INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2014 Annual Report




IHARF
Box 156
Indian Head, SK
S0G 2K0

Ph: (306) 695-4200
www.iharf.ca

Introduction

The Indian Head Agricultural Research Foundation (IHARF) is a non-profit, producer directed applied research organization which works closely with various levels of government, commodity groups, private industry and producers.

Founded in 1993, the **Mission** of IHARF is to promote profitable and sustainable agriculture by facilitating research and technology transfer activities for the benefit of its members and the agricultural community at large.

IHARF Mandate

- Identify new research priorities required to meet the needs of agriculture now and in the future.
- Support public good research - research that has value to the public but is not tied to studying or promoting a specific product or service.
- Maintain strategic alliances with the agricultural community in order to strengthen the provincial research base.
- Play an active role in the technology transfer process and be involved in public education and awareness activities.
- Maintain a scientific research base at the Indian Head Research Farm.

IHARF Board of Directors

IHARF is led by a nine member Board of Directors consisting of producers and industry stakeholders who volunteer their time and provide guidance to the organization. Residing all across south eastern Saskatchewan, IHARF Directors are dedicated to the betterment of the agricultural community as a whole. The 2014 IHARF Directors included:

- Chad Skinner - President *(Indian Head)*
- Chris Brown - Vice President *(Indian Head)*
- Terry Rein - Secretary / Treasurer *(Indian Head)*
- Fred Stilborn *(Balcarres)*
- Gus Lagace *(Fort Qu'Appelle)*
- Barry Rapp *(Regina)*
- Cameron Gibson *(Kendal)*
- Ivan Ottenbreit *(Grayson)*
- Travis Wiens *(Milestone)*

Ex-Officio

IHARF receives additional guidance from an experienced team of Agriculture and Agri-Food Canada (AAFC) personnel at the Indian Head Research Farm, they included:

- David Gehl - Officer in Charge
- Bill May - Research Scientist
- Chris Omoth - Research Assistant

IHARF Staff

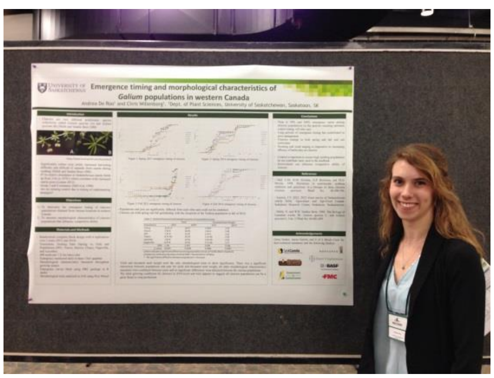
The 2014 team of IHARF staff included:

- Danny Petty - Executive Manager
- Chris Holzapfel - Research Manager
- Christiane Catellier - Research Associate
- Karter Kattler - Field & Plot Technician
- Dan Walker - Seasonal Technician
- Stephanie Knoll - Summer Student

Dr. Guy Lafond Memorial Award

Guy had a passion for agricultural research and was dedicated to the advancement of the industry. He was instrumental in establishing the Indian Head Agricultural Research Foundation, and believed in IHARF's Mission, Mandate and the training of young agronomists.

The first recipient of the Dr. Guy Lafond Memorial Award was Andrea De Roo from Fairlight, Saskatchewan. Andrea is completing her Masters in Plant Sciences at the University of Saskatchewan, studying the genetic and morphological characterization of Galium species (cleavers) in western Canada. Andrea has plans to continue on and pursue her PhD in the field of genetics.



Extension Events

Indian Head Crop Management Field Day

On July 22, 2014, IHARF hosted the annual Indian Head Crop Management Field Day. Over 200 producers and agronomists from across the Prairies came for tours led by IHARF, AAFC, the Saskatchewan Ministry of Agriculture and industry specialists. Tours and presentations were provided by:

- Chris Holzapfel (IHARF)
- Christiane Catellier (IHARF)
- Bill May (AAFC)
- Garry Hnaatowich (Irrigation Crop Diversification Corporation)
- Amanda Swanson (Ducks Unlimited Canada)
- David Gehl (AAFC)
- Lorne Klein (Saskatchewan Ministry of Agriculture)
- Phil Bernardin (Engage Agro)
- Dr. Dave Feindel (Alberta Agriculture & Rural Development)
- Zafer Bashi (Saskatchewan Ministry of Agriculture)

Agri-ARM Research Update

On January 15, 2015, IHARF, along with Agriculture Applied Research Management (Agri-ARM) sites from across the province, jointly hosted the Agri-ARM Research Update. The event highlighted components of each organization's applied research and demonstration programs. Presenters for the day included:

- Chris Holzapfel (IHARF)
- Bryan Nybo (Wheatland Conservation Area)
- Jessica Pratchler (Northeast Agriculture Research Foundation)
- Garry Hnatowich (Irrigation Crop Diversification Corporation)
- Mike Hall (East Central Research Foundation)
- Lana Shaw (South East Research Farm)
- Stu Brandt (Northeast Agriculture Research Foundation)
- George Lewko (Conservation Learning Centre)

Presentations from each speaker are available for download at www.iharf.ca.

IHARF Soil and Crop Management Seminar

On February 4, 2015, IHARF hosted its annual winter seminar in White City, SK, highlighting results of the 2014 season and current industry issues. Guests took in presentations delivered by:

- Chris Holzapfel (IHARF)
- Bill May (AAFC)
- Greg Adelman (Crop Command Agronomy)
- Dr. Jeff Schoenau (University of Saskatchewan)
- Faye Dokken-Bouchard (Saskatchewan Ministry of Agriculture)
- Dr. Ron Palmer (IHARF)
- Dr. Jill Clapperton (Rhizoterra)

Presentations from each speaker are available for download at www.iharf.ca.

2014 IHARF Partners

Platinum

Agriculture & Agri-Food Canada - Indian Head Research Farm
Agriculture & Agri-Food Canada - AgriInnovation Program
Bayer CropScience
Canada / Saskatchewan ADOPT Program
Saskatchewan Canola Development Commission
Saskatchewan Ministry of Agriculture
Western Grains Research Foundation

Gold

Agriculture Development Fund
BASF
DuPont Pioneer
Mosaic
Quarry Seed
Saskatchewan Pulse Growers
University of Saskatchewan

Silver
Agrisoma Biosciences
Canola Council of Canada
Dow AgroSciences
Emerald Seeds
Engage Agro
Koch Industries
Markusson New Holland
NorthStar Genetics
Novozymes
Paterson Grain
Saskatchewan Flax Development Commission
Syngenta
Town of Indian Head
Yara

Bronze
BrettYoung
Canaryseed Development Commission of Saskatchewan
Dekalb
Delage Farms
Delmar Commodities / Legend Seeds
E.I. duPont
FMC
GPS Services
HCI Ventures
Nite Hawk Trucking
Prairie Oat Growers Association
SeedMaster
Saskatchewan Sunflower Committee
Wheatland Financial – Paul Kuntz
Whispering Pine Farms

Agri-ARM

The Saskatchewan Agri-ARM (Agriculture Applied Research Management) program connects eight regional, applied research and demonstration sites into a province wide network. Each site is organized as a non-profit organization, and is led by volunteer Boards of Directors, generally comprised of producers in their respective areas.

Each site receives base-funding from the Saskatchewan Ministry of Agriculture to assist with operating and infrastructure costs, with project-based funding sought after through various government funding programs, producer / commodity groups and industry stakeholders. Agri-ARM provides a forum where government, producers, researchers and industry can partner on provincial and regional projects.

The eight Agri-ARM sites found throughout Saskatchewan include:

- Conservation Learning Centre (**CLC**), Prince Albert
- East Central Research Foundation (**ECRF**), Canora
- Indian Head Agricultural Research Foundation (**IHARF**), Indian Head
- Irrigation Crop Diversification Corporation (**ICDC**), Outlook
- Northeast Agriculture Research Foundation (**NARF**), Melfort
- South East Research Farm (**SERF**), Redvers
- Western Applied Research Corporation (**WARC**), Scott
- Wheatland Conservation Area (**WCA**), Swift Current

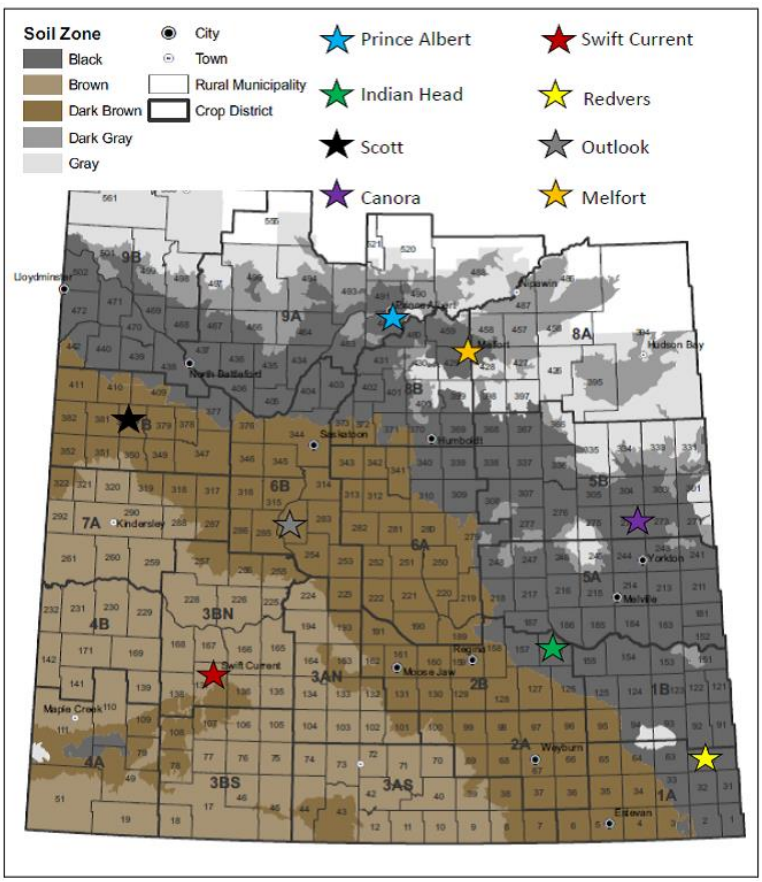


Figure 1. Saskatchewan Agri-ARM network.

Environmental Data

Weather data for Indian Head, Melfort, Scott, and Swift Current, Saskatchewan, are provided, as many of the studies were conducted at these locations and the data were combined for analyses. Data were obtained from an Environment Canada weather station found at each site, and accessed online [http://www.climate.weatheroffice.gc.ca/climateData/canada_e.html].

Seeding was delayed as a result of cold weather in April, while drier than normal conditions in May allowed for field work to progress along. Above average precipitation during harvest delayed field activities as well as downgraded many crops, and yields for most crops were near to below normal in 2014 in the Indian Head area.

Table 1. Mean monthly temperatures for the 2014 growing season and long-term normals (1981-2010).

		Apr	May	Jun	Jul	Aug	Sep	Oct
					°C			
Indian Head	2014	0.1	10.2	14.4*	17.3	17.4	12.3*	5.9*
	normal	4.2	10.8	15.8	18.2	17.4	11.5	4.0
Melfort	2014	-1.0	10.0	14.0	17.5	17.6	11.9	5.6
	normal	2.8	10.7	15.9	17.5	16.8	10.8	3.3
Scott	2014	1.6	9.3	13.9	17.4*	16.8	11.2	6.7
	normal	3.8	10.8	15.3	17.1	16.5	10.4	3.3
Swift Current	2014	2.7*	11.2*	13.5*	18.1*	17.9*	13.2*	7.9*
	normal	5.2	10.9	15.4	18.5	18.2	12.0	5.1

* = The value displayed is based on incomplete data

Table 2. Total monthly precipitation for the 2014 growing season and long-term normals (1981-2010).

		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
						mm			
Indian Head	2014	60.4	36.0	199.2*	7.8*	142.2	42.3*	21.6*	509.5
	normal	22.6	51.7	77.4	63.8	51.2	35.3	24.9	326.9
Melfort	2014	50.3	24.3*	167.3	38.8*	57.9	9.4*	34.4	382.4
	normal	26.7	42.9	54.3	76.7	52.4	38.7	27.9	319.6
Scott	2014	41.2	23.1	60.4	80.9*	30.1	23.6	4.9	264.2
	normal	21.6	36.3	61.8	72.1	45.7	36.0	17.9	291.4
Swift Current	2014	21.6*	21.7*	113.9*	14.9*	99.1*	46.8*	11.9*	329.9
	normal	19.9	48.5	72.8	52.6	41.5	34.1	18.1	287.5

* = The value displayed is based on incomplete data

Research

IHARF trials were situated at various locations in the Indian Head area, with the majority of projects located on the west half of 28-18-12 W2 and east half of 27-18-12 W2. Each trial consisted of numerous plots, each representing a specific treatment being evaluated in that particular project (eg. rates, seed treatments, varieties, etc.). Apart from the specific treatments being evaluated, plots were generally cared for using best management practices and in a manner which was consistent with normal or typical practices in the Indian Head area. Deviations in agronomy and crop management have been specified where required as a result of the study objectives or treatments being evaluated and are indicated in the description of each trial. In general, plots were seeded as early as possible in mid-May to early June, with 8’ x 35’ plots and 12” row spacing using a SeedMaster air drill, or with 12’ x 35’ plots and 12” row spacing using a ConservaPak air drill. Cultivars and varieties were representative of those used by producers in the area, and recommended seeding practices (i.e. rate, depth) were typically used. Fertility and insect, weed and disease levels were normally kept non-limiting using commercial fertilizers and registered pesticide products so that yields would not be limited by anything other than the specific treatments being evaluated. Plots were desiccated or swathed when required, and harvested as closely as possible to the appropriate timing using a Wintersteiger plot combine, Kincaid-8 XP plot combine, or modified MF300 plot combine. Apart from the treatments being evaluated, all agronomy and crop management practices were consistent for every plot within a trial.

Statistical Analyses

The majority of trials were conducted using a randomized complete block design (RCBD), or a modified version of this experimental design, meaning each treatment is randomly assigned to plots within replicates (blocks). Split-plot designs were also frequently used. Treatments were replicated 4 times allowing for the statistical analyses of results to assess whether the observed differences in the responses (eg. plant density, height, seed yield) were an effect of the treatment being evaluated or due to natural variability or experimental error. If a difference between two treatments is significant, it should be repeatable and reasonably expected, *under the conditions in which the trial was conducted*. For agricultural research, a significance level of α=0.05 is generally used, which more specifically indicates a 95% probability that an observed effect was caused by the treatment and was not due to random variability or experimental error.

In this report, statistical differences between treatments are represented by letters of the alphabet next to the observed mean (average) for each treatment. Treatment means with the same letter do not significantly differ, while means with different letters are significantly different from one another (Table 3). In this example, there was no difference in plant density between the two treatments; however, Treatment 2 resulted in a significantly higher yield than Treatment 1.

Table 3. Example of statistical significance.

Treatment	**Plant Density** *not significantly different*	**Yield** *significant difference*
Treatment 1	87 a	32 b
Treatment 2	89 a	45 a

Units

Some data are reported in metric terms (i.e. yield responses shown in kilograms per hectare), particularly in cases where it was not practical to convert the values to bushels per acre (bu/ac), as in certain figures. For reference, yield values ranging from 1000-6000 kg/ha are shown with the corresponding values in bu/ac for each crop. Alternatively, multiplying the kg/ha by 0.8921 will provide the lbs/ac, making for an easy conversion to bu/ac.

