	719	147	340	118
5 to 19%	636	490	4,707	1,091	2,132	919
Bottom 80%	27,817	22,911	131,865	50,736	46,451	34,036

Source: Statistics Canada, Census of Agriculture, 1971 and 2011.

How is corn produced?

To obtain good yield, corn requires more nutrient additions from fertilizer, manure, or other soil amendments compared to other crops to prevent soil depletion. Legumes, such as peas, beans, soybeans, clover and alfalfa, are able to “fix” nitrogen from the air and convert it into a form absorbed by the plant. Corn grown as a single crop could increase the risk of soil erosion. Corn grown in a rotation with beans (often soybeans), cereal or hay improves soil fertility and structure, reduces fertilizer application, diminishes the prevalence of weed, and also breaks disease and pest cycles. This section looks at cropping patterns that were the most prevalent in 2011.

According to the 2011 Census of Agriculture, 5.0% of the total corn for grain area was reported by growers who reported corn for grain as their only field crop. The most prevalent cropping pattern[7] was ‘corn for grain-soybeans-wheat’. Almost 20% of all corn for grain seeded area was reported by

7. The assumption was made that if producers reported more than one field crop, they should grow them in a rotation due to all benefits that a rotation can provide.

growers who had these three crops. The second most prevalent cropping pattern was 'corn for grain-soybeans'. Growers who reported these two field crops accounted for 17.9% of all corn for grain area. The third most prevalent cropping pattern was 'corn for grain-hay-soybeans-wheat' reported by growers who seeded 6.2% of all corn for grain area. Overall, 95.0% of all corn for grain and 97.9% of corn for silage seeded area were grown in a rotation with hay or another field crop like a cereal or a legume.

Table 5
Distribution of cropping pattern by corn variety and seeded area, Canada, 2011

Cropping pattern	Seeded area	Share of total seeded area
	hectares	percent
Corn for grain		
Corn for grain as a single crop	66,862	5.0
Corn for grain in a rotation		
Corn-soybeans-wheat	263,836	19.8
Corn-soybeans	239,074	17.9
Corn-hay-soybeans-wheat	83,221	6.2
Corn-wheat-soybeans-other	58,449	4.4
Corn-hay-soybeans	49,127	3.7
Other patterns	573,512	43.0
Corn for silage		
Corn for silage as a single crop	5,839	2.1
Corn for silage in a rotation		
Corn silage-hay	41,309	15.1
Corn grain-hay-soybeans-corn silage	14,804	5.4
Corn grain-hay-corn silage	14,406	5.3
Corn silage-hay-barley	12,056	4.4
Corn silage-hay-oats	8,049	2.9
Other patterns	176,714	64.7

Source: Statistics Canada, Census of Agriculture, 2011.

To be or not to be organic

Organic operations are certified through certifying bodies accredited by the Canadian Food Inspection Agency. According to the new regulations[8], producers can be either "certified organic" or "transitional". Transitional producers are those who were in the process of undertaking the three-year process of having all or part of their operations certified organic at the time of the 2011 Census of Agriculture. In 2011, certified organic operations represented 1.8% of all farms in Canada. The proportion of corn for grain growers was slightly below this national average at 1.1% of all farms reporting corn for grain. They accounted for 0.8% of all corn for grain seeded area (Table 7). The prevalence of genetically modified corn somewhat reduced the likelihood of producers seeking organic certification. In Ontario, the largest corn for grain producing province, 71.3% of the total corn area was seeded with genetically modified corn. In Quebec, 73.8% of corn for grain was genetically modified.[9]

8. In 2009, the Organic Products Regulations came into effect in Canada, which require mandatory certification to revised Canadian Organic Standards in order to claim agricultural products as being organic.
9. Statistics Canada, Field Crop Survey, data available upon request. Genetically modified seed cannot meet standards for organic production.

For sweet corn, 6.5% of farms reported being certified organic. They accounted for 1.7% of sweet corn seeded area. Strong consumer demand has probably driven more sweet corn growers to offer organic products.

