2014 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Current and Upcoming Flax Varieties

(Project #20130374)

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Project Identification

1. **Project Title:** Relative performance of current and upcoming flax varieties
2. **Project Number:** 20130374
3. **Producer Group Sponsoring the Project:** Saskatchewan Flax Development Commission (SaskFlax)
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates (month & year):** April 2014 to February 2015
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The project objective was to demonstrate the relative performance of current flax varieties in addition to some of those that will be commercially available to producers in the next few years.

8. **Project Rationale:**

Currently, more than 30 flax varieties are registered for use in western Canada and, while flax has not seen the same level of private investment towards breeding as canola, progress has been made and new varieties are being released each year. Some of this material includes early maturing varieties that are suited to regions outside of the traditional flax growing areas of southeast Saskatchewan and western Manitoba. Many current and potential f lax growers are not aware of all of the varieties which are available and the proposed demonstration will provide them with an opportunity to compare varieties in a no-till, large plot field environment, and discuss the pros and cons of each with industry experts. It will also provide information and confidence of seed for farmers who were impacted by the Triffid event. Breeding programs remain interested and invested in the crop and allow for dialogue between breeders and producers.

Methodology and Results

9. Methodology:

Field trials were completed in 2013 and 2014 by the Indian Head Agricultural Research Foundation (IHARF) on behalf of the Saskatchewan Flax Development Commission. The trials were located near Indian Head, Saskatchewan (R.M. #156) on an Indian Head Heavy Clay (Rego thin Black Chernozem) soil. The focus of the trial was to demonstrate the field performance of several current and upcoming flax varieties. Ten varieties were evaluated in 2013 and fourteen were evaluated in 2014. The treatments were arranged in a RCBD with four replicates. The varieties which were included in the demonstration were contributed by the Crop Development Centre, Agriculture and Agri-Food Canada and Crop Production Services (Table 1).

Table 1. Flax varieties evaluated at Indian Head in 2013 and 2014.

Variety	2013	2014
Bethune (CDC)	×	×
Sorrel (CDC)		×
Glas (CDC)		×
Sanctuary (CDC)		×
Neela (CDC)		×
FP 2385 (CDC)		×
Flanders (CDC)	×	
ACC Bravo (AC)		×
Prairie Sapphire (AC)		×
Prairie Thunder (AC)	×	×
Nugget (AC)	×	
Norlin (AC)	×	
Nulin 50 (CPS)	×	×
Westlin 70 (CPS)	×	×
Westlin 71 (CPS)	×	×
FP 2376 (CPS)		×
FP 2388 (CPS)	×	×
FP 2390 (CPS)	×	

All varieties were seeded directly into spring wheat stubble using a SeedMaster plot drill equipped with 8 openers spaced 30 cm apart and a trimmed plot length of 10.5 m. The seeding rate used in both years was 50 kg ha^{-1} and urea, monoammonium phosphate, potassium chloride and ammonium sulphate were side-banded at seeding to ensure that nutrient availability was not a limiting factor. Weeds were controlled using registered pre-emergent and in-crop herbicide applications which were selected to control the specific weeds encountered on the site. Plant densities were estimated by counting the number plants in 2 x 1 m sections of crop row. No lodging was observed at any point during the growing season, therefore lodging data are not presented. Days to maturity were estimated by

recording the Julian date when approximately 75% of the bolls had turned brown and are expressed as days from planting. In 2014, preharvest glyphosate was applied to terminate wild oats in the plots and to assist with crop dry down but was not required in 2013. Each plot was straight-combined using a Wintersteiger plot combine and all harvest samples were cleaned and weighed with yields expressed in kg ha^{-1} corrected to 10% seed moisture content. Selected agronomic information and dates of field operations are provided in Table 2. All response data were analysed using the GLM procedure of SAS and Tukey's studentized range test to detect individual treatment differences. Treatment effects and differences between means were considered significant at $P \leq 0.05$. Growing season weather data were monitored and recorded using the an Environment Canada weather station located within approximately 1.75 km southwest of the site.

Table 2. Selected agronomic information for flax variety demonstrations at Indian Head (2013-14).