Table 4. Conversion of kg/ha to bu/ac.

		kg/ha										
		1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
Barley	bu/ac	18.6	27.9	37.2	46.5	55.8	65.1	74.3	83.6	92.9	102.2	111.5
Canola		17.8	26.8	35.7	44.6	53.5	62.5	71.4	80.3	89.2	98.1	107.1
Faba beans		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Flaxseed		15.9	23.9	31.9	39.8	47.8	55.8	63.7	71.7	79.7	87.6	95.6
Oats		26.2	39.4	52.5	65.6	78.7	91.8	105.0	118.1	131.2	144.3	157.4
Peas		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Soybeans		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Wheat		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2

Disclaimer

Disclosure of trade names does not imply any endorsement or disapproval of any specific product(s) and is only intended to differentiate treatments and allow producers to identify the specific technologies being demonstrated in the marketplace.

Effect of Fungicide Application and Timing on Winter Wheat

C. Holzapfel[1], C. Catellier[1], L. Grenkow[2], M. Vercaigne[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Western Applied Research Corporation, Scott, SK

Description

Winter wheat response to foliar fungicide applications is not well documented in western Canada; however, foliar fungicides may provide an economic method for control of leaf and head diseases in situations where moisture conditions are favourable and yield potential is high. The objective of this study was to evaluate the yield and quality response of winter wheat to foliar fungicide applications at the flag leaf stage, early heading and both stages. The foliar fungicide treatments consisted of: 1) an untreated check, 2) a flag leaf application of Twinline (202 mL/ac), 3) an early heading application of Prosaro (324 mL/ac), and 4) both the flag leaf and early heading applications. This study was conducted at Indian Head and Scott in 2014, and data from Indian Head in 2013 was also included in the analysis.

Results

The effect of fungicide applications on leaf disease and FHB are shown separately for each site as the results differed between the sites. Severity of leaf disease was rated using the McFadden scale (1-12) for ten plants per plot. Leaf diseases ratings were completed close to the time of the early heading fungicide application at Scott but later, at the milk stage, at Indian Head. So, the ratings at Scott do not take into account any impacts of the later fungicide application on leaf disease. Leaf disease was higher in the check than with any fungicide timing application at Indian Head in both years. Other differences among site-years in leaf disease with fungicide application timing were likely a result of environmental conditions experienced at different growth stages; however, at all three sites leaf disease was significantly lower than the check with two fungicide applications (Figure 2).

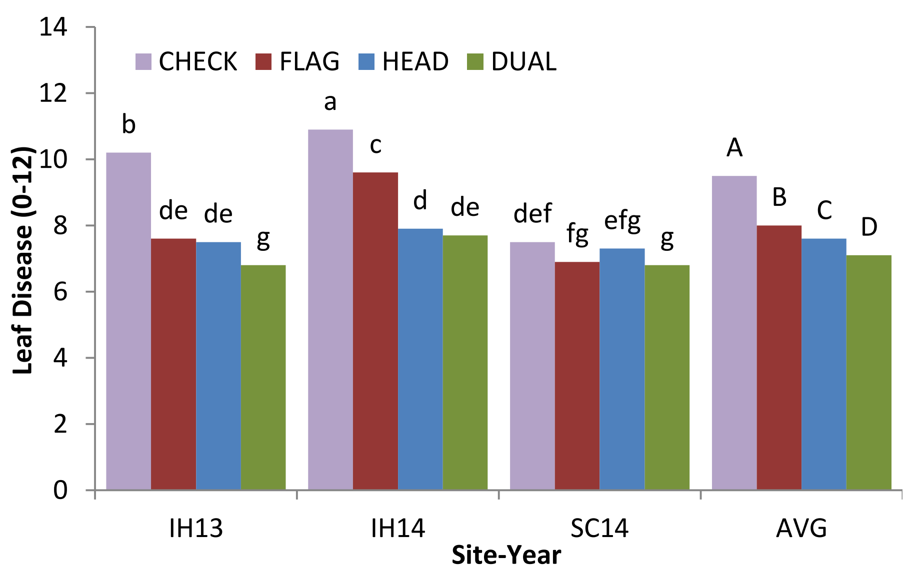


Figure 2. Winter wheat leaf disease severity as affected by different timings of foliar fungicide treatments.

Fusarium head blight (FHB) was assessed by rating the percent spike area affected for a minimum of 50 heads per plot at the milk stage. The FHB index is the product of the percent of infected heads (FHB incidence) and the percent area affected in the infected heads (FHB severity). When all three site-years were averaged, the early heading fungicide application was most successful in reducing FHB (Figure 3).

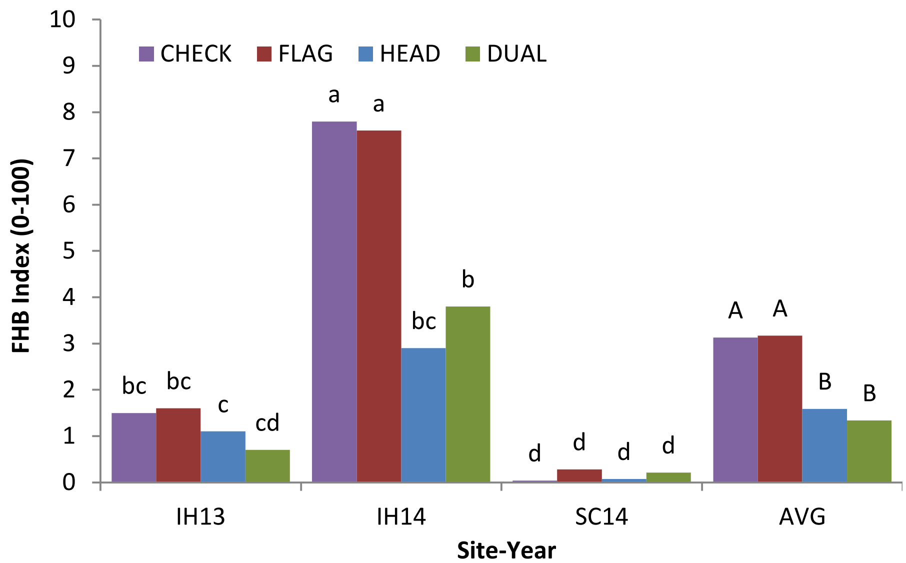


Figure 3. Winter wheat FHB index as affected by different timings of foliar fungicide treatments.

Yield and grain quality (test weight) response to fungicide application was similar at all site-years, so only the average is shown. All fungicide application timings resulted in a significant increase in yield and test weight over the check. There was no difference in yield between the two fungicide timings and there was no yield benefit to a dual application (Table 5).

Table 5. Winter wheat grain yield and test weights as affected by foliar fungicide treatments in all three site-years (Indian Head 2013 and 2014, Scott 2014) combined.

Treatment	Yield (bu/ac)	Test Weight (g/0.5L)
Check	75.0 b	396 c
Flag Leaf	87.8 a	400 b
Early heading	89.3 a	403 ab
Dual	90.5 a	403 a

Conclusions

Both fungicide application timings tended to reduce leaf disease; however, only the later application reduced FHB infection. Consequently, unless disease pressure is particularly high early in the season and already progressed to the upper canopy at the time of flag leaf emergence, producers may be better off deferring application until heading and choosing a product that is also registered for suppression of FHB. A dual application did not provide a significant improvement over a single application at early heading and products registered for suppression of FHB (i.e. Prosaro, Caramba, etc.) also protect against leaf disease. Consequently, under moderate disease pressure, fungicides applied at early heading are likely to provide the most consistent yield and quality benefits.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, with in-kind support provided by BASF and Bayer CropScience.

Winter Wheat Establishment and Disease Management

C. Holzapfel[1], C. Catellier[1], L. Grenkow[2], M. Vercaigne[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Western Applied Research Corporation, Scott, SK

Description

One of the greatest challenges in winter wheat production is successful establishment and overwintering of the crop. One of the more effective methods of improving winter wheat establishment is to use higher seeding rates; however, the benefits to increased seeding rates ultimately need to be weighed against higher seed costs. Previous studies have shown that seed treatments were also effective for improving plant stands, winter survival and yield. Foliar fungicides may provide an economic method for control of leaf and head diseases and recent field demonstrations have suggested that winter wheat is quite responsive to foliar fungicide. The objectives of this project were 1) to demonstrate the effects of using seed treatments and/or higher seeding rates to improve winter wheat establishment and 2) to investigate potential interactions between plant populations, seed treatments and foliar fungicide applications for winter wheat. The trial was conducted at both Indian Head and Scott and treatments are outlined in Table 6.

Table 6. Treatments evaluated in the winter wheat establishment and disease management trial at Indian Head and Scott in 2014.

Trt	Seeding Rate (seeds/m^2)	Seed Treatment[Z]	Foliar Fungicide[Y]
1	200	no	check
2	300	no	check
3	400	no	check
4	200	treated	check
5	300	treated	check
6	400	treated	check
7	200	no	Fungicide
8	300	no	Fungicide
9	400	no	Fungicide
10	200	treated	Fungicide
11	300	treated	Fungicide
12	400	treated	Fungicide

[Z]Raxil Pro at 325 mL/100 kg seed

[Y]Twinline 0.2 L/ac at flag leaf and Prosaro 250 EC 0.324 L/ac at anthesis

Results

Results in 2014 were not as dramatic as was observed in an earlier version of this trial at Indian Head in 2013 (see IHARF 2013 Annual Report), though conditions were more typical in 2014. At Indian Head in 2014, winter wheat establishment was estimated by measuring early season NDVI, while plant density was utilized at Scott. NDVI is an indirect measure of above-ground biomass. Seed treatment significantly increased early season NDVI/plant density and yield but had no effect on test weight at both locations (Table 7). Seeding rate affected NDVI, yield, and test weight at Indian Head, but only affected plant density at Scott. Fungicide effects on early season NDVI and plant density were not relevant as the fungicide treatments were applied after these measurements were taken. Foliar fungicide application had a large effect on yield and also a significant effect on test weight at both locations. The benefits of seed treatment, seeding rate, and foliar fungicide were independent of each other as there were no interactions between the factors in their effect on winter wheat establishment, yield, or quality.

Table 7. Effect of fungicide, seed treatment, and seeding rate on winter wheat at Indian Head and Scott, SK. in 2014.

	Indian Head			Scott		
	NDVI	Yield bu/ac	Test Weight g/0.5L	Plant Density plants/m^2	Yield bu/ac	Test Weight g/0.5L
Seed treatment						
Check	0.358 b	73.6 b	396 a	101 b	67.5 b	391 a
Treated	0.380 a	75.1 a	396 a	131 a	73.6 a	392 a
Seeding rate						
200	0.328 b	72.8 b	395 b	91 b	68.6 a	391 a
300	0.392 a	75.6 a	396 a	125 a	68.9 a	390 a
400	0.388 a	74.6 ab	396 a	133 a	74.1 a	393 a
Fungicide						
Check	NA	69.2 b	392 b	NA	61.6 b	385 b
Treated	NA	79.5 a	399 a	NA	79.4 a	398 a

Conclusions

Seed treatments are a reasonably low cost tool that protect against seed decay, diseases and can help the crop get off to as strong a start as possible, thereby increasing the likelihood of successful overwintering. The response to seed treatments in these trials was strong with significant impacts on crop establishment (NDVI/plant density) and grain yield at both sites. Seed treatment increased yield by 9% at Scott, and 2% at Indian Head. The yield increase was not as substantial as was observed at Indian Head in 2013, but 2014 results indicate the benefit is consistent. Our results also support the recommendation that producers should seed winter wheat at rates of 300 seeds/m^2 or higher and consider treated seed to increase the likelihood of strong establishment and overwintering, particularly under stressful conditions. Once the crop is established, foliar fungicides may also protect winter wheat yield potential by reducing the impact of leaf and head diseases on yield, growth and quality.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, with in-kind support provided by BASF and Bayer CropScience.

Nitrogen Fertilizer Management Options for Winter Wheat

C. Holzapfel[1], C. Catellier[1], L. Grenkow[2], M. Vercaigne[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Western Applied Research Corporation, Scott, SK

Description

The traditional recommendation for N fertilization of winter wheat in southeast Saskatchewan has been to broadcast granular N fertilizer in the spring. The preferred product, ammonium nitrate (AN), has not been readily available for many years. While banding N fertilizer sources during seeding is desirable from a logistic perspective, this practice has generally been considered risky with traditional fertilizer products and winter crops considering the extended period between planting and maximum crop uptake of N. Alternative practices need to address the long growing season of winter wheat and high potential for environmental losses with fall in-soil or spring surface applications. The objectives of this project were to: 1) Demonstrate the feasibility of side-banding the entire N requirements of winter wheat at seeding relative to top-dressing N fertilizer in the early spring; 2) Demonstrate the potential merit of using slow release N products (i.e. Super-Urea®, ESN®, Nutrisphere-N®) for either fall side-band

and spring broadcast applications and; 3) Demonstrate the potential merits of split N applications where a portion of the N is applied at seeding and the remainder top-dressed in the early spring.
Twenty-four N fertilizer treatments were evaluated where the rates, placement methods, timings and forms of N fertilizer were varied (Table 8). The applied N rate was 0, 75 or 115 kg/ha and the forms were untreated urea (46-0-0), ESN (44-0-0), Super-Urea (46-0-0), UAN (28-0-0) or AN (34-0-0). For fall applications, granular fertilizers were placed in a side-band while, for spring applications, granular fertilizer was broadcast on the soil surface. Liquid UAN was applied in surface dribble-band. The split applications consisted of 40% of total N rate as side-banded urea at seeding (or dribble-banded in the late fall) and the remainder broadcast or dribble-banded in the early spring. An additional treatment was included which represented the traditionally recommended practice of broadcasting ammonium nitrate in the spring at a rate based on soil test recommendations.

Table 8. Treatments evaluated in 2013-14 winter wheat nitrogen demonstrations at Indian Head.

N Rate (kg/ha N)	**Fall**	**Spring**	**Split**
0	-	-	-
75	Urea ESN SuperU UAN	AN Urea ESN SuperU UAN	-
115	Urea ESN SuperU UAN	AN Urea ESN SuperU UAN	Urea ESN SuperU UAN

Results
The study was conducted at Indian Head in 2013 and 2014 and at Scott in 2014. Results from Indian Head in 2014 are presented. Contrasts comparing yields of specific groups of treatments are shown in Figure 4. As expected, the check yield was significantly lower than the fertilized treatments, and yields at the 115 kg N/ha rate exceeded those at the 75 kg N/ha rate. In contrast to the previous season (refer to 2013 Annual Report), spring N applications yielded slightly higher than fall applications when averaged across products and rates. Split applications of N also produced higher grain yield than when all N was applied in the fall, while yields with spring application and split application were similar.

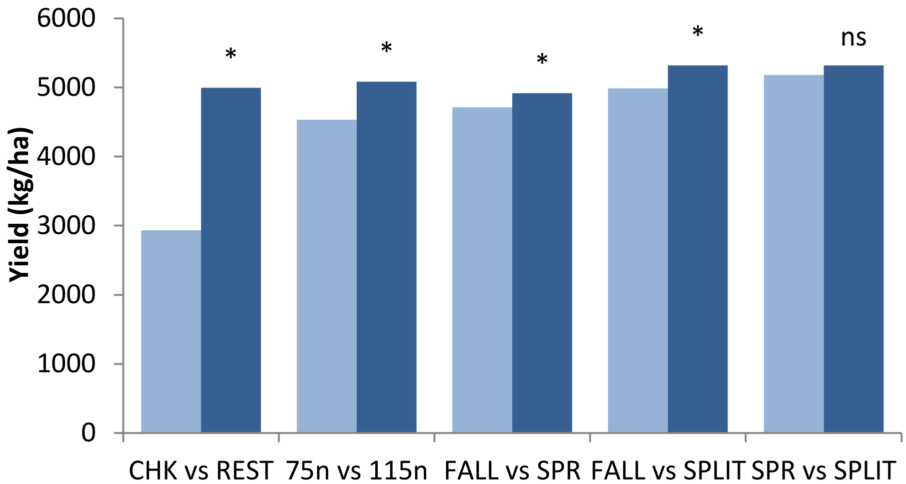


Figure 4. Contrasts comparing the yield response of specific groups of N fertility treatments on winter wheat. A '*' indicates that the contrast is significant, while 'ns' indicates that the groups are not significantly different.

