2016 Final Report

for the

Saskatchewan Flax Development Commission

Project Title: Flax response to fungicide at varying row spacing levels

(Project #160405)

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Project Identification

1. **Project Title:** Flax response to fungicide at varying row spacing levels
2. **Project Number:** 160405 (IHARF-2407)
3. **Producer Group Sponsoring the Project:** Saskatchewan Flax Development Commission
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates (month & year):** April 2014 to February 2017
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The objective of this project was to demonstrate the response of flax to fungicide at varying row spacing levels and to better understand the sensitivity of flax to wider row spacing.

8. **Project Rationale:**

Pasmo is the most common disease affecting flax yields in Saskatchewan and, like most major field crop diseases, is more severe under wet conditions and with heavy crops. Multiple foliar fungicide options are registered to control pasmo; however, producers frequently question the potential return on investment. Past field trials and demonstrations at Indian Head have shown reasonably consistent responses to fungicide applications with yield increases of nearly 30% when disease pressure is high; however, these benefits are only realized when pasmo is present therefore scouting is important. Focussing on row spacing, past research in Saskatchewan has shown no yield difference for row spacing ranging from 10-30 cm (4-12”) but information is limited for row spacing wider than 30 cm. Flax can compensate for reduced emergence through increased branching to certain extent but this crop is a relatively weak competitor with weeds early in the season and there are valid concerns as to whether row spacing ≥ 30 cm will limit yields. With respect to fungicide interactions with row spacing, it is conceivable that disease might be reduced at wider row spacing due to increased air flow through the canopy; but denser canopies also tend to be conducive to higher overall yields.

Methodology and Results

9. **Methodology:**

Field trials with flax were established near Indian Head, Saskatchewan (R.M. #156) in 2014, 2015 and 2016. The treatments were factorial combination of 5 row spacing treatments (25, 30, 36, 41, and 61 cm or 10, 12, 14, 16 and 24”) and two fungicide treatments (untreated versus 0.16 l Headline EC/ac applied mid-bloom). The treatments were arranged in a four-replicate split plot design with fungicide treatment as the main plots and row spacing levels as the sub-plots.

Table 1. Selected agronomic information for flax variety demonstrations at Indian Head (2013-14).

Description	**2014**	**2015**	**2016**
Previous Crop	Spring Wheat	Spring Wheat	2-Row Barley
Pre-Emergent Herbicide	890 g glyphosate ha^{-1} (May-18) 140 g sulfentrazone ha^{-1} (May-18)	3.8 kg triallate ha^{-1} (Apr-29) 890 g glyphosate ha^{-1} (Apr-29) 140 g sulfentrazone (Apr-29)	2250 g triallate/ha (May-7) 140 g sulfentrazone/ha (May-9) 890 g glyphosate/ha (May-15)
Seeding Date	May-17	May-8	May-9
Variety	CDC Bethune	CDC Bethune	CDC Bethune
Seed Rate	50 kg ha^{-1}	50 kg ha^{-1}	50 kg/ha
Fertility (kg N-P_2O_5-K_2O-S ha^{-1})	100-20-10-10	95-22-11-11	95-22-11-11
Plant Density	Jun-11	Jun-4	May-30
In-Crop Herbicide	99 g clopyralid ha^{-1} 553 g MCPA ester ha^{-1} 211 g sethoxydim ha^{-1} (Jul-7)	175g fluazifop ha^{-1} (Jun-10) 99 g clopyralid ha^{-1} 553 g MCPA ester ha^{-1} (Jun-13) 44 g clethodim ha^{-1} (Jun-24)	100 g clopyralid/ha 555 g MCPA ester/ha (Jun-13) 50 g tepraloxydim/ha (Jun-18)
Foliar Fungicide	99 g pyraclostrobin ha^{-1} (Jul-12)	99 g pyraclostrobin ha^{-1} (Jul-5)	99 g pyraclostrobin/ha (July 5)
Pre-Harvest Application	890 g glyphosate/ha (Sep-5)	890 g glyphosate/ha (Aug-24)	890 g glyphosate/ha (Aug-25)
Harvest Date	Sep-24	Sep-13	Sep-15

All pertinent agronomic information and dates of field operations are presented in Table 1. The plots were planted using a SeedMaster plot drill with eight openers whose position was adjusted to achieve the various row spacing treatments. All fertilizer was side-banded at planting at rates intended to be non-limiting to yield but not too excessive. Weeds were controlled using registered pre-emergent and in-crop herbicide applications and the fungicides were applied as per protocol with a field sprayer. The fungicide treatments were applied at full bloom and the product used in all years was Headline EC (250 g pyraclostrobin l^{-1}) at a rate of 0.4 l ha^{-1}. Pre-harvest glyphosate was applied at maturity in all three years for weed control and to assist with crop dry-down. All except the outside rows were mechanically harvested using a Wintersteiger plot combine, therefore 6 rows were harvested for the 25-41 cm treatments and only 2 rows were harvested at 61 cm row spacing.

The response variables measured were final plant densities, days to maturity and seed yield. Plant densities were determined at 3-4 weeks after planting by counting the number of seedlings in two separate 1 m rows per plot and calculating the average plants m^{-2}. The Julian date where each plot reached maturity (75% of bolls turned brown) was recorded in 2015 and 2016 but not in 2014 and used to calculate days from planting to maturity. Yields were determined from the harvested grain samples and are corrected for dockage and to 10% seed moisture content.