Description	**2013**	**2014**
Previous Crop	Spring Wheat	Spring Wheat
Pre-Emergent Herbicide	May 17 590 g glyphosate ha^{-1}	May 18 890 g glyphosate ha^{-1} + 140 g sulfentrazone ha^{-1}
Seeding Date	May 11	May 17
Fertility (kg N-P_2O_5-K_2O-S ha^{-1})	90-30-15-15	90-22-11-11
Plant Density	May 29	June 13
In-Crop Herbicide 1	June 12 40 g tepraloxydim ha^{-1}	July 7 99 g clopyralid ha^{-1} + 553 g MCPA ester ha^{-1} + 211 g sethoxydim ha^{-1}
In-Crop Herbicide 2	June 24 280 g bromoxynil ha^{-1} + 280 g MCPA ester ha^{-1}	n/a
In-Crop Herbicide 3	June 28 40 g tepraloxydim ha^{-1}	n/a
Foliar Fungicide	July 10 99 g pyraclostrobin ha^{-1}	July 12 99 g pyraclostrobin ha^{-1}
Pre-Harvest Application	n/a	September 5
Harvest Date	September 23	September 25

10.

11. Results:

Mean monthly temperatures and precipitation amounts for the 2013-14 growing seasons at Indian Head are presented relative to the long-term averages in Table 3. While both springs were late with respect to snow melt and accessing fields, May was drier than normal in both years. Temperatures in May were above average in 2013 but cooler in 2014. In contrast, June was wetter and cooler than average in both years, especially in 2014 when more than 2.5 times the long-term normal precipitation was received. This resulted in substantial crop injury and delayed in-crop herbicide applications in 2014. July was cooler but drier than normal in both years, but with very little precipitation in 2014; however, the extremely wet weather in June meant that soil moisture was abundant until the latter half of the month. August was extremely dry in 2013 and wet in 2014; however, the flax was approaching physiological maturity at this point. Overall growing conditions were more favourable in 2013 than they were in 2014 at Indian Head.

Table 3. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) normals for the 2013 and 2014 growing season at Indian Head, Saskatchewan.

Year	May	June	July	August	Avg. / Total
	----------*Mean Temperature (°C)* ----------				
2013	11.9	15.3	16.3	17.1	15.2
2014	10.2	14.4	17.3	17.4	14.8
Long-term	10.8	15.8	18.2	17.4	15.6
	---------- *Precipitation (mm)* ----------				
2013	17.1	103.8	50.4	6.1	177
2014	36	199.2	7.8	142.2	385
Long-term	51.8	77.4	63.8	51.2	244

2013 Results

Mean plant densities, maturity and seed yield for the varieties evaluated in 2013 are presented in Table 4. In 2013, flax plant densities were within the desired range of approximately 300-400 plants m^{-2} for all varieties except AC Nugget at 210 plants m^{-2}; however it is possible that some emergence occurred after the measurements were completed as emergence counts were completed relatively early this year. While lodging is frequently expressed as a concern amongst flax growers, no lodging was observed for any plots at any point during the growing season. Lodging is typically a greater concern with higher than recommended plant populations and excessive moisture, neither of which occurred at Indian Head in 2013. Days to maturity ranged from approximately 106.5-109 days from planting; CDC Bethune and 2388 were the earliest maturing varieties while AC Nugget and VT50 were the latest. Overall yields in 2013 were considered above average at 3243 kg ha^{-1} (51.5 bus ac^{-1}) and all varieties performed similarly. While the overall F-test was significant (P = 0.013), no differences between individual treatments were significant according to Tukey's multiple comparisons test. Overall, the highest yielding varieties were Bethune, Flanders, Prairie Thunder, Nulin 50, Westlin 71 and FP2390 (3338-3405 kg ha^{-1}) while the lowest yielding varieties were Nugget and Westlin 70 (2944-2938 kg ha^{-1}).

Table 4. Plant densities, days to maturity and seed yield for 10 flax varieties at Indian Head in 2013. Means followed by the same letter do not significantly differ according to Tukey's studentized range test ($P \leq 0.05$).