The lower yields seen with fall side-banded fertilizer compared to spring broadcast was mostly due to the UAN where yields were 21% higher when applied in the spring. For the other N fertilizer forms, urea, ESN and SUPERU, there was no significant difference between yields with fall side-band versus spring broadcast applications when averaged across the two rates. Yields obtained with ESN and SUPERU did not differ significantly from yields obtained with urea in either the spring or fall; however, UAN fertilizer produced significantly lower yields than urea in both the spring and fall (Figure 5). UAN is normally considered a good choice for spring applications due to a lower risk of volatile losses compared to untreated urea, though with prolonged wet conditions following application, potential losses could be higher for UAN.

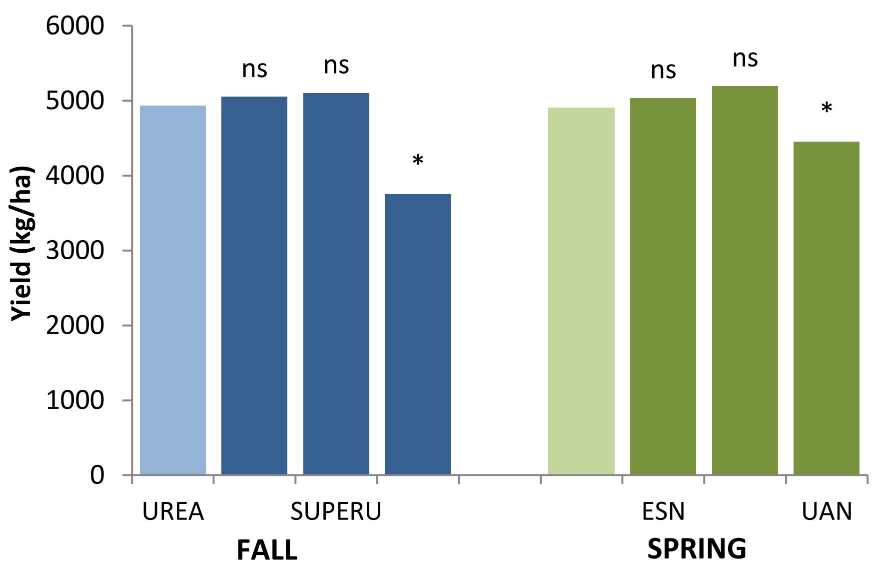


Figure 5. Contrasts comparing the yield response of ESN, SUPERU, and UAN to untreated urea with fall side-band and spring broadcast applications. A '*' indicates that the contrast is significant, while 'ns' indicates that the groups are not significantly different.

Conclusions

At Indian Head in 2013 and Scott in 2014, fall applications of N fertilizer resulted in better yields than spring applications, likely as a result of drier conditions. Furthermore, when the fall and early spring were dry, fall side-band applications of fertilizer performed as well or better than the traditional recommended practice of broadcasting ammonium-nitrate (34-0-0) in the early spring. In contrast, at Indian Head in 2014, conditions were wetter at planting, through the early spring, and following the spring fertilizer applications, so that applying N in the spring performed well and resulted in better yields than when all N was applied in the fall. Under the wet conditions, broadcast AN was one of the most effective treatments; however, yields were similar with fall-applied ESN and SUPERU and spring-applied SUPERU. Split applications performed well under all conditions and may be the lowest risk option for winter wheat producers under a broad range of conditions.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Oat Response to Phosphorus and Potassium Fertilization under Varying Nitrogen Levels

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Oats are often considered relatively unresponsive to fertilizer applications; however, the crop is known to be an excellent scavenger of residual soil nutrients. Under high yielding conditions, oats can take up a large amount of nitrogen (N), and there is increased potential for other important nutrients to become limiting. Research has shown that oat response to phosphorus (P) fertilizer application can be inconsistent, though oats can remove quite a bit of P which must be returned to maintain soil quality. Potassium (K) is rarely considered limiting in Saskatchewan soils and documented oat responses to this nutrient have been limited. Many producers are opting for full and balanced fertility as a way of enhancing grain yield and quality of oats, while also maintaining soil quality in the long-term.
The objective of this study was to evaluate the effects of P and K fertilizer applications on the yield and quality of white milling oats under both high and low N levels. The treatments compared were twelve different combinations of applied rates of N, P, and K fertilizer (Table 9). Soil residual N and P at this location were low, while K was high.

Table 9. Treatments evaluating the effect of N, P, and K fertility on oats at Indian Head in 2014.

Trt	N	P_2O_5 (kg/ha)	K_2O
1	55	-	-
2	55	20	-
3	55	40	-
4	55	-	30
5	55	20	30
6	55	40	30
7	115	-	-
8	115	20	-
9	115	40	-
10	115	-	30
11	115	20	30
12	115	40	30

Results

The oats were responsive to both N and P fertilization. Yield was increased by 20% when the N rate was increased to the higher rate, and by an additional 4% with P fertilization. There was no significant yield benefit going from 20 to 40 kg/ha P_2O_5, even at the higher rate of applied N (Figure 6). Quality declined with higher N rates; both test weight and seed size was lower at the higher rate of N. However, test weight increased significantly with P fertilization. K fertilizer application had no significant effect on grain yield or any measure of grain quality.

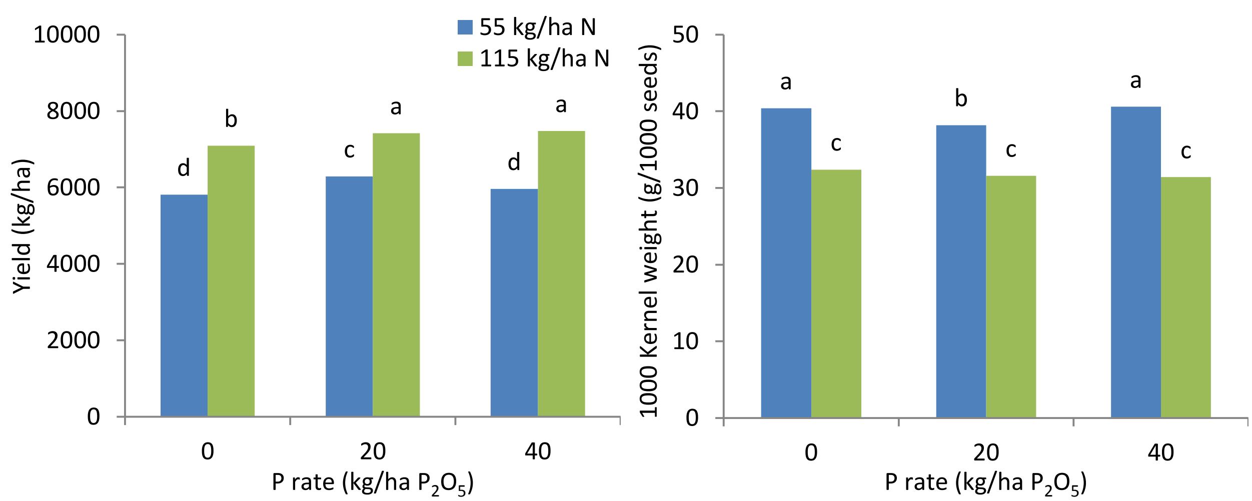


Figure 6. The effect of N and P fertilization on oat yield and grain quality at Indian Head in 2014.

Conclusions

This study indicates that the optimal N rate is likely to be higher than 55 kg/ha N under high yielding conditions, and that yield increases with P fertilization are likely when residual P is low. Soil testing is a useful tool to predict whether higher than usual N rates are required and whether P fertilization is likely to increase yield; however, growers should be cautious with N applications on oats to minimize the impact on grain quality.

Acknowledgements
This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Yield Response and Test Weight Stability of Oat to Fertilizer Nitrogen

B. May[1], M. Hall[2], S. Brandt[3], L. Shaw[4]

[1]Agriculture & Agri-Food Canada, Indian Head, SK; [2]East Central Research Foundation, Yorkton, SK; [3]Northeast Agriculture Research Foundation, Melfort, SK; [4]South East Research Farm, Redvers, SK

Description
Growers are looking for ways to increase their yield and maintain the quality of the oats they grow. Many are using higher nitrogen rates than would be considered typical, with varying degrees of success due to lodging and decreased test weights. Research indicates that some cultivars have a more stable test weight than others as the nitrogen rate is increased. This project aimed to help producers better choose the appropriate cultivar and N fertility rates when growing oats, looking at four different cultivars and four different nitrogen rates.

Results
At all locations, there was no interaction amongst the cultivars in their response to nitrogen fertilizer; which shows us that all the cultivars tested responded in a similar manor to the application of N. As the N rate increased, lodging increased and test weight decreased (Table 10), though even the highest N rate applied resulted in a test weight that still met milling quality standards.

Table 10. Yield response and test weight stability of oat to N fertilizer at Indian Head, 2014.

	Density		**Lodging**		**Grain Yield**		**Test Weight**	
	(plants/m^2)		(1 - 10)		(bu/ac)		(g/0.5 L)	
Cultivar								
Stride	241.2	a	6.8	a	97.8	a	261.9	a
Pinnacle	221.9	a	6.6	a	105.7	a	248.3	c
CDC Orrin	228.7	a	6.6	a	108.2	a	256.1	b
CDC Big Brown	228.9	a	5.8	a	106.0	a	260.5	ab
N Rate (kg/ha)								
40	228.5	a	3.8	d	89.9	b	264.3	a
60	230.9	a	5.8	c	108.7	a	261.1	a
80	234.0	a	7.4	b	106.3	a	255.6	b
120	227.4	a	8.8	a	112.7	a	245.8	c

Conclusions
It appears that in wetter than normal environmental conditions, oat yield is more responsive and test weight is less sensitive to high N rates than found in past research. More testing is required to differentiate the response of cultivars to increasing N rates.

Acknowledgements
This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Effect of Macro & Micronutrients on the Yield and Development of Canaryseed

B. May[1], M. Hall[2], S. Brandt[3], L. Shaw[4], B. Nybo[5], L. Grenkow[6]

[1]Agriculture & Agri-Food Canada, Indian Head, SK; [2]East Central Research Foundation, Yorkton, SK; [3]Northeast Agriculture Research Foundation, Melfort, SK; [4]South East Research Farm, Redvers, SK; [5]Wheatland Conservation Area, Swift Current, SK; [6]Western Applied Research Corporation, Scott, SK

Description

Recent research has identified chloride to be an important nutrient in canaryseed production, and that higher levers of N may not be necessary. This project was initiated to show producers the importance of a complete nutrient package when growing canary. The treatments evaluated are detailed in Table 11.

Table 11. Nutrient treatments in canaryseed fertility study, 2014.

Trt	**N**	**P_2O_5**	**K_2O**	**Cl**	**S**	**Cu**	**Zn**	**Cu, Zn, Mg, B**
	kg/ha							
1	0							
2	15		20	18.1				
3	30		20	18.1				
4	30	30	20	18.1				
5	30	30	20	18.1	15			
6	60	30	20	18.1	15			
7	60	30			15			
8	60	30	20	18.1	15	3		
9	60	30	20	18.1	15		3	
10	60	30	20	18.1	15			Yes
11	90	30	20	18.1	15			Yes

Results

Plant density varied among the fertilizer treatments but there does not appear to be any clear trend. The largest impact on lodging appeared to be an increase N rate, and the addition of copper. And as with oats, increasing the N rate decreased the test weight of the canary (Table 12).

Table 12. Effect of macro and micronutrients on canaryseed at Indian Head, 2014.

Trt	Plant Density (plants/m^2)		Average Height (cm)		Lodging (0-10)		Grain Yield (bu/ac)		Test Weight (g/ 0.5 L)	
1	176.3	abc	104.5	bc	3.0	de	22.3	a	374.9	a
2	237.9	a	103.4	bc	3.8	cde	24.0	a	373.3	abc
3	153.4	bc	96.4	c	2.0	e	19.6	a	375.3	a
4	147.2	bc	112.9	ab	3.3	de	25.9	a	374.4	ab
5	231.3	a	119.6	a	4.3	cd	29.7	a	375.1	a
6	187.0	abc	120.3	a	3.8	cde	29.1	a	372.5	abc
7	201.4	abc	118.3	a	3.5	de	23.4	a	362.3	e
8	162.8	bc	118.5	a	5.5	bc	27.6	a	368.8	cd
9	206.7	ab	117.4	a	4.3	cd	27.5	a	369.7	bcd
10	148.0	bc	117.6	a	6.3	b	29.4	a	371.5	abc
11	136.6	c	119.6	a	8.3	a	29.1	a	365.5	d

Conclusions

In this study, canaryseed responded to N at five of the six locations, and chloride at half of the locations. From these results and from that of past projects, producers growing canaryseed should apply chloride in the form of potash fertilizer and only use moderate amounts of nitrogen.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Fungicide Timing for Controlling Leaf and Head Disease in Spring Wheat

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

The incidence and severity of leaf disease and fusarium head blight (FHB) in spring wheat have been rising in many parts of Saskatchewan, leading to an increase in the use of fungicides and interest in new varieties with improved FHB resistance. The optimum timing of fungicide application for control of leaf spotting diseases is the flag leaf stage, while the optimum timing for suppression of FHB is at early flowering. Producers are interested in the possibility and effectiveness of a single fungicide application to control both leaf spotting diseases and FHB. Hard red spring wheat cultivars differ genetically in their resistance to fungal pathogens and, consequently, the benefits of fungicide application may differ between cultivars. This project will demonstrate the effects of fungicide timing on leaf spot disease and FHB on two wheat cultivars that differ in their genetic resistance packages to fungal pathogens.

This study was conducted at other sites and in previous years but only Indian Head in 2014 is presented here. Four fungicide treatments differing in the timing of application were applied to two spring wheat varieties (Table 13). Unity VB is rated F (fair) for both leaf spot and FHB resistance, while Goodeve VB is rated F for leaf spot and VP (very poor) for FHB resistance. The T1 application was at the flag leaf stage and consisted of 0.5 L/ha of Twinline, and the T2 application was at the early flowering stage and consisted of 0.8 L/ha Prosaro 250 EC. Leaf disease ratings were conducted using the McFadden Scale and FHB index (product of incidence and severity) was calculated from ratings of 50 heads per plot at the late milk/early dough stage.

Table 13. Treatments evaluating the effect of fungicide timing on spring wheat.

Trt #	Variety	Fungicide Timing
1	Unity VB	no fungicide
2	Unity VB	T1
3	Unity VB	T2
4	Unity VB	T1 + T2
5	Goodeve VB	no fungicide
6	Goodeve VB	T1
7	Goodeve VB	T2
8	Goodeve VB	T1 + T2

Results

Both fungicide applications resulted in a significant reduction in leaf disease, but the greatest reduction was associated with the early flowering application. There was a tendency for higher leaf disease with Goodeve compared to Unity (Figure 7). The fungicide options registered to suppress FHB (with an early flower application) are also registered to control leaf spot disease, and conditions at Indian Head in 2014 were conducive to disease development later in the season.

