Chapter 11: Varieties
Varietal Development in Canada

Three major breeding programs develop flax varieties for Canada: the Agriculture and Agri-Food Canada (AAFC) program located at the Cereal Research Centre in Morden, Manitoba; the Crop Development Centre (CDC) program located at the University of Saskatchewan in Saskatoon, Saskatchewan; and the Saskatoon R and D facility of Crop Production Services Canada Inc. (CPS). Another breeding program targeting flax for crop diversification in Québec is active at CÉROM (Centre de recherche sur les grains), located in Saint-Mathieu-de-Beloeil. Some seed companies are also introducing cultivars from other countries.

Disease resistance to rust and wilt has been emphasized by all of these programs in order to manage disease effectively. Thus, all registered flax varieties are resistant to rust and must have moderate resistance to fusarium wilt. Breeding for disease resistance has been effective as the last outbreak of rust occurred in 1973.

Currently, flax varieties registered in Canada can be either brown or yellow seeded with high levels of alpha-linolenic fatty acid (ALA). Current Canadian linseed varieties have an oil content ranging between 45% and 50%, reported on a moisture-free basis. Linseed oil is composed of five main fatty acids: palmitic, stearic, oleic, linoleic, and linolenic (ALA). Linseed's high proportion of ALA (>50%) provides drying properties desired for the fabrication of paints, varnishes, and linoleum flooring coverings. Similarly, flax straw, in a partially or completely processed form, is used in the manufacture of fine papers. More recently, there is renewed interest for the use of straw fibre for industrial fibre products such as pulp sweeteners, geotextiles, insulation and plastic composites.

Flax baked goods are increasingly in demand as functional or health-promoting foods.

In addition to these industrial uses, new feed and food markets underpin market stability and fuel growth. **In 2014, flax was approved by Health Canada for a health claim linking eating ground whole flaxseed to lowered blood cholesterol levels, a major risk factor for heart disease.** The claim is only one of eleven approved in Canada. The omega-3 (ALA), fibre and antioxidants in flax are nutrients that keep us healthy. Seen as a health-promoting ingredient, premium quality flax is rapidly being absorbed into the expanding functional food markets. The consumer market for whole and milled flax seed and flax oil is also expanding. For more information on flax as a healthy food choice, check out 'healthyflax.org' website or the Flax Council of Canada website.

A high ALA content (68%) variety called VT 50 has been registered in Canada by CPS (www.cpsagu.ca). The trademark for the high ALA flax varieties is NuLin®. This high ALA oil may result in further food, feed and industrial market opportunities.

Flax in animal feeds could be an important contributor to animal performance and health. Omega-3 eggs have become a popular consumer choice. In the pork and beef industries, flax use in hog rations and cattle is being investigated for improved production. Meanwhile, flax processors have seen growth in the use of flax by pet food manufacturers. Flax in pet food formulations has been promoted as solving digestive and skin problems in dogs and cats.

In order to meet the fatty acid composition profile of the margarine industry, mutation breeding efforts led to development of varieties with major reductions in ALA levels (~3%). These flax varieties were known as Linola™ or solin. The fatty acid composition of solin oil is similar to other premium polyunsaturated oils, such as sunflower oil. Oils from such varieties have higher

solidification temperatures that are suitable for the margarine industry. Unfortunately, the market niches for these specialty linseed varieties remain underdeveloped. As a consequence, solin varieties are no longer registered for production in Canada. The yellow seed coat trait was previously used as a phenotypic (grade) marker for solin. As commercial production of solin has ceased in Canada, the yellow seed coat has been decoupled from solin. Currently, yellow seed coat flax lines with traditional high ALA contents are being developed and commercialized in Canada.

AGRICULTURE AND AGRI-FOOD CANADA PROGRAM

Since the early 1900s, Agriculture and Agri-Food Canada and its predecessors have been active in developing new flax varieties for Canada and, in particular, for the Canadian Prairies. The initial program was located at the Central Experimental Farm in Ottawa and produced varieties such as Diadem, Ottawa 770B, Ottawa 829C, and Novelty. During the 1950s, this program was particularly active, releasing varieties such as Linott, Raja, and Rocket. The 1950s and 1960s also marked the beginning of an evolution and transition in flax breeding in Canada. A new program was initiated at the Indian Head Experimental Farm and the Winnipeg Cereal Breeding Laboratory. This led to the development of the variety, Cree. In parallel, a breeding program was established in the 1960s at the Fort Vermilion Experimental Farm and Beaverlodge Research Station, Alberta. This resulted in the variety Noralta, which was the predominant variety grown in northern Alberta and northern Saskatchewan. The AAFC breeding programs were eventually consolidated and moved to Winnipeg in 1960 and then later to Morden, Manitoba. Varieties from the AAFC program and released by the Morden Research Centre include Dufferin, McGregor, NorLin, NorMan, AC Linora, AC McDuff, AC Emerson, AC Carnduff, AC Lightning, Hanley, and Macbeth. Recent varieties released from the AAFC breeding program include AAC Bravo, Prairie Blue, Prairie Grande, Prairie Sapphire, Prairie Thunder and Shape.