Trt #	Variety	Plant Density	Maturity	Seed Yield
		------ plants m^{-2} ------	--------- days ---------	------- kg ha^{-1} --------
1	Bethune	373 a	106.5 cd	3377 a
2	Flanders	355 a	107.9 ab	3358 a
3	Norlin	325 a	107.1 bcd	3119 a
4	Nugget	210 b	108.8 a	2983 a
5	Prairie Thunder	294 ab	107.5 abcd	3405 a
6	Nulin 50	356 a	108.0 ab	3338 a
7	Westlin 70	297 ab	107.1 bcd	2944 a
8	Westlin 71	266 ab	107.8 abc	3385 a
9	FP 2388	314 ab	106.3 d	3128 a
10	FP 2390	315 ab	107.8 abc	3392 a
	SE	22.4	0.26	104.1
	Pr > *F*	0.001	<0.001	0.013
	CV	14.5	0.5	6.4

2014 Results

Mean plant densities, days to maturity and seed yields for the varieties evaluated in 2014 are provided in Table 5. In 2014, estimated plant densities were higher than the previous season; however, these measurements were completed substantially later than the previous season. While the plant densities differed across varieties, ranging from 421-683 plants m^{-2}, all were well above the recommended minimum of 300 plants m^{-2} and unlikely to limit maturity or seed yield in any cases. Overall, days to maturity ranged from as low as 104 days (FP2388 and FP 2385) to over 107 days (Nulin 50 and Westlin 70) with the remaining varieties falling somewhere between these values. Overall when averaged across varieties, the number of days from planting to maturity was similar in 2013 and 2014 and the plots were harvested at a similar date in both years. Due to the extremely wet conditions throughout the month of June and heavy wild oat pressure, flax yields were much lower (1550 kg ha^{-1}; 25 bu ac^{-1}) at Indian Head in 2014 at Indian Head when compared to the previous season. In contrast to 2013, the overall *F*-test for varietal effects on flax yield was significant in 2014 ($P < 0.001$) with yields ranging from 1351-1865 kg ha^{-1}. In 2014, the overall variety rankings differed somewhat relative to the previous season with the highest yielding varieties being Sorrel and Neela (1789-1865 kg ha^{-1}) and the lowest being Bethune, FP 2385, Prairie Saphire, Prairie Thunder, Westlin 71 and FP 2388 (1351-1465 kg ha^{-1}). However, in this second year of the demonstration, the varieties evaluated differed to some extent and many of the observed differences were not statistically significant.

Table 5. Mean plant densities, days to maturity and seed yield for fourteen flax varieties at Indian Head in 2014. Means followed by the same letter do not significantly differ according to Tukey's studentized range test ($P \leq 0.05$).

Trt #	Variety	Plant density	Maturity	Yield
		------ plants m^{-2} ------	--------- days ---------	------- kg ha^{-1} --------
1	Bethune	570 abc	105.6 cd	1462 bc
2	Sorrel	480 cd	105.8 bc	1865 a
3	Glas	646 ab	106.3 bc	1537 abc
4	Sanctuary	532 bcd	106.3 bc	1581 abc
5	Neela	544 bcd	106.5 abc	1789 ab
6	FP 2385	683 a	104.1 de	1465 bc
7	ACC Bravo	524 bcd	106.5 abc	1558 abc
8	Prairie Sapphire	497 cd	105.3 cde	1381 c
9	Prairie Thunder	421 d	105.9 bc	1397 bc
10	Nulin 50	528 bcd	107.3 ab	1577 abc
11	Westlin 70	522 cd	108.0 a	1683 abc
12	Westlin 71	447 cd	106.0 bc	1351 c
13	FP 2376	561 abc	106.5 abc	1618 abc
14	FP 2388	502 cd	104.0 e	1440 bc
	S.E.M.	24.5	0.32	77.8
	Pr > *F*	<0.001	<0.001	<0.001
	CV	9.20	0.60	10.03

Project Extension Activities

This demonstration was shown at the Indian Head Crop Management Field Days on July 23, 2013 and on July 22, 2014 which were attended by approximately 200 producers and industry representatives each year. A dedicated Flax Field Day was co-hosted by IHARF and SaskFlax on July 23, 2013 which was attended by 68 participants. At the 2014 IHARF field day, the discussion at the site was led by Zafer Bashi (Saskatchewan Ministry of Agriculture) and Christiane Catellier (IHARF) and revolved around some the current opportunities and challenges of flax production in Saskatchewan. Signs were in place to identify treatments and acknowledge the support of the Agricultural Demonstrations of Technologies and Practices (ADOPT) program. The results were also presented by Chris Holzapfel (IHARF) at both the Agronomy Research Update at the University of Saskatchewan in December 2013 and at the Agri-ARM Research Update on January 15, 2015 at

Prairieland Park during the Crop Production Show. Finally, results from this project will be made available in the 2014 IHARF Annual Report (available online) and also through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, etc.) where there is opportunity to do so.