Without a fungicide application, FHB index was significantly lower with Unity than Goodeve. Fungicide application tended to lower FHB index in Unity but not significantly. The flag-leaf application did not significantly affect FHB index, but the early flowering application did significantly decrease FHB in Goodeve. The dual application did not provide a benefit in lowering leaf disease or FHB in either cultivar.

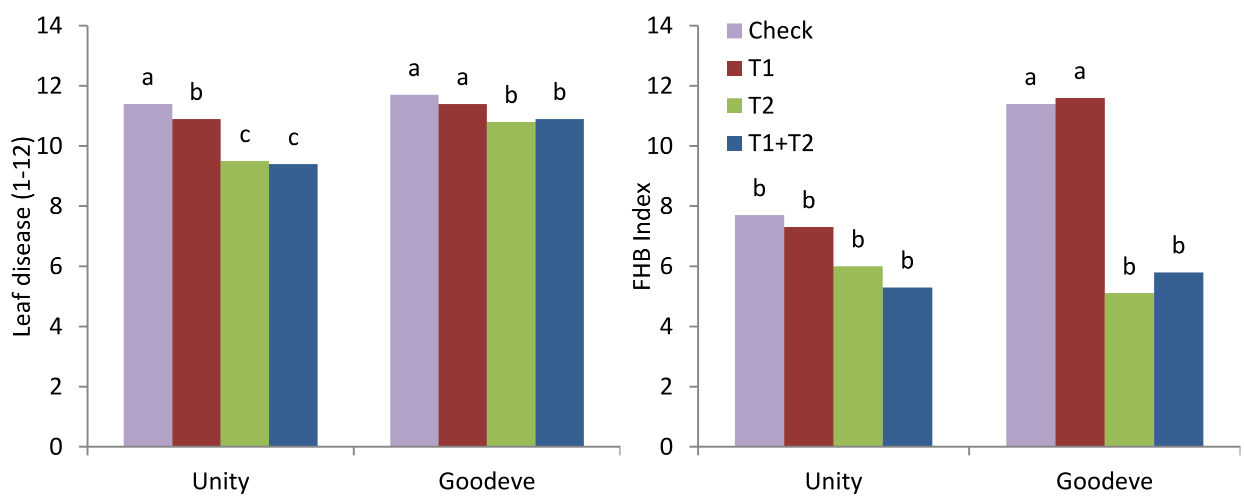


Figure 7. The effect of different fungicide application timings on leaf disease and FHB index in spring wheat at Indian Head in 2014.

Though the two varieties differed in the development of disease, they did not differ in yield response to the different fungicide application timings (Table 14). Test weight was lower in Goodeve, but the effect of fungicide applications on test weight was the same for both varieties. Yield and test weight generally increased with fungicide, though the greatest benefit occurred with the early flower application.

Table 14. The effect of cultivar and fungicide treatment on spring wheat yield and quality at Indian Head in 2014.

Main Effect	Grain Yield (bu/ac)		Test Weight (g/0.5 L)	
Variety				
Unity VB	63.7	a	394	a
Goodeve VB	63.5	a	388	b
Fungicide				
Untreated	59.9	c	388	c
Flag Leaf (T1)	62.2	bc	390	b
Anthesis (T2)	65.1	ab	392	a
Dual (T1 + T2)	67.3	a	393	a

Conclusions

The results of this demonstration were consistent with those of the previous season. As the varieties responded similarly to the fungicide application treatments, it is likely that when disease pressure is moderate to high, similar yield and quality benefits to foliar fungicide applications can be expected regardless of differences in genetic disease resistance. This is not to say that genetic disease resistance is ineffective or unimportant; however, it suggests that fungicides may still be beneficial when using a variety with improved resistance when disease pressure is sufficiently high.
Applying fungicide at the flag leaf stage was consistently less beneficial than fungicides applied at early flowering to target FHB. The later application may provide adequate protection against leaf disease while also suppressing FHB because the optimal time to control FHB is typically only 7-10 days past the flag-leaf stage and the registered products for this application also control leaf disease. A dual application did not provide a significant benefit over a single application at early flowering.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, with in-kind support provided by BASF and Bayer CropScience.

Application Timing and Fertility Effects on Spring Wheat Response to Plant Growth Regulator

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Plant growth regulators (PGR) are typically used to reduce internode elongation in cereals to decrease plant height, thicken stems, and reduce the potential for lodging. Previous research in Indian Head showed that yield can be significantly reduced at higher seeding rates when using varieties that are susceptible to lodging. The reduction in lodging that could be achieved with PGR potentially allows other inputs, such as fertilizer, to be increased or intensified to promote higher yields than would otherwise be possible. The objective of this study was to determine the effect of application timing and fertility level on the response of spring wheat to the plant growth regulator Manipulator® (chlormequat chloride).

The treatments tested were a combination of four PGR application timings (including a control) and three fertility levels. The PGR treatments were 1) No PGR; 2) Early application - late herbicide timing, growth stage Zadocks 21 (start of tiller formation); 3) Late application - growth stage Zadocks 31 (start of stem elongation); and 4) Zadoks 41 (Flag leaf). The fertility treatments were 100%, 125%, and 150% of the recommended fertility package for spring wheat in the thin Black soil zone (112-34-17-17 kg/ha N-P_2O_5-K_2O-S).

Results

The effect of PGR application and timing on spring wheat height, lodging, and yield was similar to what was seen in this trial in previous years. An application of PGR at any time significantly decreased plant height relative to no PGR application; however, the later application was the most effective in reducing plant height. Fertility rate did not have any effect on height for the ranges of fertilizer included (Figure 8). An application of PGR significantly reduced lodging relative to no PGR, and there was no difference in lodging between the different timings of application. Lodging was more severe at higher fertility levels (Figure 9). Yield increased with the application of PGR, and the latest application was the most effective. The yield benefit with PGR application was more apparent at higher rates of fertility (Figure 10).

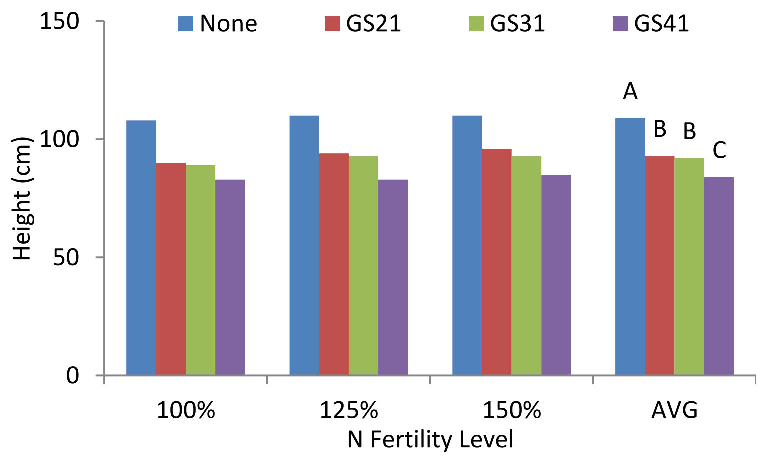


Figure 8. Effects of PGR application and timing on spring wheat plant heights at different fertility levels.

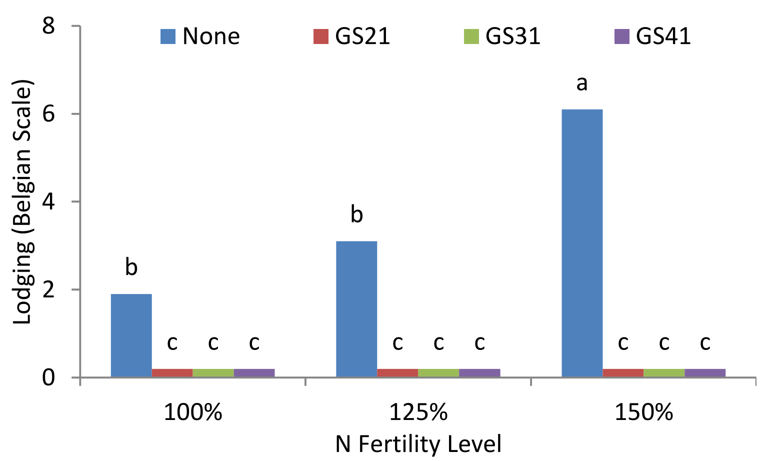


Figure 9. Effects of PGR application and timing on spring wheat lodging at different fertility levels.

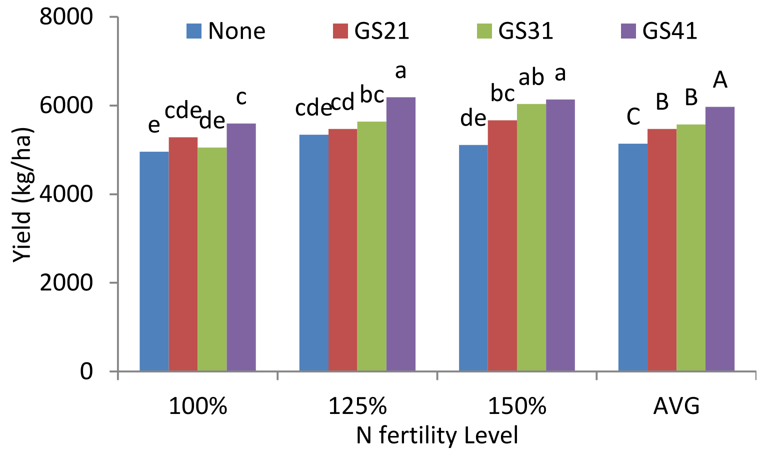


Figure 10. The effects of PGR application and timing on spring wheat yield at different fertility levels.

Conclusions

Results from 2014 are consistent with results from 2013, and indicate the potential for PGR applications to reduce height and lodging while enhancing wheat yields, particularly when combined with high fertility rates. Tank-mixing with herbicides is a possibility but optimal timing for herbicide application may be earlier than for the PGR if weed pressure is high. There is also risk of reduced efficacy if the PGR is applied too early.

Acknowledgements

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Soil Building Effects of Long-term No-till Using a Canola-Spring Wheat Rotation

C. Catellier[1], C. Holzapfel[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Yields may improve with time spent under no-till management for many reasons, including enhanced soil organic matter (SOM) content and thus potential N mineralizability, and this effect is likely mediated by N fertility management. Producers are interested in knowing how to further enhance the productivity of no-till soils, and if soil and crop management approaches for soils that have been under no-till management for many years (long-term no-till) should differ from soils that were recently converted to no-till management (short-term no-till). Furthermore, it is desirable for producers to manage nutrient fertility efficiently, to sustain maximum crop productivity and profitability while minimizing wasteful nutrient application. In this study, we examined the cumulative and on-going changes occurring as the length of time under no-till increases by comparing measures of crop productivity at two sites differing in the period of time under no-till, long-term (LT) 34 years no-till and short-term (ST) 11 years no-till. A canola-spring wheat rotation was maintained on each site, where one of five rates of N fertilizer (0, 30, 60, 90, and 120 kg N/ha) was applied consecutively to the same plot over a 10 year period, in order to capture the long-term effect of the various N fertility rates. In 2012 to 2014, a uniform N rate (80 kg N/ha) was applied to half the replicates, and the variable N fertility rates were continued on the remaining replicates. The treatments are outlined in Table 15. Wheat was grown in 2012 and 2014, while canola was grown in 2013.

Table 15. Summary of treatments which were arranged randomly in each of the LT and ST no-till fields.

Trt	Rate Type	Past N Rate (kg N/ha)	Applied N Rate (kg N/ha)
1	Variable	0	0
2	Variable	30	30
3	Variable	60	60
4	Variable	90	90
5	Variable	120	120
6	Constant	0	80
7	Constant	30	80
8	Constant	60	80
9	Constant	90	80
10	Constant	120	80

Results

The measures of crop productivity that were compared between LT and ST no-till sites were plant density, flag leaf N (wheat rotation only), grain yield, and grain N content. The response to N rates was similar at both the LT and ST sites for most of the variables; however, there was a difference in flag leaf N response between the two sites.

Variable and constant N rate plots were analyzed separately, but both years (wheat rotation, 2012 and 2014) were analyzed together to simplify interpretation of the results. The flag leaf N response to applied N in variable N rate plots indicated that no matter the current or past fertility level, LT no-till has a greater ability to provide plant-available N during the growing season, especially at the lowest and highest N fertility rates Figure 11.

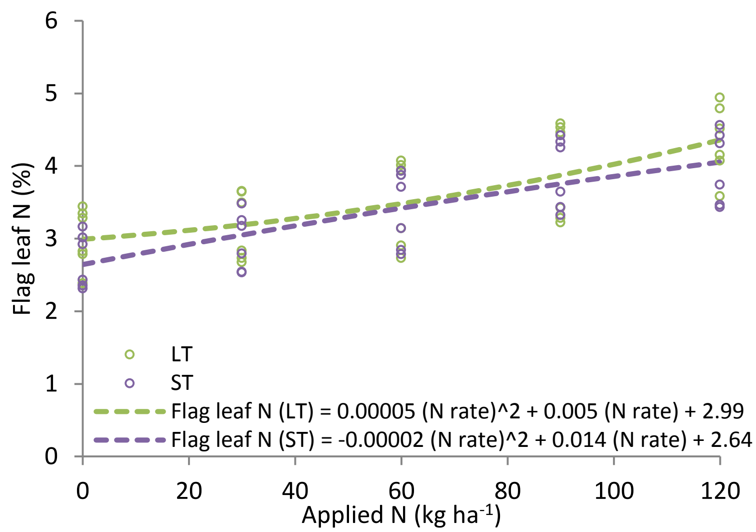

Figure 11. The effect of applied N and no-till history on wheat flag leaf N in variable rate plots at Indian Head in 2012 and 2014 combined.

The flag leaf N response to past N in constant N rate plots also indicated that LT no-till has a greater ability to provide plant-available N during the growing season, at any current or past N fertility level. In addition, there was a linear increase with past N even though applied rates were constant. This indicates that N mineralization increased with past N rates in both ST and LT no-till fields (Figure 12).

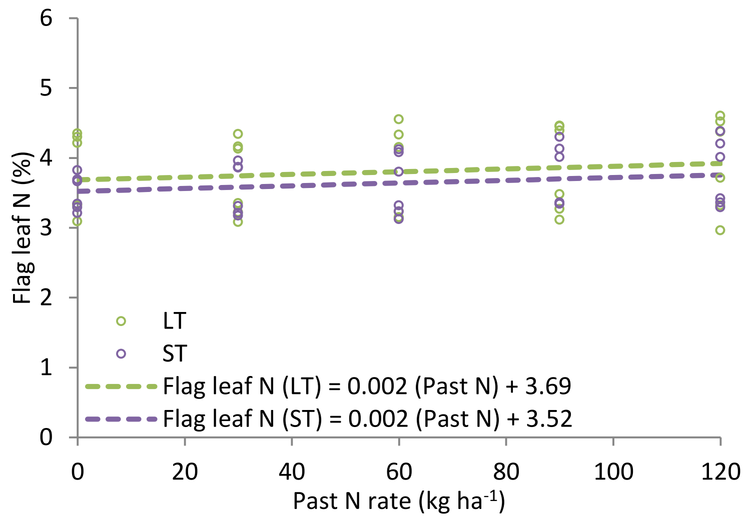

Figure 12. The effect of past N rate and no-till history on wheat flag leaf N in **constant** rate plots at Indian Head in 2012 and 2014 combined.