Data for plant density, maturity and seed yield were analysed using the Mixed procedure of SAS with the effects of year, fungicide, row spacing, and all possible interactions considered fixed. Treatment means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the responses to row spacing were linear or quadratic (curvilinear) in shape. Heterogenous variance estimates were permitted for individual years for all variables; however, the more complex models were only utilized when doing so improved convergence. Treatment effects and differences between means for all variables were considered significant at $P \leq 0.05$.

10. Results:

Growing Season Weather

Mean monthly temperatures and precipitation amounts for the 2014-16 growing seasons at Indian Head are presented relative to the long-term averages in Tables 2 and 3, respectively. The spring of 2014 was late, cool and wet followed by nearly 250 mm of precipitation in May and June. The site was saturated for most of June and yields were further limited by heavy populations of Group 1 resistant wild oats. In 2015, the spring was drier and warmer but seed and fertilizer were placed into good soil moisture. Conditions following planting became quite dry with no precipitation until late in June when the flax was near the flowering stage. From late June on precipitation was above-average and flax yields were considered approximately average for the region. 2016 was dry at planting which allowed for excellent seed/fertilizer placement; however, with heavy crop residues and fine-textured soils, the seed was still placed into adequate moisture. Substantial amounts of rain were received in mid- to late-May and, with average to above-average precipitation in June and July, moisture was never limiting. Combined with warm temperatures, conditions were optimal for high yields and also for potential disease development. Hail occurred on July 18 but damage to the flax was negligible and uniform across the study area.

Table 2. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2014-16 growing seasons at Indian Head, SK.

Year	May	June	July	August	Avg. / Total
	------------------------------------- Mean Temperature (°C) --------------------------------------				
2014	10.2	14.4	17.3	17.4	14.8
2015	10.3	16.2	18.1	17.0	15.4
2016	14.0	17.5	18.5	17.2	16.8
Long-term	10.8	15.8	18.2	17.4	15.6

Table 3. Mean monthly precipitation amounts along with long-term (1981-2010) averages for the 2014-16 growing seasons at Indian Head, SK.

Year	May	June	July	August	Avg. / Total
	----------- Precipitation (mm) -----------				
2014	36.0	199.2	7.8	142.2	385
2015	15.6	38.3	94.6	58.8	207
2016	72.6	63.0	112.8	29.8	278
Long-term	51.8	77.4	63.8	51.2	244

Flax Response to Row Spacing and Fungicide

Results from the tests of fixed effects for crop response variable are provided in Table 4 and main effect means appear in Table 5. Briefly, all variables (plant density, maturity and yield) were affected by both year (P < 0.001) and row spacing (P < 0.001). When all years were combined, fungicide only affected maturity (P =0.002); however, a year by fungicide treatment (Y × F) interaction was detected for seed yield (P = 0.004) indicating that the fungicide response varied from year-to-year. The year by row spacing interaction (Y × RS) was significant for plant density (P = 0.001) and maturity (P < 0.001) but not seed yield (P = 0.145). The lack of a Y × RS interaction indicates that row spacing effects on flax yield were consistent across years. Importantly, the RS × F interaction was not significant for any variables (P = 0.21-0.96) which indicated that row spacing did not influence flax response to foliar fungicide applications or vise versa.

Table 4. Foliar fungicide and row spacing effects on flax plant density, maturity and seed yield at Indian Head in 2014-16.

	Plant Density	**Maturity** [Z]	**Seed Yield**
Effect	----------- p-values [Y] -----------		
Year (Y)	**< 0.001**	**< 0.001**	**< 0.001**
Fungicide (F)	0.408	**0.002**	0.121
Row spacing (RS)	**< 0.001**	**< 0.001**	**< 0.001**
F × RS	0.206	0.956	0.934
Y × F	0.350	**< 0.001**	**0.004**
Y × RS	**0.001**	**< 0.001**	0.145
Y × F × RS	0.637	**0.032**	1.000

[Z] 2015 and 2016 only [Y] p-values ≤ 0.05 indicate that a treatment effect was significant and not random

Averaged across all treatments, plant densities were lowest in 2013 (345 plants/m^2) and significantly higher in 2015 and 2016 (476-495 plants/m^2; Table 5). The Flax Council of Canada recommends a minimum of 300 plants/m^2 for optimal yield, therefore, on average, plant populations were not considered to be yield limiting factors in any years. Across years, there was a linear decline in plant density with increasing row spacing (P < 0.001) with an average of 480 plants/m^2 observed at 25 cm and 332 plants/m^2 at 61 cm. However, with a significant Y × RS interaction, the response varied depending on the overall plant populations and/or environmental conditions. In 2014, with lower overall plant populations, plant densities were similar regardless of row spacing level; however, in 2015 and 2016, populations declined by 36-37% when row spacing was increased from 25 cm to 61 cm (Table 7). In all cases the minimum plant populations were at or above the minimum threshold of 300 plants/m^2 and, statistically, plant populations were always similar for row spacing levels ranging from 25-36 cm.

Table 5. Least squares means for main effects of year, foliar fungicide and row spacing on flax plant density, maturity and seed yield at Indian Head in 2014-16.