12. Conclusions and Recommendations

This project demonstrated the relative performance of a wide range of current and upcoming flax varieties at Indian Head, Saskatchewan over two contrasting growing seasons. In 2013, the flax was generally free of environmental stress (i.e. excess or lack of moisture, weed / disease competition) over the course of the growing season and yields were well above average. In 2014, on the other hand, the flax was affected by prolonged wet conditions resulting from the extreme rainfall in June along with heavy wild oat pressure (due to herbicide being delayed, stressful conditions at spraying and suspected Group 1 resistance). Plant densities were higher overall in 2013; however, this may have been due in part to the relative timing of the emergence measurements and observed differences amongst varieties were likely due to variation in seed size and germination which was not accounted for in the seeding rates. Ranging from 106-109 days in 2013 and 104-108 days in 2014, maturity was similar from year to year and, while differences amongst varieties existed, they were relatively small under the environmental conditions encountered. In 2013, while there was a substantial range from 2983-3405 kg ha^{-1}, none of the differences amongst varieties were significant in the multiple comparisons test and all were highly competitive. In 2014, with a wider range of varieties evaluated and much more stressful growing conditions, the overall mean yield was several differences were significant; however, the relative performance of the varieties varied to a certain extent. Taking both years into consideration, this demonstration illustrates the importance of considering multiple site-years of data when comparing varieties. Since actual results commonly vary from one year/location to the next, growers need to consider long-term averages when choosing a flax variety for a specific region. The most current provincial guide to grain varieties is typically the best source of such information as it is based on data from many site years and provides regionally specific recommendations. In addition to yield, other factors to consider are lodging resistance, maturity and the ability to withstand certain stresses such as short growing seasons, drought or prolonged wet conditions.

Supporting Information

13. Acknowledgements:

The project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Acknowledgement of the Saskatchewan Ministry of Agriculture's support for this demonstration will be included as part of all written reports and oral presentations that arise from this work. Seed for the project was provided in-kind by the Agriculture and Agri-Food Canada, the Crop Development Centre and Crop Production Services, Bayer CropScience and BASF.

14. Appendices

No additional appendices are included with this report.

Abstract

15. Abstract/Summary:

The Indian Head Agricultural Research Foundation (IHARF) conducted field demonstrations in 2013 and 2014 on behalf of the Saskatchewan Flax Development Commission (SaskFlax) to demonstrate the relative performance of a wide range of current flax varieties in addition to some that will become commercially available over the next few years. Overall, the two seasons differed greatly with 2013 being near optimal with well above average yields and more stressful conditions and much lower yields in 2014. Plant densities were lower in 2013 in 2014 but this may have been due in part to the relative timing of the measurements and differences amongst varieties were likely due largely to differences in seed size and germination which were not accounted for. Maturity was similar from one year to the next and all of the varieties matured within 3-4 days of one another on average. Seed yields averaged 3243 kg ha^{-1} (52 bu ac^{-1}) and no differences amongst varieties were significant according the multiple comparisons test. In 2014, yields were lower at 1550 kg ha^{-1} (25 bu ac^{-1}) and ranged from 1351-186 kg ha^{-1} with several significant differences detected. It is not uncommon for relative varietal performance to vary with growing conditions and this project illustrates the importance of considering large datasets and long-term averages and factors other than mean yield when comparing and selecting varieties. The project was shown at the IHARF Crop Management Field Days in both 2013 and 2014 and also at an IHARF-SaskFlax Field Day in 2013. In addition, results were presented at the Agronomy Research Update (University of Saskatchewan) in December 2013 and at the Agri-ARM Research Update (Crop Production Show) in January 2015. Project highlights and results from each year are available in the 2013 and 2014 IHARF Annual Reports.