Flax oil capsules are sold in health food markets.

The focus of the breeding effort at Morden has been to develop improved flax cultivars for the Prairies. Consequently, most of the cultivars developed have wide adaptation to Prairie conditions. The breeding program is now devoting its attention to the development of new cultivars with increased yield potential, decreased time to maturity, better lodging resistance, improved disease resistance, increased seed oil content and increased ALA content.

CROP DEVELOPMENT CENTRE (CDC) PROGRAM

The CDC flax breeding program develops cultivars for Western Canadian growers. A modest breeding program was carried out at the University of Saskatchewan from the 1920s through the 1960s, which produced the varieties Royal and Redwood 65. The program was enlarged in 1974 when the CDC initiated a flax breeding program that has produced 12 registered varieties. Commercially available cultivars include Vimy, CDC Bethune, and CDC Sorrel and more recently, CDC Sanctuary, CDC Glas and CDC Neela.

The main goal of the CDC flax breeding and genetics program is to increase the area of adaptation that flax can be grown successfully. It is also working to provide better genetics for improved agronomic performance and seed quality for the industrial, human health, and animal nutrition markets. The research program is striving to better understand the genetics of traits of economic importance in flax. The reduction in flax breeding activities announced by other organizations, including AAFC and CPS Canada, have made the CDC flax breeding efforts critical for the broader flax industry.

CROP PRODUCTION SERVICES (CPS) PROGRAM

In 1987, a flax breeding program was initiated by Biotechnica Canada in cooperation with Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) to develop solin (low ALA flax). These varieties were trademarked as Linola™. In 1990, United Grain Growers Ltd. (UGG) purchased Biotechnica's interest in the program and moved the program from Calgary, Alberta to the AAFC Morden Research Centre. Field evaluation was conducted by the UGG Rosebank Research Farm. The solin breeding program produced the following cultivars: Linola™ 947, 989, 1084, 2047, 2090, 2126, and 2149.

Following the acquisition of Agricore Cooperative Limited by UGG in 2006, the program was relocated to the Alberta Research Council/Alberta Innovates Technology Futures (ARC/AITF) Research Centre in Vegreville. Shortly thereafter, the Linola™ breeding program was shelved and a NuLin® (high ALA) program was established. This program was transferred to Viterra when the Saskatchewan Wheat Pool merged with Agricore United in 2007. After a few years, the program started developing brown and yellow seeded flax varieties with traditional levels of ALA. In 2011, the program relocated to the Viterra Research and Development facility in Saskatoon, Saskatchewan. CPS acquired the Viterra breeding program in late 2013. Varieties released from the recent program include NuLin™ VT 50, WestLin 70, WestLin 71 and WestLin 72.

The current program is focused on developing high yielding, earlier maturing, lodging resistant, enhanced quality yellow and brown seeded flax varieties adapted to Western Canada. Since 2010, CPS has worked on the Northern Adapted Flax Variety Development Project (NAFVDP) with the Saskatchewan Flax Development Commission, ARC/AITF, the British Columbia Grain Producers Association (BCGPA), Manitoba Agriculture, Food and Rural Development/Parkland Crop Diversification Foundation (MAFRD/PCDF) and AAFC. The NAFVDP is focused on developing flax varieties adapted to northern/shorter growing seasons and to develop best agronomic practices for these varieties.

CÉROM, CENTRE DE RECHERCHE SUR LES GRAINS

In 2000, a small breeding program was initiated in Québec with the intent of providing oilseed flax as an additional crop for Québec growers. Though flax was first introduced in Canada by the French settlers in the 1600s, this crop is no longer a major crop in Québec. However, flax may be a valuable crop rotation alternative, especially in more northern regions such as the lower Gaspé peninsula.

The initial germplasm for the program was sourced from the Crop Development Centre in Saskatoon, Saskatchewan and has been enriched by several sources of exotic germplasm from various countries. Both brown and yellow flax varieties are being developed. The focus is on adaptation to Eastern Canada, high yield, lodging resistance and enhanced quality. No varieties have been released yet, however, the program has reached maturity and several cultivars should be released soon.

Characteristics of Flax Varieties

The characteristics of current flax varieties registered for production in Canada are described in Table 11-1. Varietal yield performance is presented in Table 11-2. For more information on variety performance and suitability of varieties to your local area, refer to the Saskatchewan Seed Guide, Seed Manitoba, Alberta Seed Guide, Varieties of Grain Crops, your local retailer/agronomist or seed company.