Table 6
Distribution corn for grain and sweet corn by conventional and organic certification, Canada, 2011

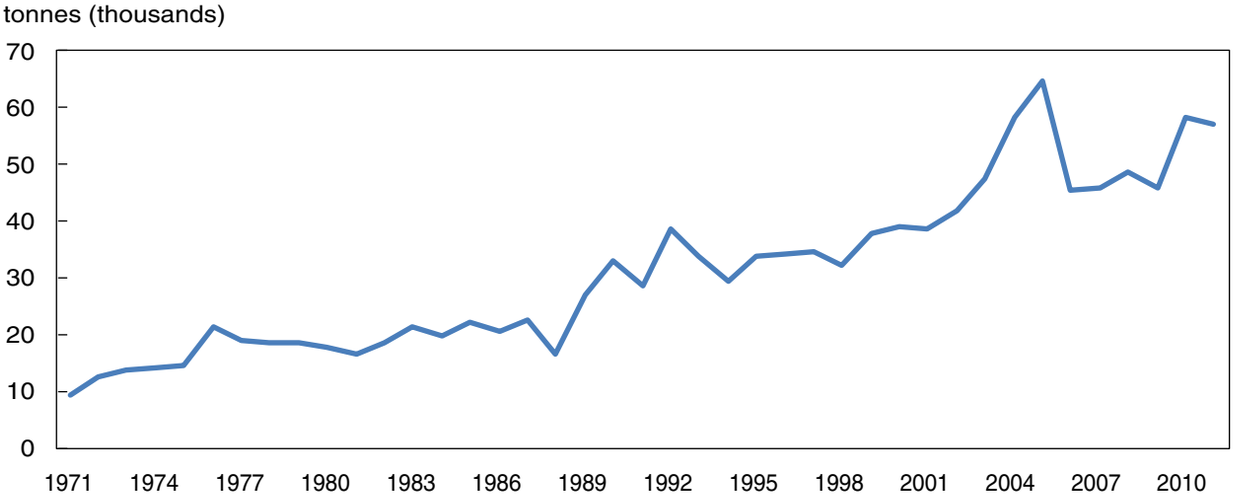
Method of agriculture	Corn for grain		Sweet corn	
	number of farms	hectares	number of farms	hectares
Conventional	23,206	1,323,192	2,803	22,777
Organic[1]	266	10,889	194	396
		percent		
Conventional	98.9	99.2	93.5	98.3
Organic[1]	1.1	0.8	6.5	1.7

1. Includes growers certified by an organic certifying body or in transition to be certified.
Source: Statistics Canada, Census of Agriculture, 2011.

How sweet it is!

A signature dish of summer BBQs is fresh corn on the cob, yet this product was not always the succulent and sweet treat it is today. The gene responsible for high sugar levels can be traced to a genetic mutation in grain corn originating in the U.S. in the mid-1700s. Prior to this, fresh corn was starchier and less sweet. The genetic mutation presented disadvantages, however, since it reduced the storability of corn grain and hindered soil germination in colder regions. But with time, further breeding produced corn varieties with higher sugar levels (i.e., sugar enhanced and super sweet varieties), while also maintaining these sugar levels over time. In addition, growers began to plant sweet corn in black plastic mulch to help it mature earlier, thereby extending the length of the growing season. As a result of these developments, fresh sweet corn evolved from being a localized product – i.e., harvested and consumed in the same day – to one that was transported long distances without spoiling. This evolution would have contributed significantly to increasing imports of fresh sweet corn (Chart 5).

Chart 5
Fresh sweet corn imports, Canada, 1971 to 2011



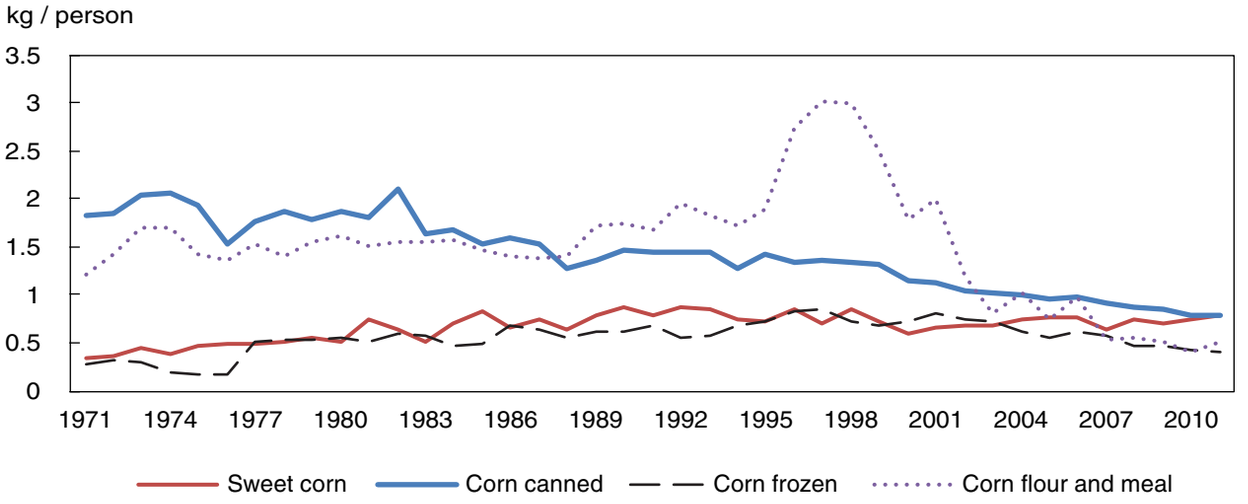
Source: Statistics Canada, CANSIM Table 002-0010.