Conclusions

It was determined that early season plant N availability was higher in long-term than short-term no-till, and that plant available N in the early season also increased with past N application rates. By completing this project, we have gained a more in-depth understanding of the long-term impact of no-till combined with long-term N fertilizer management in crop production. The project will generate information on appropriate N fertilizer rates for maximizing productivity while reducing the impacts of N inputs on the environment.

Acknowledgements

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Seeding Rates for Precision Seeded Canola

L. Grenkow[1], M. Vercaigne[1], C. Holzapfel[2], C. Catellier[2], S. Brandt[3], L. Shaw[4]

[1]Western Applied Research Corporation, Scott, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]Northeast Agriculture Research Foundation, Melfort, SK; [4]South East Research Farm, Redvers, SK

Description

The establishment of a uniformly distributed canola stand is essential to yield, as uneven seed distribution within the row can lead to increased plant to plant competition. Further, the uniform distribution of plants within the row may potentially allow reduced seeding rates due to reduced seedling mortality, resulting from lower competition amongst canola plants. SeedMaster's UltraPro canola roller has been designed to space seeds more evenly within each row, as opposed to the more conventional bulk metering systems and fluted rollers which can lead to clusters and gaps in seed distribution, particularly at low seeding rates. The objectives of this project were to: 1) determine if the UltraPro canola roller produces more uniform canola seed placement, and 2) determine if more uniform seed placement has the potential for allowing lower canola seeding rates. Treatments included seeding rates of 10, 20, 40, 80, 160 and 320 seeds/m applied with both the traditional Valmar fluted roller and SeedMaster's UltraPro roller.

Results

When all 12 site-years were combined, spring and fall plant density and yield increased with seeding rate while days to maturity decreased with seeding rate; however, all values were similar for the two rollers, within each seeding rate (Table 16). Yield was significantly decreased at the 10 plants/m^2 seeding rate but did not significantly differ at any of the other seeding rates, demonstrating canola's ability to compensate for low plant populations through plasticity in growth habit.

Table 16. The effect of seeding rate and roller type on canola spring and fall plant density, maturity, and yield over 12 site-years combined.

Roller	**Seeding Rate** (seeds/m^2)	**Spring Plant Density** (plants/m^2)		**Days to Maturity**		**Seed Yield** (bu/ac)		**Fall Plant Density** (plants/m^2)	
Valmar	10	13	e	99.7	a	33.4	b	11	g
Valmar	20	20	de	99.3	a	40.9	ab	19	fg
Valmar	40	36	de	97.9	abc	41.6	a	31	efg
Valmar	80	72	cd	96.6	bcde	44.1	a	57	cde
Valmar	160	136	b	95.1	de	44.0	a	91	bc
Valmar	320	212	a	94.4	e	44.0	a	139	a
UltraPro	10	12	e	99.4	a	33.6	b	12	g
UltraPro	20	17	e	98.8	ab	38.4	ab	16	fg
UltraPro	40	36	de	97.2	abcd	43.2	a	32	efg
UltraPro	80	60	de	97.2	abcd	44.9	a	52	def
UltraPro	160	118	bc	95.3	cde	44.9	a	88	bcd
UltraPro	320	193	a	94.5	e	43.9	a	120	ab

Mean distance between seedlings in the spring was similar for both rollers at each level of seeding rate, and standard deviation of the mean distance, indicating the variability in distance between plants was also very similar between the two rollers (Figure 13).

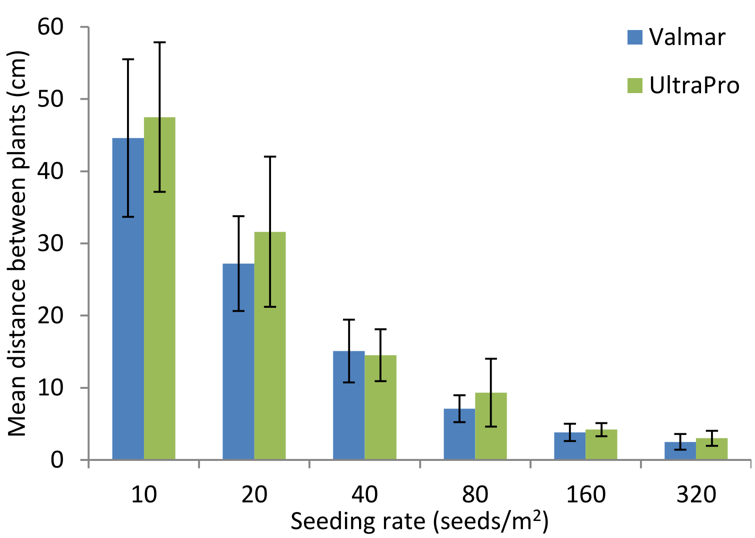

Figure 13. The mean distance between plants, in the spring, at each seeding rate with each the Valmar and UltraPro rollers. Error bars indicate the standard deviation of the mean distance.

Conclusions
Roller type did not have a significant effect on plant density, maturity, or yield, and the distance between plants and distribution of the plants within the row was similar for the two rollers. Thus, any advantage that the UltraPro roller may provide would appear to have minimal effects on intraspecific competition in canola.

Acknowledgements
Funding for this project was provided by the Saskatchewan Canola Development Commission, with in-kind support provided by Bayer CropScience and SeedMaster.

Quantifying Genetic Differences in Seed Losses Due to Pod Drop and Pod Shattering in Canola

C. Holzapfel[1], C. Catellier[1], L. Grenkow[2], M. Vercaigne[2], B. Nybo[3]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Western Applied Research Corporation, Scott, SK; [3]Wheatland Conservation Area, Swift Current, SK

Description
Information on potential varietal differences in resistance to pod shattering and pod dropping is useful to producers who are interested in straight-combining canola, and minimizing the risks associated with this practice. Canola growers interested in straight-combining would also benefit from an improved understanding of the potential frequency and magnitude of environmental seed losses in standing, mature canola, particularly when harvest is delayed past the optimal harvest stage.
This study was initiated in 2011 to quantify the relative resistance to pod shattering and pod drop amongst high-yielding *Brassica napus* hybrids and to identify cultivars which may be well suited for straight-combining. Field trials were conducted at Indian Head, Scott, Swift Current, and Melfort in 2011-14, and over the 4 year period, a total of 15 canola hybrids were evaluated including: 1) 5440, 2) L130, 3) L140P, 4) L150, 5) 45H29, 6) 45H31, 7) 45H32, 8) 73-75, 9) 73-45, 10) 74-44BL, 11) 6050, 12) 6060, 13) 9553, 14) 46H75, and 15) 5525. Yield losses were estimated by measuring the amount of shattering and pod dropping at the optimal harvest date (T1) and with delayed harvest (T2) by using seed trays inserted beneath the crop canopy throughout the entire harvest period. The T2 harvest operation varied between sites and years, but averaged approximately 3-4 weeks after the T1 harvest operation.

Results
When harvest was completed early, environmental yield losses were below 5% at 12 of the 13 site-years, averaged across hybrids. Losses generally increased when harvest was delayed by 3-4 weeks; however, total losses were still lower than 5% at 7 of the 13 site-years and 10% or lower at 10 of the 13 site-years.

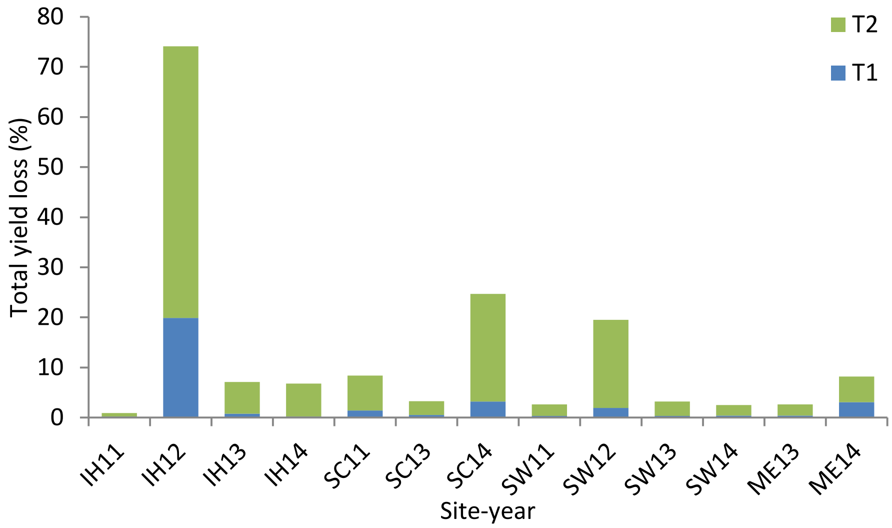

Figure 14. Overall site-year averages for total yield losses (pod shatter + pod drop) at maturity (T1) and with delayed harvest (T2). Data are averaged across the 6 hybrids which were present at all 13 site-years. Differences are not necessarily statistically significant.

Environmental conditions had a large effect on the magnitude of yield losses and were generally of greater importance than hybrid differences within any given site. With delayed harvest, hybrids differed significantly in the total yield losses at 10 of the 13 site-years; however, the relative performance of the hybrids was not always consistent across the sites where differences were detected. Total losses by hybrid are shown in Figure 15 for hybrids included in the trial in 2011 and 2012, and Figure 16 for hybrids included in the trial in 2013 and 2014. There were some differences between the hybrids, but variability overall is much lower than when the data are separated by site-year, as in Figure 14. The two figures are shown on the same axis scale (0-30%), thus we can see that yield losses were greater in 2011-12 than in 2013-14, even though many of the hybrids were the same. This further indicates the strong influence of environmental conditions on yield losses, regardless of hybrid.

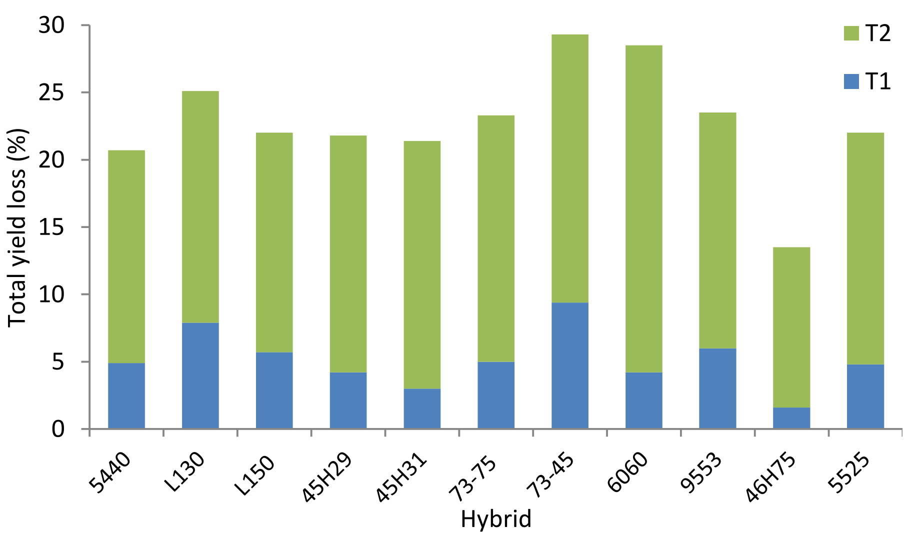

Figure 15. Overall hybrid averages (2011-2012 hybrids) for total yield losses (pod shatter + pod drop) at maturity (T1) and with delayed harvest (T2). Data are averaged across five site-years. Differences are not necessarily statistically significant.

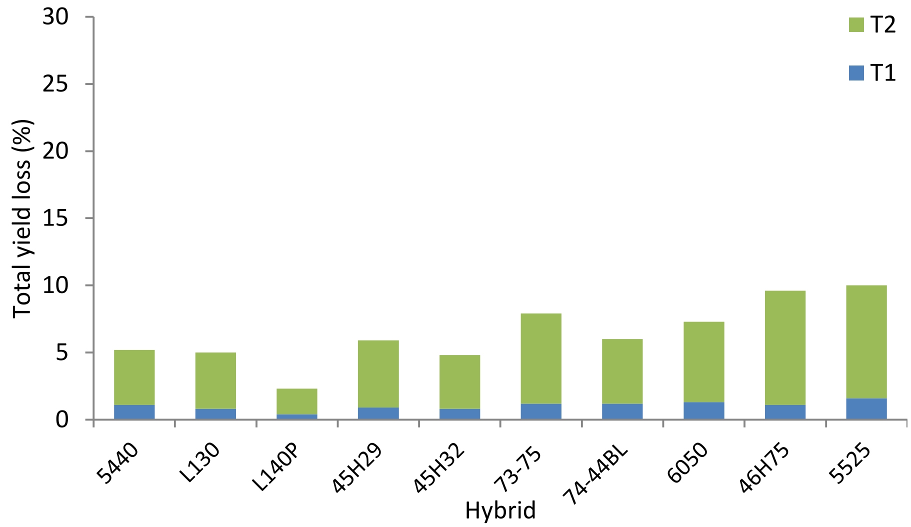

Figure 16. Overall hybrid averages (2013-2014 hybrids) for total yield losses (pod shatter + pod drop) at maturity (T1) and with delayed harvest (T2). Data are averaged across eight site-years and differences are not necessarily statistically significant.

In an attempt to rank hybrids in a manner that allowed all of them to be compared simultaneously, total losses at the T2 date within each site-year were ranked on a scale of 1-3. A value of 1 indicated that losses were not significantly higher than those observed with the best hybrid. Hybrids assigned a value of 2 had significantly higher losses than the best hybrids, but lower losses than any hybrids assigned a ranking of 3. In cases where no significant differences amongst hybrids were detected, all received a ranking of 1. The derived values ranged from 1.0-2.2 and the relative rankings from lowest to highest total losses using this system were: L140 < 45H32 < 5440 < L150 < L130 < 74-44BL < 9553 < 45H29 < 6050 < 73-75 = 46H75 < 45H31 < 5525 < 73-45 < 6060.

Conclusions

While varietal differences in resistance to pod drop and pod shatter were frequently detected, these differences were generally smaller than those observed either between harvest dates or across site-years. Furthermore, the observed differences were not always consistent from year to year or site to site. While varietal differences in resistance to environmental seed losses do exist and can contribute towards reducing the overall risk of yield loss, all of the hybrids evaluated were straight-combined successfully, provided that harvest was not delayed too long. New shatter tolerant hybrids showed excellent potential for further reducing the risks of yield loss with straight-combining; however, factors such as overall yield potential, maturity and herbicide system continue to be important when choosing a canola hybrid, regardless of harvest method. While choosing a variety with reduced potential for pod shattering or dropping can contribute to successful straight-combining of canola, growers should still strive to complete harvest as soon after the crop is fit to combine as possible.

Acknowledgements

Funding for this project was provided by the Saskatchewan Canola Development Commission, with in-kind support provided by Bayer CropScience, Pioneer Hi-Bred, Dekalb, Brett Young and Dow AgroSciences.

Investigating Wider Row Spacing in No-till Canola: Implications for Weed Competition, Response to Nitrogen Fertilizer, and Seeding Rate Recommendations

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

There has been considerable interest among canola growers and equipment manufacturers regarding wider row spacing in canola. With larger implements, producers will be able to increase the timeliness of seeding and reduce fuel use and tractor hours as utilizing fewer openers significantly reduces the draft requirements for seeding on a per acre basis. Past research on canola row spacing has led to varied conclusions in regards to canola yield response and agronomic implications, thus, revisiting the topic of row spacing in canola is well justified with the changes in canola varieties, fertilizer management and seeding equipment over the past twenty years.

