

Determining Agronomic Suitability of European Flax (linseed) Cultivars in Manitoba

Project Duration: 2018-2019

Objectives

The current study was developed to examine agronomic attributes (yield, height, maturity) of European-origin flaxseed cultivars and to see if they have a competitive advantage and agro-climatic fit within Manitoba flax production areas.

Collaborators

Manitoba Flax Growers Association (MFGA), Parkland Crop Diversification Foundation (PCDF), Prairies East Sustainable Agriculture Initiative (PESAI), Westman Agricultural Diversification Organization (WADO), Crop Development Centre (CDC), BASF (financial support) and varietal sponsors Limagrain Nederland and van de Bilt saden en vlas.

Background

With the declining popularity of flax as a rotational crop choice in Manitoba, farmers need incentive to grow alternative crops. A longstanding complaint is that current flax cultivars are not keeping up with yield advances, similar to gains made in canola, soybeans and to a lesser extent, cereals. This disparity is what encourages a switch away from flax and into higher-yielding, more profitable crops.

Flax does have an important role to fill in Manitoba. As a non-host crop for many of the major diseases in western Canada, flax is well suited to break disease cycles and provide a stable, steady return as part of a balanced rotation. With the closure of breeding programs at Nutrien Ag Solutions and Agriculture and Agri-Food Canada (AAFC), only a single flax breeder remains in Canada at the Crop Development Centre (CDC) in Saskatoon, Saskatchewan. With the introduction and evaluation of European lines, a higher yielding cultivar, or a cultivar with more desirable quality characteristics may be found to be well suited to Manitoba's agro-climate.

Materials & Methods

Experimental Design – Randomized Complete Block Design

Locations – Arborg (PESAI), Melita (WADO), and Roblin (PCDF)

Treatments – Seven flax cultivars (planted at seeding rate of 40 lbs/acre)

Varieties – Batsman, Biltstar, CDC Bethune, LG Aquarius, LG Lion, OVB 0815-02, OVB 1001-01

Recommended fertility and weed control practices were followed.

Data collected – yield, plant height at maturity, days to maturity, flowering period

Agronomic information

Stubble, soil type : Arborg – fallow, heavy clay soil; Melita – wheat/oats/sunflowers, Waskada loam; Roblin – oat/barley silage, Erickson clay loam

Table 1: Applied Treatment List

			Fertility (lb/acre)					
Location	Plot Size	Seeding Date	Available	Applied	Herbicides	Spray Date	Desiccation Date	Harvest Date
Arborg	9.12m ²	15-May	104 N 30 P 680 K	50 N 20 P	Curtail M @ 0.8L/acre Centurion @ 0.075L/acre Reglone @ 0.7L/acre	10-Jun	06-Sep	16-Sep
Melita	12.96m ₂	06-May	81 N 10 P 192 K	108 N 35 P 20 K	Select @ 0.120L/acre Basagran Forté @ 0.91L/acre	10-Jun 18-Jun	--	29-Aug
Roblin	5.98m ²	21-May	57 N 26 P 450 K	63 N 12 P	(PRE) Glyphosate @ 0.64L/acre + Authority @ 0.18L/acre Assure II @ 0.3L/acre + Basagran Forté @ 0.9L/acre Reglone @ 1L/acre	24-May 10-Jun	17-Sep	24-Sep

Results

Yield - Yield differences were significant between European-origin lines and the Canadian-origin check, CDC Bethune, at only Melita (2018) and Roblin (2019) sites. At Melita in 2018, two European lines produced less yield than CDC Bethune while at Roblin in 2019, CDC Bethune also yielded significantly more than four of the six European lines (Tables 2 & 3). LG Lion and LG Aquarius were the only European lines to show significant yields similar to CDC Bethune at Melita in 2018 and Roblin in 2019.

Plant height - All three sites reported significant differences in plant height in 2018, with most lines being significantly shorter than CDC Bethune. However, the number of cultivars statistically differing from the check varied from site to site and year to year (Table 4). Roblin reported significant height differences in 2019, where CDC Bethune was statistically taller than all European-origin cultivars.

Days to Maturity & flowering - The number of days for flax to reach physiological maturity (75% bolls brown and rattling) at Arborg was similar in both 2018 and 2019. Melita and Roblin experienced a greater number of days required to reach the same flax maturity levels in 2019 than 2018, which may have been a factor of rainfall and environmental differences (Table 5). Length of flowering period rose in 2019 over 2018 (Table 6).

Table 2. Performance of different flax lines in European flaxseed test during 2018.