Table 11-1. Characteristics of Flax Varieties

Variety[1] (Year of Registration)	Seed Colour[2]	Maturity[3]	Resistance to Lodging[4]	Seed Size[5]	Oil Content[6]	Oil Quality[7]		to[10]	
						Iodine Value[8]	ALA Content[9]	Wilt	Powdery Mildew
AAC Bravo (2012)	B	L	G	L	46.8	196.0	60.9	MR	MR
CDC Bethune (1998)	B	L	G	M	45.6	187.6	54.2	MR	MR
CDC Glas (2012)	B	L	VG	M	47.4	196.0	58.4	MR	MR
CDC Neela (2013)	B	L	G	M	46.5	198.3	60.7	MR	MR
CDC Plava (2015)	B	M	G	M	47.0	195.8	57.8	MR	–
CDC Sanctuary (2009)	B	L	F	M	45.3	188.2	56.2	MR	–
CDC Sorrel (2005)	B	L	G	L	44.2	195.0	58.8	MR	–
VT 50 (2009)	Y	L	G	M	48.8	210.3	67.8	MR	–
Prairie Blue (2003)	B	L	VG	S	45.9	191.0	56.8	MR	MR
Prairie Grande (2007)	B	M	VG	M	45.2	194.9	58.4	MR	MR
Prairie Sapphire (2009)	B	L	G	M	49.0	194.3	57.8	MR	MR
Prairie Thunder (2006)	B	M	VG	M	44.4	196.5	58.9	MR	R
Omega (interim 2015-17)	Y	L	F	M	44.3	184.7	51.8	MR	MR
Shape (2008)	B	L	G	L	50.2	196.8	59.1	MR	MR
WestLin 70 (2013)	B	L	G	L	46.8	198.4	60.8	MR	MR
WestLin 71 (2013)	B	L	VG	M	47.4	199.2	61.2	MR	MS
WestLin 72 (2014)	B	L	G	M	47.0	192.4	56.8	MR	MR

Based on data from Flax Cooperative Tests in the Prairie Provinces.

[1] Number in brackets refers to year registered.

[2] B = Brown; Y = Yellow

[3] E = Early; M = Medium; L = Late

[4] VG = Very Good; G = Good; F = Fair; P = Poor

[5] S = Small; M = Medium; L = Large

[6] Oil Content: Results are reported as percent, calculated to a moisture-free basis.

[7] Oil quality of flax is based on the amount of linolenic acid measure in the seed or as measured by iodine value calculated from the fatty acid composition of the seed. A higher iodine value and/or higher ALA content indicate a higher overall oil quality in the seed.

[8] Iodine value: Iodine number is calculated from the fatty acid composition

[9] ALA (alpha-linolenic acid): Percent of total fatty acid composition

[10] S = Susceptible; MS = Moderately Susceptible; MR = Moderately Resistant; R = Resistant

Table 11-2. Relative Yield of Flax Varieties

Variety[1] (Year of Registration)	Soil Zone[2]		
	Black & Grey (long growing season)	Brown & Dark Brown	Black and Grey (shorter growing season)
CDC Bethune (1998)	100	100	100
AAC Bravo (2012)	105 (12)	96(12)	99(12)
CDC Glas (2012)	102 (7)	98(6)	103 (8)
CDC Neela (2013)	109 (6)	105 (7)	105 (7)
CDC Plava (2015)	–	–	106 (12)
CDC Sanctuary (2009)	98 (14)	105 (12)	93 (11)
CDC Sorrel (2005)	99 (13)	102 (10)	101 (9)
VT50 (2009)	102 (13)	101 (7)	–
Omega (interim 2015-17)	83 (6)	96 (4)	83 (1)
Prairie Blue (2003)	–	–	–
Prairie Grande (2007)	93 (13)	93 (10)	97 (12)
Prairie Sapphire (2009)	97 (14)	95 (11)	93 (11)
Prairie Thunder (2006)	102 (13)	98 (10)	98 (9)
Shape (2008)	96 (12)	91 (10)	93 (12)
WestLin 70 (2013)	97 (6)	94 (7)	99 (7)
WestLin 71 (2013)	94 (4)	100 (8)	95 (5)
WestLin 72 (2014)	113 (5)	106 (6)	103 (4)

Based on data from Flax Cooperative Tests in the Prairie Provinces

[1] Number in brackets refers to year registered.

[2] Number in brackets is the site years in Cooperative trials in the Prairie Provinces available for comparison with the check variety, CDC Bethune. The more site-years used, the more dependable the result. The check CDC Bethune is present in all site-years. Yield of varieties is expressed relative to CDC Bethune for the same number of site years. Because the number of site-years varies with varieties, yield performance of a variety can only be compared to CDC Bethune and not to other varieties.