While N use-efficiency could potentially be increased with banded N at wider spacing (i.e. reduced N losses / immobilization), the fact that banded fertilizer becomes more concentrated as row spacing increases could increase the potential for seedling injury with side-banding in cases where seed-fertilizer separation is inadequate. With respect to seeding rates, wider row spacing could result in a temptation to reduce seeding rates since canola seed costs are significant and the within row distance between seeds is reduced at any given seeding rate as row spacing is increased. From a weed management perspective, it is generally accepted that canola would not compete as well against weeds as row spacing is increased, especially early in the growing season, though this may not be an issue of great concern with modern, herbicide tolerant hybrid canola varieties.

The objectives of this project were to evaluate the overall performance of canola grown in row spacings that exceed the conventional 10-12” width. Three separate field trials were designed to investigate whether wider row spacing might affect current recommendations regarding side-banded N fertilizer and seeding rates, and whether competition with weeds would become problematic as row spacing is increased. The treatments in the three trials consisted of combinations of 5 different row spacings (10”, 12”, 14”, 16”, and 24”) with either 1) side-banded N fertilizer rates (0, 50, 100, and 150 kg N/ha), 2) seeding rates (1.5, 3.0, 4.5, and 6.0 kg/ha) or 3) weed control (no in-crop herbicide compared to a single in-crop herbicide application). The trial was conducted in 2013-2014, and will be continued in 2015.

Results

1) *Implications for side-banded nitrogen fertilizer*

There was a reduction in emergence with 100-150 kg/ha of side-banded N in 2013 and 2014. The effect of N rate on plant density differed among the row spacings in both years, such that plant density did not decline with increasing row spacing when no N fertilizer was applied, but there was a reduction in emergence with increased N rate at the wider row spacings. This suggests that there is a higher potential for increased seedling injury with side-banded N at wider row spacing; however, N effects on emergence at the different row spacings were not consistent (data not shown).

Despite the reduction in plant populations, canola responded well to side-banded N with seed yields increasing at all N rates, regardless of row spacing. The yield response to row spacing with no N fertilizer appeared to differ from that in the fertilized plots whereby yields increased slightly with row spacing in the absence of N but tended to be highest at the narrowest and widest row spacing levels in the fertilized plots (Figure 17).

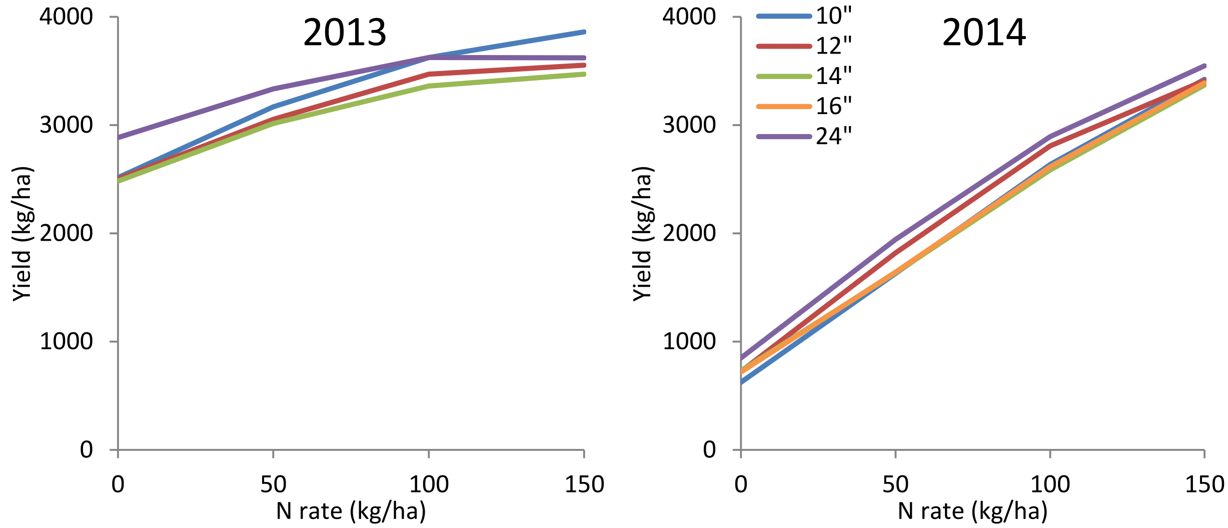

Figure 17. The effect of N rate and row spacing on canola seed yield at Indian Head in 2013 and 2014. There was no 16" row spacing in 2013 due to technical errors at seeding.

While the results to date are not necessarily conclusive, there were indications that the optimal N rate may be slightly lower at wide row spacing and utilizing lower rates would simultaneously reduce the potential for seedling injury.

2) Implications for seeding rates

The effect of seeding rate differed with row spacing in both years, such that plant populations were not reduced with greater row spacing at the lowest seeding rate. At the widest row spacing in 2014, there were no increases in plant density beyond the 4.5 kg/ha seeding rate; however, this was not the case in 2013. That said, only the lowest seeding rate resulted in plant populations substantially below 40 plants/m^2 at all row spacings, except 24" where at least 3.0 kg/ha was required to meet the recommended minimum plant density (data not shown). Similar yields were achieved with seeding rates from 3.0-6.0 kg/ha in both 2013 and 2014; however, yields were reduced by 8-9% at the 1.5 kg/ha seeding rate (Figure 18).

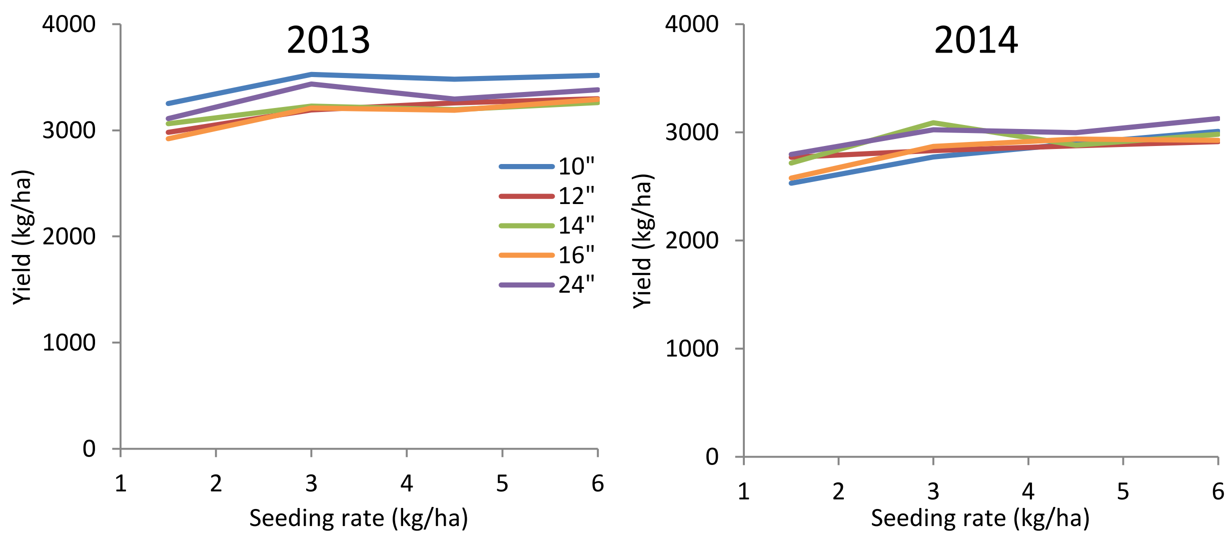

Figure 18. The effect of seeding rate and row spacing on canola seed yield at Indian Head in 2013-14.

Based on these results, it would not be recommended to reduce canola seeding rates while implementing wider row spacing, especially considering that emergence was reduced as row spacing increased for all but the lowest seeding rate and, at the widest spacing, higher seeding rates were required to achieve final populations of ≥40 plants/m^2.

3) Implications for weed control

Canola was grown with and without herbicide at each row spacing to assess whether there were any agronomically significant impacts on the crop's ability to compete with weeds at wider row spacing. Despite high weed pressure in both years, a single in-crop herbicide application kept weed competition acceptably low at all row spacing levels, with mean reductions of weed biomass ranging from 98-99.5%. While it's uncertain whether there may be longer-term impacts, this study has not shown any substantial short term effects of row spacing on weed establishment, as herbicides were highly effective at all row spacing levels. Failure to control weeds resulted in an average yield loss of 43% in 2013 and 28% in 2014 and the losses were similar regardless of row spacing.

Acknowledgements

Funding for this project was provided by the Saskatchewan Canola Development Commission, with in-kind support provided by Bayer CropScience.

Effects of Genetic Sclerotinia Tolerance, Foliar Fungicide Applications, and their Interactions on Incidence and Severity of Sclerotinia in Canola

C. Holzapfel[1], C.Catellier[1], S. Brandt[2], D. Tomasiewicz[3], R. Mohr[4], D. McLaren[4], S. Chalmers[5], R. Kutcher[6]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Northeast Agriculture Research Foundation, Melfort, SK; [3]Agriculture & Agri-Food Canada, Outlook, SK; [4]Agriculture & Agri-Food Canada, Brandon, MB; [5]Manitoba Agriculture Food & Rural Initiatives, Melita, MB; [6]University of Saskatchewan, Saskatoon, SK

Description

Sclerotinia stem rot causes significant yield loss for canola in western Canada each year, though the degree to which this disease affects individual fields is highly variable depending on the specific environmental and weather conditions that are encountered. Foliar fungicides are the most consistent and effective method of controlling sclerotinia; however, in many canola growing regions of the Prairies, annual applications are unlikely to be economically viable over the long-term. More recently, commercial cultivars that are considered tolerant to sclerotinia stem rot have been introduced. Even when using such cultivars, conditions may sometimes exist where foliar fungicide applications are still desirable and economically advantageous, as sclerotinia infection is not eliminated in tolerant cultivars. This project aims to add to our current understanding of the potential benefits and limitations that may be expected with both tolerant cultivars and foliar fungicide applications and to establish if, and under what conditions, foliar fungicide applications may be required when growing a cultivar with genetic tolerance to sclerotinia.

The treatments were a combination of two canola hybrids and four foliar fungicide timing treatments. One canola hybrid was susceptible to sclerotinia stem rot (45H29 RR) while the other was tolerant (45S54 RR). The foliar fungicide treatments were: 1) untreated check, 2) fungicide applied at 20% bloom, 3) fungicide applied at 50% bloom, and 4) fungicide applied at both crop stages. The trial was conducted at five sites in 2013 and 2014, though the sites were analyzed separately and only results from Indian Head in 2014 are presented here.

Results

At Indian Head in 2014, initial populations were relatively low as a result of heavy residues (i.e. poor seedbed conditions) and substantial flea beetle pressure. While the established populations were considered adequate, extensive injury to the canola occurred as a result of prolonged wet conditions in June, when nearly 200 mm of precipitation was received. Disease incidence is the percent of infected plants out of 100 plants per plot. Values shown in Figure 19 should be observed with caution as they only represent one out of the four replicates at Indian Head in 2014. Sclerotinia assessment was only done on one replicate at Indian Head as the other plots were too severely damaged. There appeared to be lower overall disease incidence with the tolerant variety; however, it is difficult to say how the fungicide treatments affected disease incidence. There was no effect of variety or fungicide treatment on canola yield at Indian Head in 2014, and yields overall were very low (Figure 19).

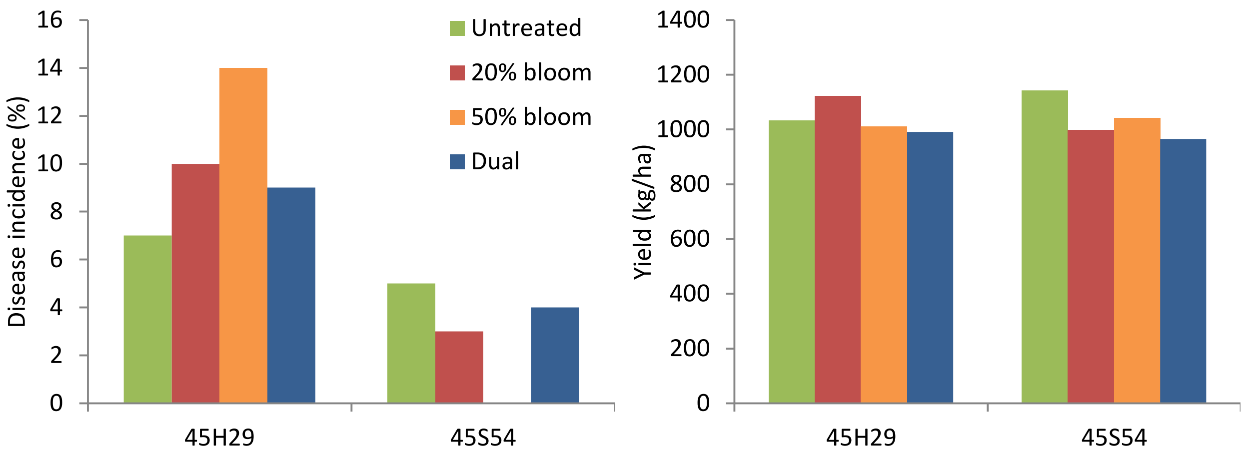

Figure 19. Sclerotinia incidence <u>in one replicate only</u> and mean yield with fungicide treatments at Indian Head in 2014.

Conclusions

Overall, sclerotinia stem rot pressure in canola has been considered low to moderate at the study sites to date and any treatment effects that were detected have been relatively subtle. When all sites and years are considered, results of this study suggest that disease levels usually tended to be lower with the tolerant hybrid (45S54) than with the susceptible hybrid, 45H29. The results also suggest that foliar fungicides provided less consistent benefits when a tolerant variety was used. Foliar fungicides frequently reduced disease levels and, at some locations, increased seed yields. Furthermore, no benefits to a dual fungicide application over a single application were detected, but again, this may not apply under high disease pressure. This was the second of three years for this study and the field trials are to be continued at all five locations in 2015. A full report has been compiled which includes results from all sites and years and can be provided upon request.

Acknowledgements

Funding for this project was provided by the Saskatchewan Canola Development Commission, with in-kind support provided by Pioneer Hi-Bred.

Canola Direct-Cut Harvest System Development

N. Gregg[1], C. Holzapfel[2], B. Nybo[3], M. Stumborg

[1]Prairie Agricultural Machinery Institute, Humbolt, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]Wheatland Conservation Area, Swift Current, SK

Description

The first objective of the project was to compare and evaluate the field performance of commercially available combine headers as part of a direct-cut canola harvest system, with the conventional swathing operation as the benchmark standard. Harvest equipment utilized in the course of the project included a 2014 New Holland CR8090 twin rotor combine. The combine was configured for canola operation based on the manufacturers recommended settings, and optimized for each sites conditions, adjustments were made by harvesting adjacent crop. Drop pans were used to aid in the adjustments, then the combine settings were not altered during or in-between the plot harvesting to maintain consistency. A swathed treatment was evaluated, along with three straight-cut header treatments: 1) draper; 2) rigid; 3) extended knife (42" ahead of auger).

Two canola varieties were evaluated; a "typical" canola variety (L130) and a variety with documented shatter resistant traits (L140P). At Indian Head, both varieties were swathed on September 6, and harvested on October 9-11, 2014.

Aluminum catch trays were placed in the plots at the time of swathing, and remained in the field until harvest in order to catch environmental losses experienced with the standing canola. Upon harvest, the trays were moved and placed ahead of the combine in order to catch header losses.

Results

At Indian Head, there were several days of strong winds between swathing and harvest, resulting in the typical canola variety to experience statistically significant shatter losses (Table 17).