2018 Yield							
VARIETY	Arborg		Melita			Roblin	
	kg/ha	bu/ac	kg/ha	bu/ac		kg/ha	bu/ac
CDC Bethune	1675.00	26.6	2226.67	35.4	<i>ab</i>	2057.00	32.7
OVb 1001-01	1673.67	26.6	2168.67	34.5	<i>ab</i>	1959.00	31.1
LG Lion	1717.00	27.3	2313.67	36.8	<i>a</i>	1598.33	25.4
Batsman	1559.67	24.8	1973.00	31.4	<i>cd</i>	1669.67	26.5
LG Aquarius	1357.67	21.6	2156.33	34.3	<i>b</i>	1518.00	24.1
OVb 0815-02	1361.67	21.7	2116.33	33.6	<i>bc</i>	1564.67	24.9
Biltstar	1447.33	23.0	1840.00	29.3	<i>d</i>	1608.33	25.6
GRAND MEAN	1541.72	24.5	2113.52	33.6		1710.71	27.2
CV %	9.1		3.7			14.8	
LSD	-	-	140.80	2.2		-	-
Sign Diff	No		Yes			No	

Means contain the same letter are not statistically different at $P < 0.05$.

Table 3. Performance of different flax lines in European flaxseed test during 2019.

VARIETY	2019 Yield						
	Arborg		Melita		Roblin		
	kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac	
CDC Bethune	2119.00	33.7	2719.00	43.2	3616.00	57.5	<i>a</i>
OVB 1001-01	1885.00	30.0	2798.00	44.5	3166.00	50.3	<i>bcd</i>
LG Lion	1960.00	31.2	2704.00	43.0	3464.00	55.1	<i>ab</i>
Batsman	1933.00	30.7	2848.00	45.3	3071.00	48.8	<i>cde</i>
LG Aquarius	1833.00	29.1	2849.00	45.3	3302.00	52.5	<i>abc</i>
OVB 0815-02	1913.00	30.4	2738.00	43.5	2689.00	42.8	<i>ef</i>
Biltstar	1844.00	29.3	2758.00	43.9	2792.00	44.4	<i>def</i>
GRAND MEAN	1926.71	30.6	2773.43	44.1	3157.14	50.2	
CV%	7.3		6.0		7.0		
LSD	-	-	-	-	395.40	6.3	
Sign Diff	No		No		Yes		

Means contain the same letter are not statistically different at $P < 0.05$.

Table 4. Plant height (cm) comparisons among different flax lines during 2018 & 2019 testing.

VARIETY	Arborg18		Arborg19		Melita18		Melita19		Roblin18		Roblin19	
CDC Bethune	44.0	<i>a</i>	44.0		62.0	<i>a</i>	57.0		55.3	<i>a</i>	64.0	<i>a</i>
OVB 1001-01	36.0	<i>cd</i>	37.0		51.7	<i>b</i>	59.0		55.7	<i>a</i>	56.0	<i>b</i>
LG Lion	38.0	<i>bcd</i>	40.0		51.7	<i>b</i>	53.0		46.0	<i>b</i>	44.0	<i>c</i>
Batsman	40.0	<i>abc</i>	37.0		53.3	<i>b</i>	58.0		48.0	<i>b</i>	50.0	<i>bc</i>
LG Aquarius	37.0	<i>bcd</i>	38.0		49.3	<i>bc</i>	57.0		45.7	<i>b</i>	48.0	<i>c</i>
OVB 0815-02	36.3	<i>cd</i>	35.0		50.0	<i>bc</i>	54.0		46.3	<i>b</i>	48.0	<i>c</i>
Biltstar	41.7	<i>ab</i>	39.0		46.0	<i>c</i>	49.0		45.3	<i>b</i>	49.0	<i>c</i>
GRAND MEAN	39.0		38.5		52.0		55.3		48.9		51.1	
CV %	6.8				5.9				7.4		7.3	
LSD	4.7				5.5				6.4		6.7	
Sign Diff	Yes		No		Yes		No		Yes		Yes	

Means contain the same letter are not statistically different at $P < 0.05$.

Table 5. Days to physiological maturity during 2018 & 2019 testing.

Variety	Arborg18	Arborg19	Melita18	Melita19	Roblin18	Roblin19	Average18	Average19
CDC Bethune	95	92	84	92	82	84	87	89
OVB 1001-01	98	91	86	96	81	105	88	98
LG Lion	94	92	85	93	79	106	86	97
Batsman	91	90	84	95	77	101	84	95
LG Aquarius	90	91	83	98	74	102	82	97
OVB 0815-02	91	90	84	99	79	104	85	98
Biltstar	91	92	84	100	76	119	84	104

Table 6. Length of flowering period (in days) during 2018 & 2019.