Main effect	**Main Effect Means**		
	Plant Density	**Maturity** [Z]	**Seed Yield** [Y]
Year (Y)	-------- plants/m^2 --------	----------- days -----------	----------- kg/ha -----------
2014	345 b	–	1313 c (77.6)
2015	476 a	98.9 b	2043 b (71.3)
2016	495 a	101.7 a	2682 a (63.6)
S.E.M.	*14.3*	*0.14*	–
Fungicide (F)			
No fungicide	434 a	99.8 b	1953 a
Fungicide [X]	444 a	100.8 a	2073 a
S.E.M.	*13.2*	*0.14*	*70.5*
Row spacing (RS)			
25 cm (10”)	480 a	99.5 d	2259 a
31 cm (12”)	487 a	99.8 c	2161 a
36 cm (14”)	458 ab	100.2 b	2026 b
41 cm (16”)	438 b	100.3 b	1986 b
61 cm (24”)	332 c	101.8 a	1634 c
S.E.M.	*16.2*	*0.15*	*77.0*
Contrast	---------------- p-values [Y] ----------------		
RS – linear	< 0.001	< 0.001	< 0.001
RS – quadratic	0.100	0.043	0.606

[Z] 2015 and 2016 only [Y] Heterogenous variance estimates [X] 0.16 l/ac Headline EC/ac applied mid-bloom

Flax maturity was affected by all three factors but was only recorded in 2015 and 2016. Averaging 98.9 days, the 2015 crop maturity approximately 3 days earlier than in 2016 where the average was 101.7 days from planting (Table 5). The difference was presumably due to the drier conditions and lower yield potential in 2015. Averaged across both years, fungicide delayed maturity by 1 day (Table 5) but the Y × F interaction revealed that the delay was only observed in 2016 where fungicide resulted in a relatively minor but significant 2-day delay in maturity (Table 6). Days to maturity also increased with increasing row spacing with a 2.3 day spread between the narrowest and widest treatments when averaged across years (Table 5); however, bear in mind that the Y × RS interaction was significant for this variable. Despite the significant interaction, the overall effects of RS on maturity were similar for both years (Table 7).

Table 6. Least squares means for effects of interactions between fungicide and year on flax plant density, maturity and seed yield at Indian Head in 2014-16.

Interaction	Fungicide Effects by Year (Y × F)		
	Plant Density	**Maturity** [Z]	**Seed Yield** [Y]
Year × Fungicide	------- plants/m^2 -------	---------- days ----------	--------- kg/ha ---------
2014 – check	344 c	–	1218 d
2014 – fungicide [X]	346 c	–	1412 d
S.E.M.	*17.1*	–	*93.0*
2015 – check	459 b	99.0 c	2070 c
2015 – fungicide	492 ab	98.9 c	2015 c
S.E.M.	*17.1*	*0.15*	*82.4*
2016 – check	498 a	100.7 b	2570 b
2016 – fungicide	495 ab	102.7 a	2793 a
S.E.M.	*17.1*	*0.15*	*68.6*

[Z] 2015 and 2016 only [Y] Heterogenous variance estimates [X] 0.16 l/ac Headline EC/ac applied mid-bloom

Again, seed yield was affected by year, fungicide treatment and row spacing with a significant Y × F interaction. There was an ideal range in overall yield conditions over the study period with what were essentially considered below-average yields in 2014 (1313 kg/ha), average yields in 2015 (2014 kg/ha) and above-average yields in 2016 (2682 kg/ha) when averaged across treatments (Table 5). The range of potential yields realized was ideal for testing the effects of row spacing on flax under contrasting environmental conditions. Focussing on fungicides, while the main effect (across years) was not significant (P = 0.121), numerically, yields were 6% higher with fungicide and the Y × S interaction revealed that the response to fungicide differed from year-to-year. In 2014, under wet but low yielding conditions, there was a tendency for higher yields with fungicide (16%) but, with the lower yields and relatively high variability, the effect was not statistically significant. Under the much drier growing conditions in 2015 there was no benefit to fungicides and, in 2016, under high yielding conditions and heavier disease pressure, a significant 9% yield increase with fungicide was detected. Overall, these results are consistent with previous IHARF field trials which have shown substantial benefits under heavy disease pressure (up to 30% yield increase) but no benefit when pasmo was not present or at low levels.

Despite the wide range of conditions, row spacing effects on flax yield were consistent for all three years and showed a clear linear decline in flax yield when row spacing was increased from 25-61 cm. Averaged across years, yields declined by 28% from 2259 kg/ha to 1634 kg/ha for the range of 25 61 cm. Although the Y × F interaction was not significant, as a matter of interest the observed proportional yield reductions across the range of row spacing levels tested were remarkably similar at 27%, 28%, and 28% in 2014, 2015 and 2016. No interactions between row spacing and fungicide were detected for yield either when averaged across years or for any individual years which suggested that the response to fungicide was not affected by row spacing and, alternatively, row spacing effects were consistent regardless of whether fungicide was applied or disease was a yield limiting factor.

Table 7. Least squares means for effects of interactions between row spacing and year on flax plant density, maturity and seed yield at Indian Head in 2014-16.