On several occasions, the draper header experienced material flow issues in which the side belts did not properly convey the canola, and the combine had to be stopped to clear the material. The rigid and extended knife header did not encounter this conveying issue. In terms of the location on the header for seed loss, losses tended to be greatest towards the edges of the header and less in the centre; however, no conclusive results beyond this could be determined at this point.

Table 17. Straight-cut canola field loss measurements at Indian Head in 2014.

		Environmental Loss	Swathing Loss	Header Loss	Combine Loss	Total Loss	Yield
		bu/ac					
Typical	Draper	3.5	0.0	2.5	0.6	6.5	48.0
	Rigid	3.9	0.0	2.5	0.6	7.0	47.3
	Extended Knife	3.4	0.0	1.8	0.6	5.8	48.6
	Swath	0.1	0.1	0.5	0.4	1.1	51.4
Shatter Resistant	Draper	0.9	0.0	1.5	0.8	3.3	54.5
	Rigid	0.3	0.0	1.3	0.8	2.5	53.4
	Extended Knife	0.5	0.0	1.1	0.8	2.5	55.0
	Swath	0.1	0.1	0.5	0.8	1.5	53.7

Conclusions

It should be noted that these results are from a single year of data, and trends that may appear should not be strictly relied upon nor should specific conclusions be drawn at this stage of the project. In 2015, the trial will again take place at Indian Head and Swift Current, with the addition of a third site in the Humbolt area. The project is scheduled to be completed after the 2016 growing season, when a comprehensive final report will be completed.

Acknowledgements

Funding for this project was provided by the Saskatchewan Canola Development Commission, the Agriculture Development Fund and the Western Grains Research Foundation, with in-kind support provided by Bayer CropScience, Honey Bee Manufacturing and New Holland Agriculture.

Brassica Carinata Advanced Yield Trial

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Brassica carinata, commonly known as Ethiopian mustard, has an oil profile optimized for use in the biofuel industry, specifically for bio jet fuel. This crop exhibits good resistance to biotic stressors, such as insects and disease, as well as abiotic stressors, such as heat and drought, and is well suited to production in semi-arid climates. This project was implemented in collaboration with Agrisoma Biosciences to evaluate the relative performance of 14 experimental *Brassica carinata* lines relative to commercial varieties at Indian Head.

The trial was seeded into wheat stubble on May 17, 2014. A pre-emergent application of glyphosate was applied on May 22, with Edge broadcast over the trial area prior to seeding. Urea (46-0-0) and a blend (14-20-10-10) were side-banded at seeding to target 122-28-14-14 kg/ha of N-P_2O_5-K_2O-S. In-crop herbicide consisted of Poast Ultra applied on July 7. Lance was applied in two separate applications, on July 11 and July 15, to account for differences in flowering.

Results

Mean plant densities, days to flower, days to maturity, plant height, lodging, and yield for the *B. carinata* lines evaluated are presented in Table 18.

Table 18. Performance of 12 experimental lines of *B. carinata* relative to two checks (110994EM and AACA110) at Indian Head.

Variety	Plant Density (plants/m²)		Days to 1st Flower		Days to Maturity		Height (cm)		Lodging (1-5)		Seed Yield (bu/ac)	
5223	156	c	52.1	de	115.3	a	87	ab	2.3	cd	33.3	ab
5228	206	abc	52.9	c	114.0	abc	85	ab	3.5	ab	32.0	ab
5454	217	abc	53.9	a	115.5	a	87	ab	2.3	cd	34.7	ab
5488	175	c	54.0	a	115.0	ab	93	a	2.0	d	38.0	a
5489	200	abc	53.0	c	114.5	abc	78	bcd	3.3	abc	34.9	ab
5492	165	c	53.6	ab	114.8	ab	83	ab	3.3	abc	34.2	ab
5493	188	bc	53.1	bc	112.5	c	66	cd	3.5	ab	31.7	ab
5494	189	bc	53.1	bc	114.3	abc	65	d	3.5	ab	30.6	ab
5499	152	c	53.0	c	114.3	abc	78	bcd	2.8	bcd	36.4	a
5500	195	bc	50.0	g	113.0	bc	77	bcd	3.5	ab	33.4	ab
5503	182	bc	51.0	f	114.3	abc	77	bcd	3.5	ab	24.7	b
5509	251	ab	50.0	g	113.1	bc	79	abc	3.8	ab	24.7	b
110994EM	205	abc	52.6	cd	113.8	abc	76	bcd	4.0	a	39.1	a
AACA110	273	a	51.9	e	114.3	abc	79	bcd	3.0	abcd	36.9	a

Conclusions

In contrast to previous years, there were significant differences in plant density, flowering period, maturity, height, lodging, and yield amongst varieties. Two of the experimental varieties yielded significantly lower than the two checks and the rest were not significantly different from the checks. As in previous years, yields were more or less similar to canola in adjacent trials. Management practices are similar to canola and the crop exhibits superior shattering resistance and is well suited to straight-combining.

Acknowledgements

Funding for this project was provided by Agrisoma Biosciences.

Fall 2,4-D Preceding Canola, Field Pea, and Flax

S. Brandt[1], C. Holzapfel[2], L. Grenkow[3], L. White[4], L. Shaw[5]

[1]Northeast Agriculture Research Foundation, Melfort, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]Western Applied Research Corporation, Scott, SK; [4]Conservation Learning Centre, Prince Albert, SK; [5]South East Research Farm, Redvers, SK

Description

Wet weather favours greater infestation of crops by perennial broadleaf weeds, which can be both persistent and difficult to control with herbicides. One relatively inexpensive control strategy has been to use fall applied 2,4-D; however, wet weather can also delay seeding and extend maturity, often meaning that harvest and fall applications of 2,4-D are postponed. Delaying application of high rates of 2,4-D increases the risk of residues remaining in the soil, potentially damaging sensitive crops such as canola, field peas and flax. Fall 2,4-D applications at even the lowest rates are not recommended for either canola or flax due to the high risk of crop injury. In the case of field pea, early fall applications at low rates are not likely to cause crop injury, but late fall and early spring applications should be avoided. This project was intended to demonstrate the frequency and extent of subsequent canola, field pea and flax damage arising from fall applied 2,4-D at high rates as used for control of perennial weed species. Fall 2,4-D application rates of 0, 210, 420, 840, and 1680 g active ingredient per hectare were applied to each canola, field pea, and flax.

Results

Heavy rain in late June and early July caused flooding damage in many plots. As a result, all pea plots were lost at the early flowering stage. The canola was also affected by the prolonged wet conditions with delayed maturity and low yields in all plots. Yield data from three of the four replicates was not considered reliable and was excluded.

Canola: Even at very high rates, fall-applied 2,4-D amine did not affect canola emergence or the proportion of deformed seedlings. Canola yield data was not statistically analyzed due to the lack of replication, there was no indication of high rates of fall applied 2,4-D negatively impacting seed yield. There was a slight trend towards a greater plant density loss with increasing rates of applied 2,4-D, but this was not statistically or agronomically significant.

Field pea: Neither pea emergence nor deformed seedlings were affected by fall-applied 2,4-D and there was no trend in plant density loss with the higher rates.

Flax: As with the other two crops, none of the variables of interest were affected by the rate of fall-applied 2,4-D.

Conclusions

The observed effects of fall applications of high rates of 2,4-D amine at Indian Head in 2014 were consistent with those observed at Indian Head in 2013 and with the results observed at other Agri-ARM locations. However, previous research has shown that fall applications of 2, 4-D amine preceding these crops can cause significant injury and yield reduction, particularly at high rates required for effective perennial weed control. Also, previous research has shown that damage can be higher on heavy clay or clay soils than on coarser textured soils, and that risk of damage may be higher on low compared with high organic matter soils. The lack of seedling injury or yield reduction may be a result of the trials being conducted under no-till conditions. It appears that previous studies have all been conducted under conventional tillage. Organic matter stratified at the soil surface in a no-till system could promote greater losses or inactivation of the herbicide compared with conventional tillage. It would be of interest to compare 2,4-D rate effects under contrasting tillage systems.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Optimal Fertilizer Management for Flax Production

C. Holzapfel[1], C. Catellier[1], W. Thompson[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Saskatchewan Flax Development Commission, Saskatoon, SK

Description

Fertilizer is one of the largest input costs for most crops, including flax. Fertilizer typically provides a large return on investment when appropriate rates are applied. Flax responds well to N fertilizer application rates ranging from 35 to 90 kg N/ha, depending on residual N and soil moisture. On the other hand, flax response to P fertilizer is less consistent and pronounced than for many other crops, such as spring wheat and canola. Still, many producers choose to apply at least enough P fertilizer to replace what the crop removes, as an important strategy for maintaining soil fertility and quality over the long-term. Flax is particularly sensitive to seed-placed P and therefore, it is recommended that no more than 20 kg/ha P_2O_5 be placed in the seed row. Side-banding is also an effective method of applying P in flax and is safer than seed row placement when high rates are utilized. While deficiencies of potassium (K) and sulphur can potentially limit yields in any crop, serious deficiencies are uncommon in most soils in Saskatchewan, and documented flax seed yield responses to K and S fertilizer application are rare. This project was initiated to demonstrate the response of flax to varying rates and placements of N, P, K and S fertilizer and to inform growers on potential toxicity issues with seed-placed fertilizer. 14 treatments were evaluated and are listed in Table 19. This study was also conducted in 2013 – see 2013 IHARF Annual Report for results.

Table 19. Fertilizer treatments assessed for flax at Indian Head in 2013.

Rates Applied (kg/ha)				**PKS Placement**	
N	P_2O_5	K_2O	S	Seed-Placed	Side-Banded
0	0	0	0	n/a	
45	0	0	0	n/a	
45	15	0	0	✔	✔
45	15	7.5	7.5	✔	✔
90	0	0	0	n/a	
90	15	0	0	✔	✔
90	15	7.5	7.5	✔	✔
90	30	0	0	✔	✔
90	30	15	15	✔	✔

Results

Excess moisture affected crop development and caused a delay in the in-crop herbicide application, resulting in poor yields in 2014. There was no consistent trend or reduction in plant density with the different rates of seed-placed and side-banded fertilizer in 2014 (Figure 20).

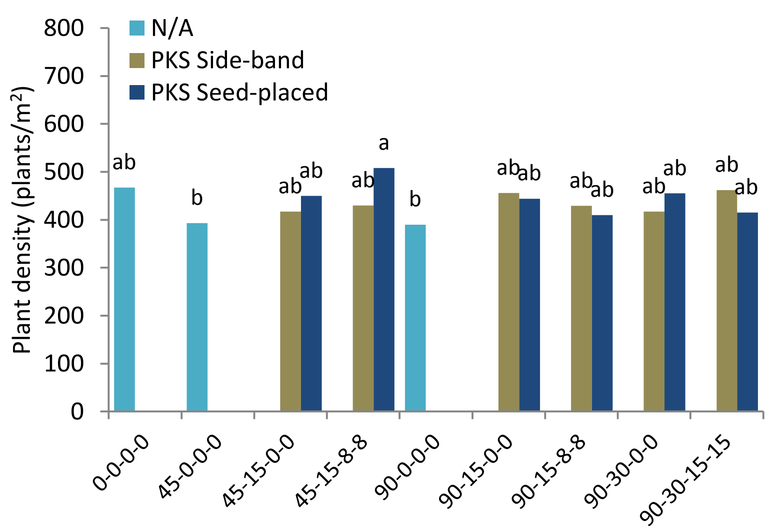

Figure 20. The effect of different rates and placement of N, P, K, and S fertilizer on flax establishment at Indian Head in 2014.

In general, flax yield was higher with the 90 kg/ha rate of N than the 45 kg/ha rate (Figure 21). Yields were not affected by P-K-S fertilizer placement, and there was no significant evidence of a yield response to P, K, or S fertilizer application in flax.

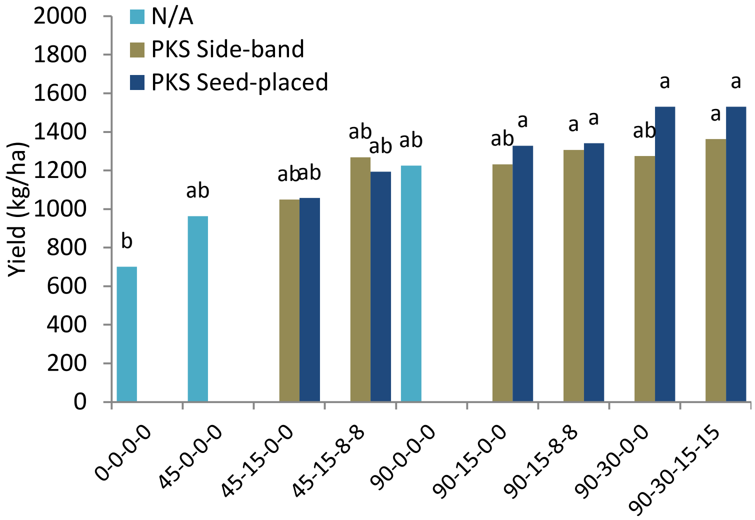

Figure 21. The effect of different rates and placement of N, P, K, and S fertilizer on flax yield at Indian Head in 2014.

Conclusions

Over the two year period, this demonstration has shown that flax is most responsive to fertilizer applications when residual nutrients are low and other factors, such as soil moisture and competition with weeds are not limiting to yield. While it is broadly accepted that flax is sensitive to seed-placed fertilizer, rates of 15 kg P_2O_5 as MAP (11-52-0) did not affect plant populations in either year. Side-banded P, K and S fertilizer did not impact flax establishment, regardless of the rates applied in this demonstration. Flax yields were increased with fertilizer application in both years and, in both cases, 45 kg N/ha was not sufficient to reach maximum yield.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, and the Saskatchewan Flax Development Commission.

Relative Performance of Flax Varieties

C. Holzapfel[1], C. Catellier[1], W. Thompson[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Saskatchewan Flax Development Commission, Saskatoon, SK

Description

Currently, more than 30 flax varieties are registered for use in western Canada 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 flax growers are not aware of all of the varieties which are available and the objective of this study 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. A total of 14 varieties were tested in 2014.

Results

Measurements of plant density, maturity, and yield for each of the varieties are shown in Table 20. Due to the extremely wet conditions throughout the month of June and heavy wild oat pressure, average flax yields were quite low at Indian Head in 2014. There were significant differences in yield between the varieties, while in 2013 there was no difference in yield between the varieties.

Table 20. Plant density, maturity, and yield for 14 flax varieties at Indian Head in 2014.

Variety	Plant Density (plants/m^2)		Maturity (days)		Yield (bu/ac)	
Bethune	570	abc	105.6	cd	23.3	bc
Sorrel	480	cd	105.8	bc	29.7	a
Glas	646	ab	106.3	bc	24.5	abc
Sanctuary	532	bcd	106.3	bc	25.2	abc
Neela	544	bcd	106.5	abc	28.5	ab
FP 2385	683	a	104.1	de	23.3	bc
ACC Bravo	524	bcd	106.5	abc	24.8	abc
Prairie Sapphire	497	cd	105.3	cde	22.0	c
Prairie Thunder	421	d	105.9	bc	22.3	bc
Nulin 50	528	bcd	107.3	ab	25.1	abc
Westlin 70	522	cd	108.0	a	26.8	abc
Westlin 71	447	cd	106.0	bc	21.5	c
FP 2376	561	abc	106.5	abc	25.8	abc
FP 2388	502	cd	104.0	e	22.9	bc

Conclusions

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.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, and the Saskatchewan Flax Development Commission.