Variety	Arborg18	Arborg19	Melita18	Roblin18	Roblin19	Average18	Average19
CDC Bethune	29	37	22	11	32	21	34
OVB 1001-01	31	39	25	11	34	22	37
LG Lion	20	37	15	10	29	15	33
Batsman	13	39	22	11	33	15	36
LG Aquarius	16	39	17	11	39	15	39
OVB 0815-02	16	39	22	12	34	17	36
Biltstar	16	39	12	13	33	14	36

No data from Melita during 2019.

Table 7. Precipitation and Growing Degree Day Seasonal Summary for 2018.

ENVIRONMENTAL VARIABLE	2018 Growing Season Summary					
	Arborg		Melita		Roblin	
	Actual	Normal	Actual	Normal	Actual	Normal
Seeding Date to Harvest Date						
Precipitation (mm)	217	270	164	256	431	279
Growing Degree Days (base 0°C)	1543	1408	1706	1529	1331	1314
Seeding Date	22-May		07-May		22-May	
Desiccation Date	06-Sep		09-Aug		14-Sep	
Harvest Date	20-Sep		14-Aug		11-Oct	

Table 8. Precipitation and Growing Degree Day Seasonal Summary for 2019.

ENVIRONMENTAL VARIABLE	2019 Growing Season Summary					
	Arborg		Melita		Roblin	
	Actual	Normal	Actual	Normal	Actual	Normal
Seeding Date to Harvest Date						
Precipitation (mm)	154	274	272	284	229	262
Growing Degree Days (base 0°C)	1373	1430	1331	1382	1283	1292
Seeding Date	16-May		06-May		21-May	
Desiccation Date	06-Sep		-		17-Sep	
Harvest Date	16-Sep		29-Aug		24-Sep	

Table 9. 2018 European flaxseed quality analysis by fatty acid content and iodine value.

Omega level / Fatty Acid (%)	Ω -9		Ω -6		Ω -3		Ω -9	Iodine Value
	Palmitic	Stearic	Oleic	Linoleic	α -Linolenic	Eicosenoic		
	C16:0	C18:0	C18:1	C18:2	C18:3	C20:1		
VARIETY								
CDC Bethune	6.00	3.8	18.75	17.5	53.94	0.0		187.57
OVB 1001-01	5.55	5.0	21.17	23.3	44.94	0.1		176.09
LG Lion	6.08	4.1	18.65	14.0	57.15	0.0		189.73
Batsman	6.39	4.2	18.50	14.4	56.39	0.1		188.35
LG Aquarius	5.82	3.8	18.21	15.6	56.53	0.0		190.53
OVB 0815-02	6.59	5.0	18.19	13.9	56.22	0.1		186.71
Biltstar	5.50	5.1	17.52	15.3	56.52	0.1		189.31
GRAND MEAN	5.99	4.4	18.71	16.3	54.53	0.0		186.90

Quality - Shannon Froese at the CDC, Saskatoon, conducted flaxseed quality analysis for the 2018 crop. Results are shown in Table 9. Higher iodine values are preferred by the industrial use buyers of flaxseed.

Project Findings

Dry and drought-like conditions at the test sites contributed to overall lower yields particularly at Arborg site, as evidenced by low commercial yield across the province according to Manitoba Agricultural Insurance Corporation (MASC). Provincial average yields were 26 and 20 bu/acre in 2018 and 2019, respectively, compared to the 10-year average of 22 bu/acre. Rainfall distribution and time of arrival played an important role in crop development, affecting plant height and yield across the three test locations (Tables 2 & 3).

Short-stature flax was a result of continued moisture stress, along with overall thinner than ideal stands and the opportunity for weed competition. European flax lines were consistently shorter when compared to CDC Bethune, ranging from 4 to 10 centimeters shorter than check in both years.

Overall days to maturity (DTM) were +1 to -5 days from the 87 DTM CDC Bethune rating in 2018 (Table 5), while in 2019 all European lines took 6 to 9 days longer than the check. Correspondingly, flowering period in European flax cultivars was +1 to -7 days in variance from the average 21 days of CDC Bethune in 2018 (Table 6). In 2019, flowering period lengthened overall and European cultivars ranged from +4 to -1 days against a check variety flowering length of 34 days.