Interaction	Row Spacing Effects by Year (Y × RS)		
	Plant Density	**Maturity** [Z]	**Seed Yield** [Y]
Year × Row Spacing	------- plants/m^2 -------	---------- days ----------	--------- kg/ha ---------
2014 – 25 cm (10”)	338 ef	–	1454 gh
2014 – 30 cm (12”)	382 e	–	1421gh
2014 – 36 cm (14”)	337 ef	–	1297 hi
2014 – 41 cm (16”)	369 e	–	1335 hi
2014 – 61 cm (24”)	299 f	–	1067 i
S.E.M.	*23.7*	–	*123.0*
2015 – 25 cm (10”)	530 abc	98.0 f	2276 e
2015 – 30 cm (12”)	517 a-d	98.3 f	2194 ef
2015 – 36 cm (14”)	506 bcd	98.7 e	2068 ef
2015 – 41 cm (16”)	487 cd	98.9 e	2040 f
2015 – 61 cm (24”)	338 ef	100.7 d	1635 g
S.E.M.	*23.7*	*0.16*	*102.5*
2016 – 25 cm (10”)	572 a	101.0 c	3047 a
2016 – 30 cm (12”)	563 ab	101.4 b	2868 b
2016 – 36 cm (14”)	531 abc	101.6 b	2712 c
2016 – 41 cm (16”)	458 d	101.6 b	2582 d
2016 – 61 cm (24”)	358 ef	102.9 a	2199 ef
S.E.M.	*23.7*	*0.16*	*72.6*

[Z] 2015 and 2016 only [Y] Heterogenous variance estimates

Extension and Acknowledgement

This project was discussed at both the 2014 and 2015 IHARF Crop Management Field Days which were held on the third Tuesday of July in both years. Each year, the tour was attended by over 200 registered guests and signs were in place to acknowledge the support of the Saskatchewan Flax Development Commission (SaskFlax) and the ADOPT program. In both years, the provincial oilseed specialists were also on site to discuss major issues in flax production and some of the treatments being demonstrated. Preliminary results were also presented by Chris Holzapfel and Stu Brandt at the 2015 Saskatchewan Oilseed Producer Meetings (Nov. 16-20) and by Chris Holzapfel at 2016 CropSphere (Jan. 12-13) and the 2016 Saskatchewan Oilseed Meetings (Nov. 14-18). Results from the project will be made available in the 2016 IHARF Annual Report (available online) and through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, social media, etc.) as opportunities arise.

Conclusions and Recommendations

Focussing on fungicides, the results from this project are consistent with previous research showing substantial benefits to spraying when pasmo pressure is sufficiently high but no benefits in the absence of disease. For this reason, careful scouting and monitoring of weather conditions is recommended to get the maximum benefit out of fungicide applications on a year-to-year basis. This disease moves progressively up the plant starting on the bottom leaves and the distinct banded stem lesions do not typically appear until relatively late in the season. Scouting should begin as soon the crop starts to flower and optimal fungicide application is normally about 7-10 days after the initiation of flowering. Later applications may be more beneficial if disease does not appear until relatively late during flowering. In the current project, fungicides only significantly increased yields in 1/3 years but the overall average yield increase of annual preventative applications (3-years) was 6%.

As for row spacing, flax appears to be quite sensitive to increasing row spacing when compared to other crops such as oats, wheat, canola and soybeans. Apart from 2014 where overall densities were lower and there was no effect of row spacing, flax populations declined as row spacing was increased. That said, the minimum recommended threshold of 300 plants/m^2 was achieved with normal seeding rates in all cases, even 2014 at 61 cm row spacing. In 2015-16, plant densities declined by 37% when row spacing was increased from 25 cm to 61 cm. This suggests that the potential for higher morality should potentially be taken into consideration when seeding flax at wider row spacing. Yields also declined linearly with increasing row spacing and the results were remarkably consistent across years, despite the wide range of overall flax yield potential. The observed yield loss was 28% from 25 cm (10”) spacing to 61 cm (24”) spacing, or 2% for every 2.5 cm (1”) increase in row spacing. While the observed yield loss may be partly attributable to reduced competitiveness with weeds, even where weed pressure was relatively low, full canopy closure was still not achieved with wider row spacing, even at maturity (Fig. 1-5, Appendices). While these results do not by any means suggest that growing flax at row spacing wider than 25 cm is not a viable option for producers, they clearly show that this crop is better-suited to narrower rows and yield losses can be expected as row spacing is increased.

Notably, there were no agronomically important interactions between foliar fungicide applications and row spacing for flax. Despite the hypothesis that wider row spacing may result in a more open canopy and subsequently less disease and potential benefit to fungicides, there was no evidence of this actually occurring. Yield increases with fungicide (or the lack thereof) were consistent across row spacing levels on average and within individual years. Similarly, the observed row spacing effects were consistent regardless of whether fungicide was applied.

Supporting Information

11. Acknowledgements:

This project was initiated by the Saskatchewan Flax Development Commission (SaskFlax) and funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement in 2014 and 2015. In 2016 the study was funded exclusively by the Saskatchewan Flax Development Commission. Crop protection products used in the project were provided in-kind by BASF, FMC Bayer CropScience and Syngenta. SeedMaster Manufacturing contributed to the design and manufacturing of the drill along with IHARF and AAFC. The many technical and professional contributions of Danny Petty, Christiane Catellier, Dan Walker, Karter Kattler, Carly Miller, Andrea De Roo and Stephanie Knoll are greatly appreciated.

12. Appendices

Table 8. Least squares means for effects of interactions between foliar fungicide and row spacing on flax seed yield at Indian Head in 2014-16.