Sweet corn is not solely consumed as corn on the cob. Since 1971, consumption of fresh corn more than doubled to reach 0.79 kilogram per capita in 2011. During the same period, consumption of canned corn declined from 1.83 kilogram to 0.79 kilogram per capita. Consumption of frozen corn increased from 0.28 kilogram to 0.41 kilogram per person (Chart 7).

Although corn is often enjoyed as sweet corn on the cob, it is an important ingredient in many foods. For instance, on any given day a person might eat a breakfast cereal made of corn flakes, use corn syrup to bake a cake, and enjoy corn bread or corn tortillas with their supper. In 2011, Canadians consumed, on average, 0.52 kg of corn flour and meal (Chart 6). Corn is also consumed indirectly as corn is used to feed livestock, which provide the meat, milk and eggs purchased at grocery stores. Almost half of all domestic consumption went to feed livestock.[10]

10. Statistics Canada, CANSIM table 001-0042.

Chart 6
Average annual consumption of corn in Canada, 1971 to 2011



Source: Statistics Canada, CANSIM table 002-0011.

The future of corn

Corn is one of Canada's traditional crops. It was first grown by First Nations' farmers, then by European settlers, and, today, by farmers across the country. This crop's story continues to unfold. Foremost, corn's productivity has increased significantly with the evolution of agricultural practices, the development of hybrid varieties, and new advancements in the field of biotechnology that transfer a gene from one organism to another (e.g., technologies using recombinant DNA). The versatility of this crop, combined with the breeding advances made by plant scientists, make it a popular commodity for the feed, livestock, and industrial sectors. Thus, the future of corn appears to be sweet, and with ongoing research and development it seems that the sky – or rather, the farm field – is the limit.

Corn: A jack of all trades

Corn grain is used as human food, animal feed, and feedstock for industrial products. Different processing methods produce the variety of corn products available. For instance,

- Whole corn grains intended for livestock feed are ground or 'cracked.'
- In contrast, corn destined for human consumption is progressively ground into a fine powder to make corn grits, hominy, corn meal and corn flour.
- Masa, the corn flour used for tortillas, is produced when whole corn kernels are cooked in an alkali water solution to render the corn more nutritious. The process converts the protein niacin into a form that can be absorbed by the body and avoids beriberi disease, a condition that afflicted early Western settlers to the Americas.

While some products are made from the whole corn kernel, other products use only one component of the whole grain illustrated in the following table. Specifically, the kernel can be broken down into four components: bran, gluten, starch, and germ. Through specialized processing, the kernel's individual parts can be separated and used in different commodities. Flaked corn cereal, for example, is produced by putting the high starch cap of the corn kernel through rollers which flatten and stretch it, after which point it is toasted.

Component fractions of a kernel of corn

Components of kernel	Proportion of the grain (varies according to variety)
Starch	72 to 73
Protein	8 to 11
Oil and fatty acids	3 to 18
Plant fibre	8 to 14

Source: Food and Agriculture Organization of the United Nations, 2008.

Corn starch, the component that comprises the bulk of the kernel, is used for both human consumption and industrial purposes including as a thickening, gelling, and binding agent for a variety of products, including puddings and pie fillings, wallpaper paste, aspirin, chalk, drywall panelling, and biodegradable plastics.

It can be used to produce a range of sweeteners including corn syrup (or glucose) as a substitute for white sugar produced from sugar cane or sugar beets. The syrup is found in a variety of foods because it holds moisture, prevents crystallization, adds texture, and can serve as a thickener in food products. Its ability to hold moisture prevents breads, bakery products, and confections such as marshmallows from becoming stale and it also can be found in lollipops and hard candies and frozen desserts.

Corn is also used to produce vegetable oil—specifically, corn oil—and can be further transformed into margarine and other food oils. The oil originates from the germ portion of the corn kernel. Gluten is the main protein in corn and can be transformed into a product that is used in the feed of beef and dairy cattle, poultry and hogs.