Interaction	Individual Treatment Means (F × RS)		
	Plant Density	**Maturity** [Z]	**Seed Yield**
Fungicide × Row Spacing	------- plants/m^2 -------	---------- days ----------	--------- kg/ha ---------
Check – 25 cm	476 abc	99.1 f	2194 abc
Check – 31 cm	456 bc	99.3 f	2072 bcd
Check - 36 cm	458 bc	99.7 e	1991 d
Check – 42 cm	444 bc	99.8 e	1918 d
Check – 61 cm	334 d	101.3 b	1589 e
Fung – 25 cm	483 ab	99.9 e	2324 a
Fung – 31 cm	519 a	100.3 d	2251 ab
Fung – 36 cm	458 bc	100.6 c	2060 cd
Fung – 42 cm	432 c	100.8 c	2053 cd
Fung – 61 cm	329 d	102.3 a	1679 e
S.E.M.	*20.3*	*0.17*	*92.0*
Orthogonal Contrasts	------------------------------------- Pr. > *F* -------------------------------------		
RS (check) – lin	< 0.001	< 0.001	< 0.001
RS (check) – quad	0.137	0.067	0.748
RS (fung) – lin	< 0.001	< 0.001	< 0.001
RS (fung) – quad	0.398	0.291	0.682

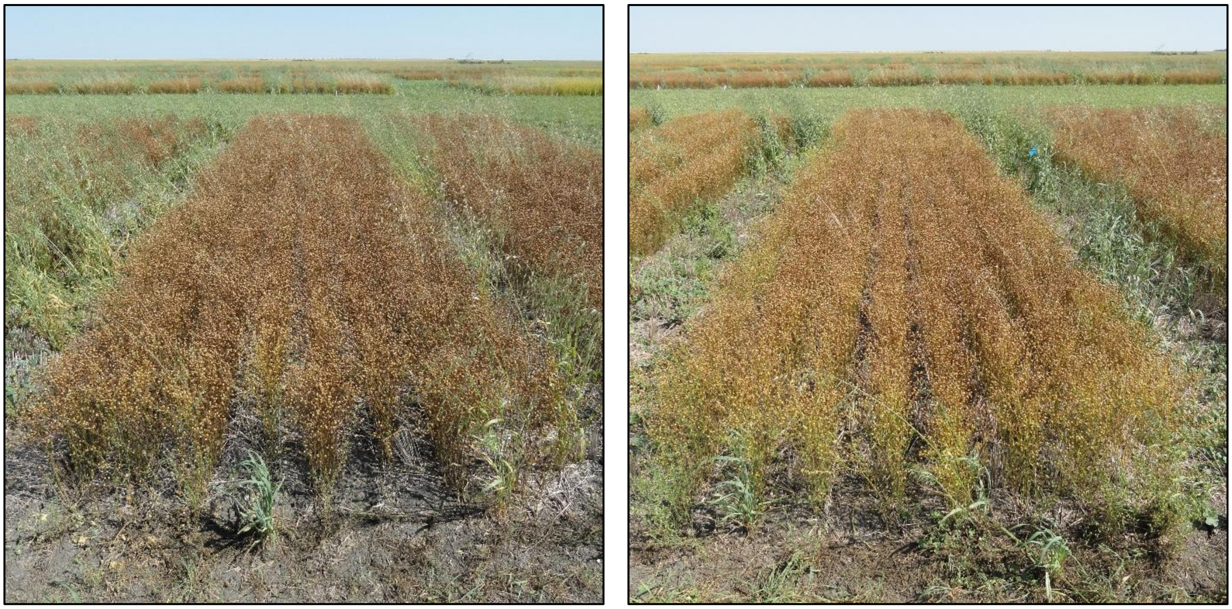

Figure 1. Flax at 25 cm (10") row spacing without (left) and with (right) fungicide (Indian Head 2016).

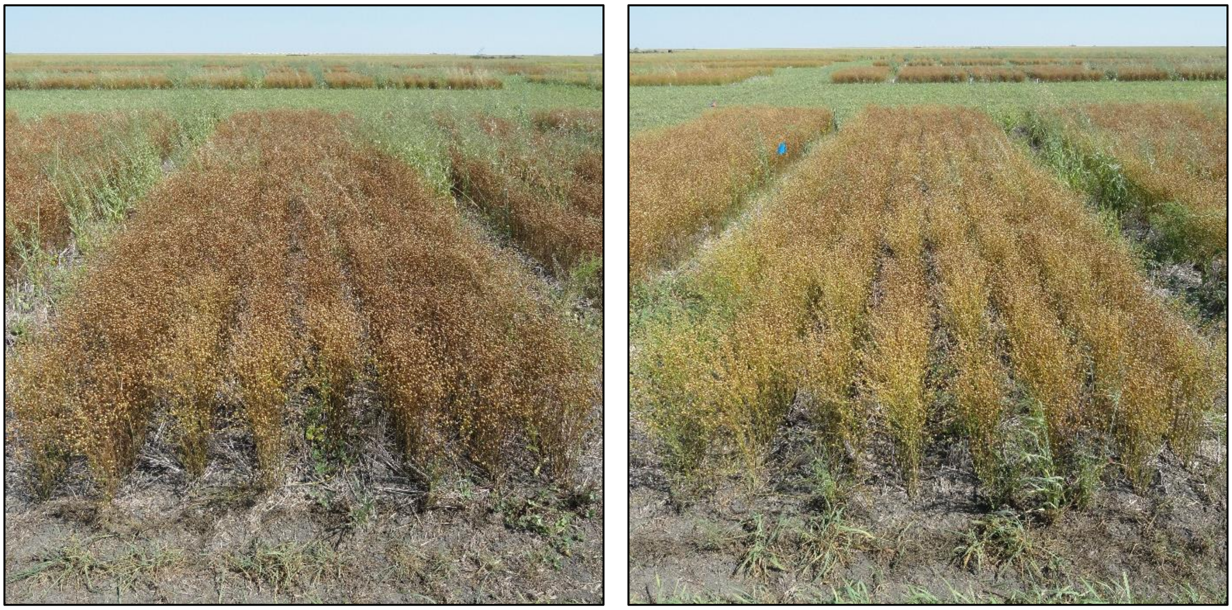

Figure 2. Flax at 30 cm (12") row spacing without (left) and with (right) fungicide (Indian Head 2016).

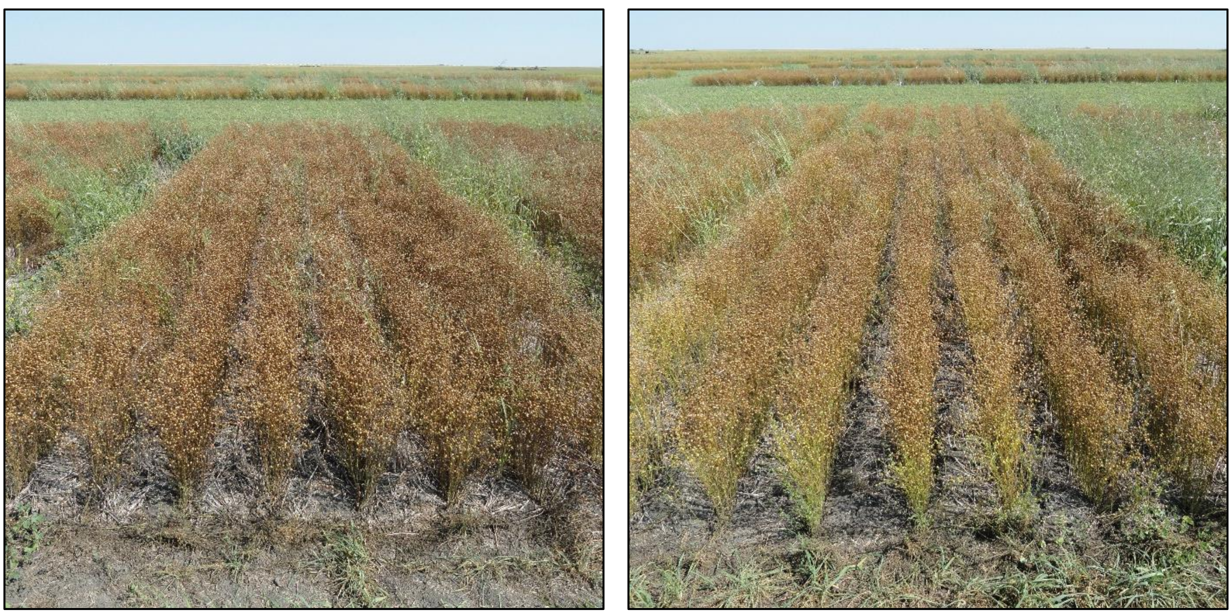

Figure 3. Flax at 36 cm (14") row spacing without (left) and with (right) fungicide (Indian Head 2016).

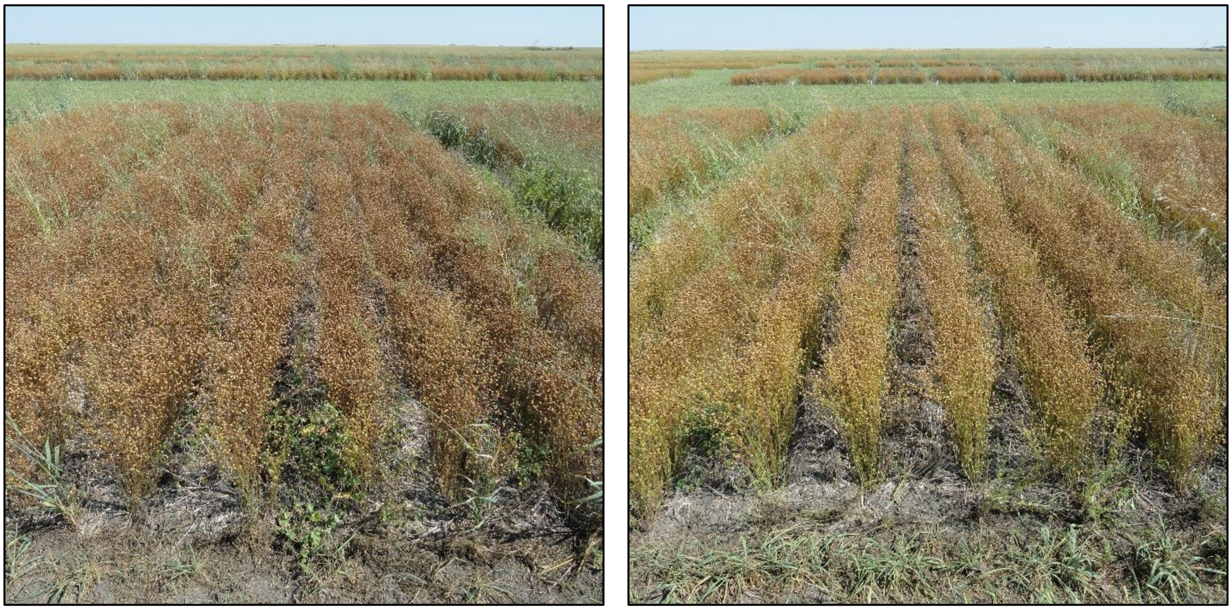

Figure 4. Flax at 41 cm (16") row spacing without (left) and with (right) fungicide (Indian Head 2016).

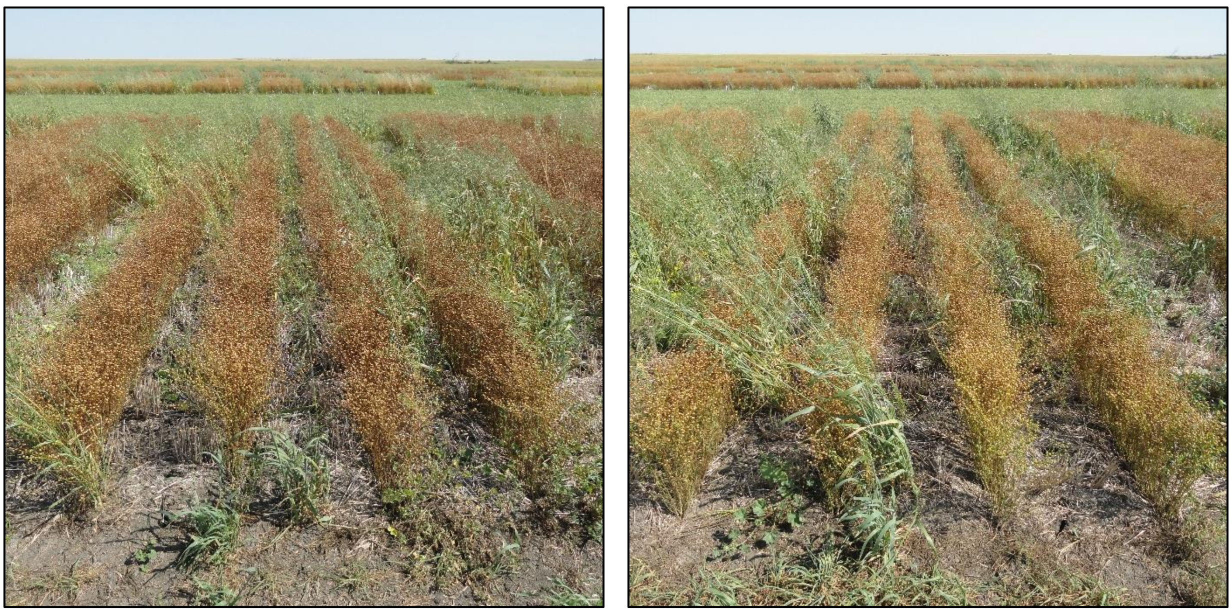

Figure 5. Flax at 61 cm (24") row spacing without (left) and with (right) fungicide (Indian Head 2016).

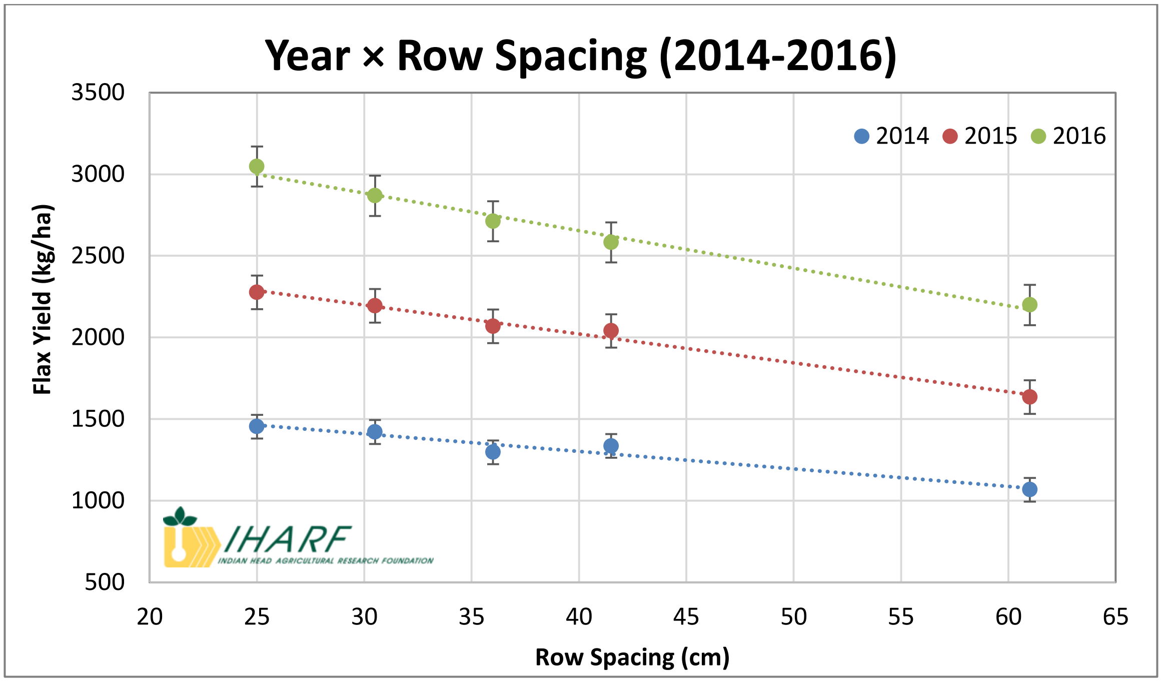

Figure 6. Row spacing effects on flax yield for individual years at Indian Head. The year by row spacing interaction was not signficant, therefore the response was consistnet across years.

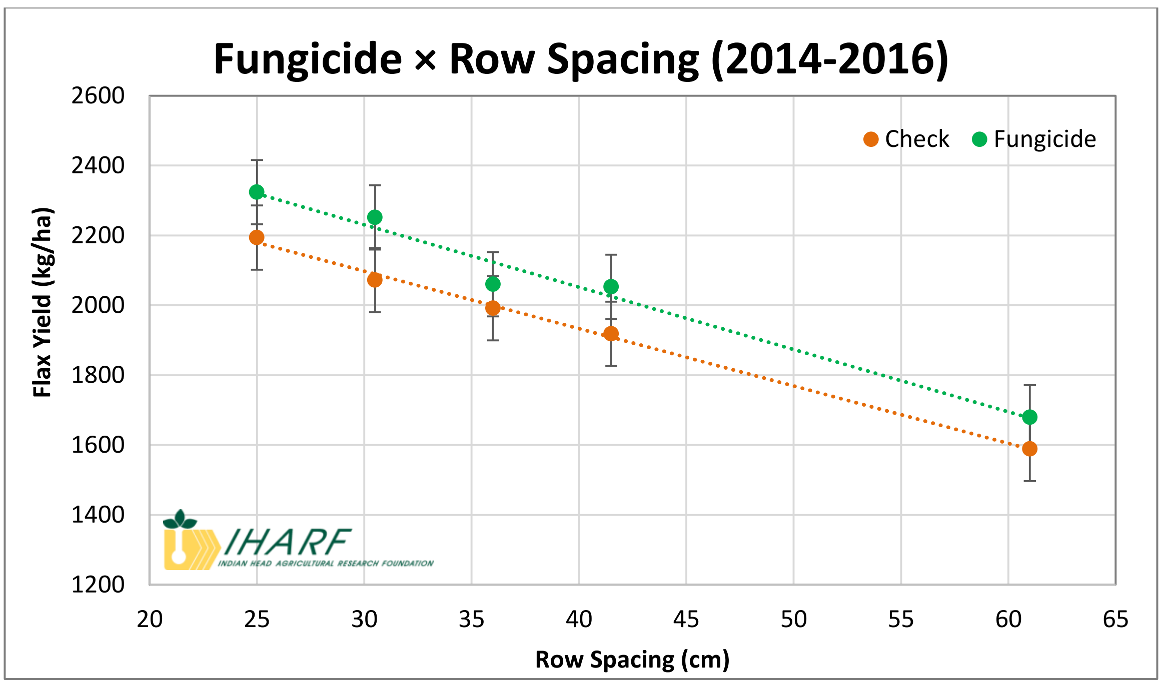

Figure 7. Row spacing effects on flax yield for individual fungicide treatments at Indian Head. The fungicide by fungicide interaction was not signficant, therefore the response was consistnet across years.

Abstract

13. Abstract/Summary:

Field trials were conducted near Indian Head in 2014-16 to investigate row spacing and fungicide effects and interactions with flax. The treatments were a factorial combination of five row-spacing levels (25-61 cm) and two fungicide (untreated versus 0.16 l Headline EC/ac at mid-bloom) treatments. Over the three-year period, a wide range of conditions were encountered which led to below-average (1313 kg/ha), average (2014 kg/ha) and above-average (2682 kg/ha) flax yields in 2014, 2015 and 2016, respectively. Flax yield response to fungicide was consistent with previous field trials at Indian Head where significant yield increases were observed under sufficient disease pressure but there was no benefit to spraying in the absence of disease. In 2016, when the yield response to fungicide was significant, the increase was 9% relative to the control and, averaged across all three years, fungicides increased flax yield by 6%. Maturity was only affected by fungicide in 2016 where a yield response occurred and fungicide application delayed maturity by 2 days. Increasing row spacing reduced plant populations in 2015 and 2016 but not in 2014 when overall populations were significantly lower. The effects of row spacing on seed yield were significant and consistent across years, despite the contrasting growing conditions and differences in overall yield potential. Yields declined by 37% on average (625 kg/ha) when row spacing was increased from 25 cm to 61 cm. The response was linear and indicated that flax yields declined by 2% for every 2.5 cm increase in row spacing. These results do not suggest that growing flax on wider than 25 cm is not viable; however, they do show clear and significant yield reductions as row spacing is increased from relatively narrow levels. There were no agronomically important interaction between row spacing and fungicide which indicates that flax response to fungicide in any given year (and averaged across years) was similar regardless of row spacing.