Seeding Rate and Seeding Date Effects on Flax Establishment and Yield

C. Holzapfel[1], C. Catellier[1], S. Brandt[2], W. Thompson[3]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Northeast Agriculture Research Foundation, Melfort, SK; [3]Saskatchewan Flax Development Commission, Saskatoon, SK

Description

Minimum plant populations of 300 plants/m^2 are typically recommended in Saskatchewan for optimal flax yields. Flax is a poor competitor with weeds early in the season and experience has shown that this crop has difficulty recovering from a poor start; therefore, problems with plant establishment often result in sub-optimal yields. Postponing seeding until soils have warmed up can result in more rapid and complete emergence; however, flax requires a relatively long growing season and yields can be compromised if seeding is delayed too long. This project will help producers see the potential benefits of using early maturing varieties and/or higher seeding rates, particularly when seeding early into cool soil. The 12 treatments were combinations of three seeding rates low (35 kg/ha), normal (50 kg/ha), and high (75 kg/ha), two seeding dates (early and late May), and two flax varieties: CDC Bethune (traditional), and FP2454 (northern). The trial was conducted at Indian Head (2013-14) and Melfort (2014).

Results

The number of days to maturity decreased with each increase in seeding rate, and yield increased with seeding rate but seemed to level off beyond the recommended seeding rate of 55 kg/ha (Figure 22).

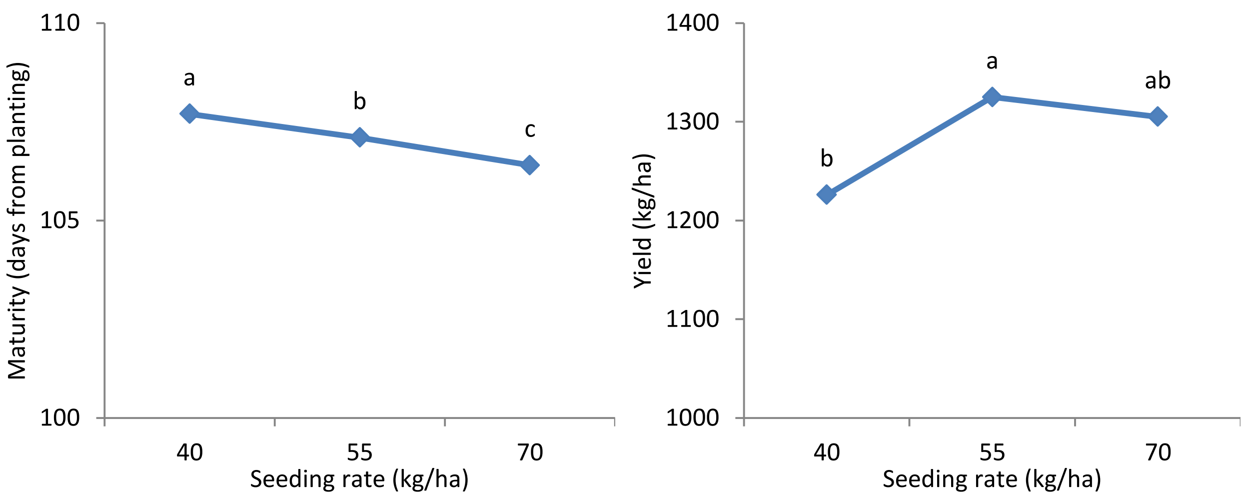

Figure 22. The effect of seeding rate on maturity and yield of flax at Indian Head in 2014.

Maturity in the two varieties responded differently to the two seeding dates (Figure 23). The number of days to maturity decreased proportionately more with later seeding date in the northern variety than the traditional variety, indicating that the northern variety was more flexible in its ability to adapt to a later seeding date.

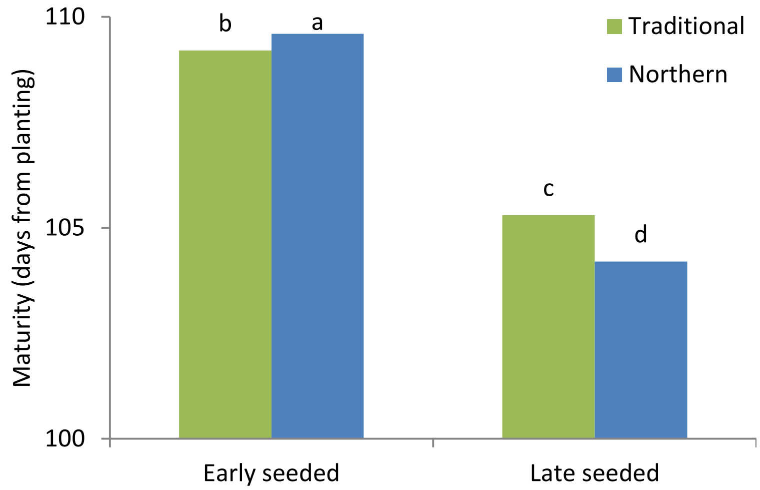

Figure 23. The effect of seeding date on maturity of two different flax varieties at Indian Head in 2014.

There was no significant difference between each variety's yield responses to the two seeding dates, though the traditional variety tended to have a higher yield with later seeding while yield of the northern variety did not change with delayed seeding (Figure 24).

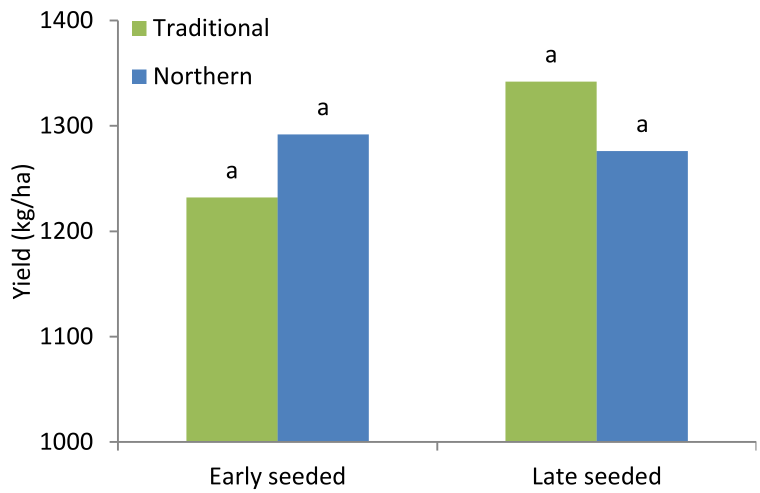

Figure 24. The effect of seeding date on yield of two different flax varieties at Indian Head in 2014.

Conclusions

The overall agronomic performance of flax was relatively insensitive to the seeding dates and rates that were evaluated in this demonstration. While seeding early is recommended, this showed that postponing seeding by 2-3 weeks will not necessarily result in lower yields or maturity issues. That said, the further seeding is delayed, the greater the risk of fall frost and yield and quality reduction will be, particularly in regions with shorter growing seasons.

While significant at two of three sites, the effect of seeding rate was relatively small (at the rates used) and environmental conditions encountered with this demonstration. Excellent emergence was achieved at all three sites and higher seeding rates are likely to be more beneficial under less favourable conditions at and immediately following planting. Higher seeding rates also tended to accelerate maturity which can be advantageous with delayed seeding or in more northern environments.

At Melfort, the northern adapted variety yielded consistently higher than the traditional variety, with a mean yield advantage of 6%. While the new northern adapted flax varieties such as FP2454 were not necessarily bred for more southern regions such as Indian Head, this variety was competitive with the traditional variety CDC Bethune at this location. These varieties were bred for early season vigour, indeterminate flower habits, accelerated stem dry-down and earlier maturity, and therefore may be good fits for cooler, more northern locations where flax acres have been traditionally small and the length of the growing season can potentially be limiting.

Acknowledgements
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Row Spacing and Fungicide Effects on Flax Yield

C. Holzapfel[1], C. Catellier[1], W. Thompson[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Saskatchewan Flax Development Commission, Saskatoon, SK

Description
Pasmo (*Septoria linicola*) is the most common disease that affects flax yields in Saskatchewan and is often most severe in wet environments and with heavy crop canopies. Headline EC (250 g pyraclostrobin l^{-1}) is currently the only registered foliar fungicide for control of pasmo. Field trials at Indian Head over the past four years have shown reasonably consistent response to fungicide applications with increases of nearly 30% when disease pressure is high. As expected, the response was smaller or not significant in years or at locations where disease pressure was low.
Disease pressure is often higher with dense crop canopies, thus management factors such as seeding rates, row spacing and fertility may indirectly affect flax response to fungicide. The objective of this project was to demonstrate the response of flax to fungicide, and to evaluate the effects of row spacing and its interaction with crop response to fungicide. Ten treatments were arranged in a split-plot design where two foliar fungicide treatments (check, treated) comprised the main plots and the sub-plots were five row spacing levels.

Results
Prolonged wet conditions throughout the month of June resulted in substantial crop injury and delayed in-crop herbicide applications; wild oat pressure was considered a significant yield limiting factor. Both fungicide application and row spacing had a significant effect on the disease level, though the effect of row spacing was difficult to interpret (Figure 25). In 2014, fungicide did not have a significant effect on flax yield, though there was a significant effect of row spacing (Figure 25). Pasmo was present at significant levels but did not likely infect the flax until later in the season and therefore was not expected to have a major impact on seed yield.

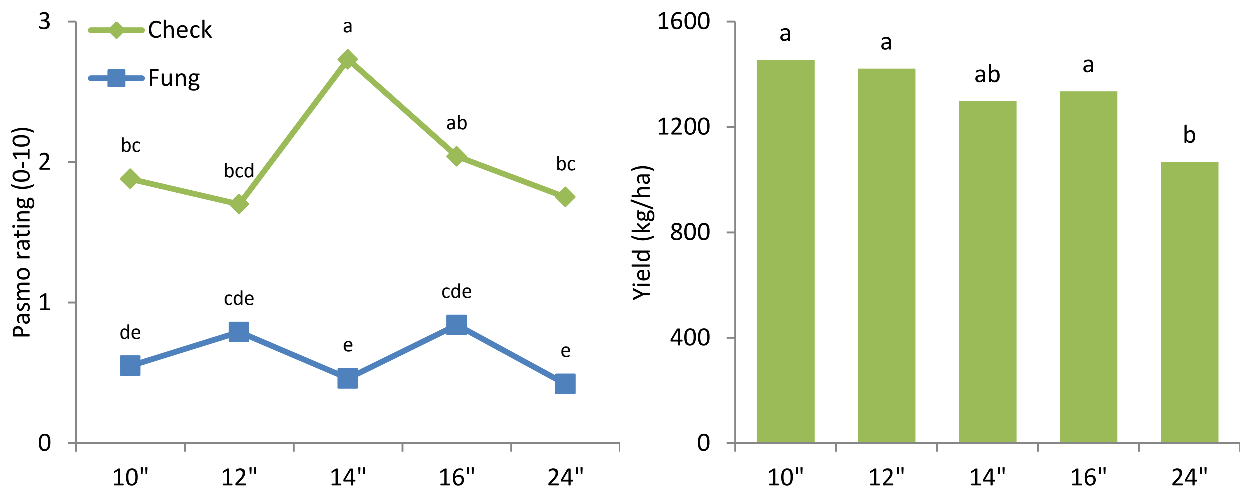

Figure 25. The effect of fungicide and row spacing on disease level and yield of flax at Indian Head in 2014.

Conclusions

While further testing is required to provide conclusive recommendations, it is likely that the effects of row spacing would be less prominent under more optimal growing conditions and with better weed control. At 24”, yields were significantly lower than the other row spacings and planting flax at wider than 16” row spacing is not recommended. While a significant yield increase with foliar fungicide application was not detected at Indian Head in 2014, when results from previous years are considered the potential for a positive response under heavier disease pressure is higher, though it is clear that environment plays a critical role.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement, and the Saskatchewan Flax Development Commission.

Intercropping Chickpea with Flax

B. May[1], D. Petty[2], L. Shaw[3]

[1]Agriculture & Agri-Food Canada, Indian Head, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]South East Research Farm, Redvers, SK

Description

Crop rotations in certain areas of Saskatchewan are often limited, and producers may be interested in introducing new crops to increase diversity in their rotation. Southeast Saskatchewan is not a traditional chickpea producing area; however, chickpea and flax intercrops have been grown commercially in the Midale area with good success. The objective of this project was to demonstrate that chickpeas can be grown in a non-traditional chickpea growing area, either in monocrop or when intercropped with flax. Two varieties of chickpea were compared and intercropped with flax at different seeding rates and fertility rates (data not shown) to identify which combination of agronomic practices were most productive.

Results

The analysis examined the effect of chickpea variety and seeding rate on the yield of flax and chickpeas in intercrops relative to monocrops of each crop. Flax yield was much higher than chickpea yield and was unaffected by the presence of chickpeas, as the yields were not significantly different in the intercrop plots relative to the monocrop. The two chickpea varieties did not differ in yield potential; however, chickpea yield was significantly higher when intercropped with flax but only at the highest seeding rate and with the Desi variety (Figure 26). Chickpea yields were quite variable, thus intercrop yields were not significantly higher than monocrop in most cases, though there did seem to be a trend towards higher chickpea yields when grown in intercrop with flax, and with increased seeding rates.

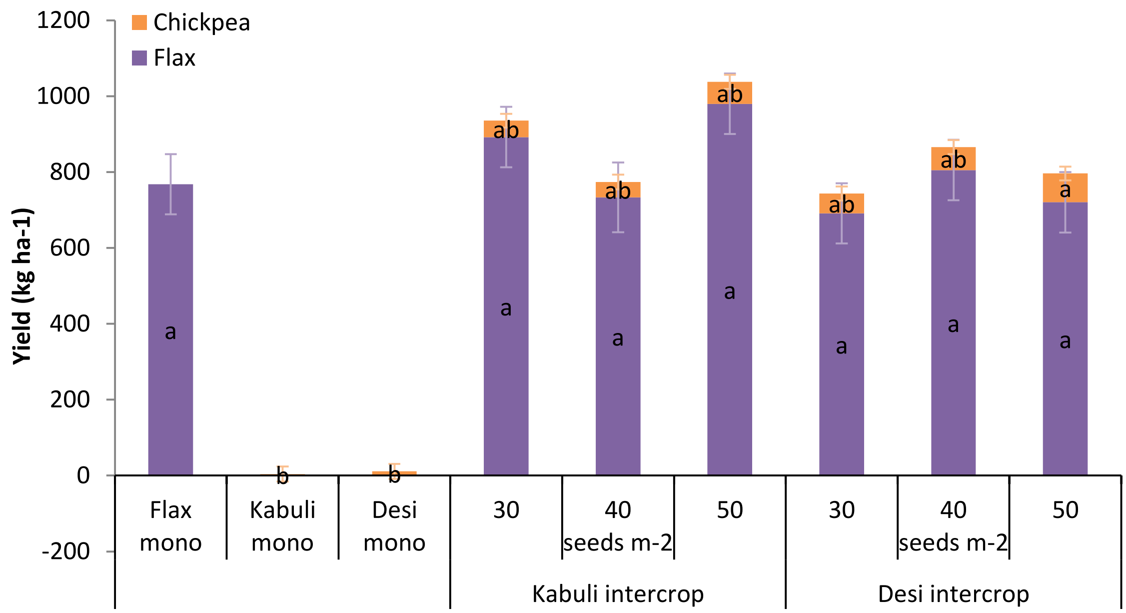

Figure 26. Effect of chickpea variety and seeding rate on flax and chickpea yield when intercropped relative to monocrops.

Conclusions

Chickpea yields and quality were low at Indian Head in 2014, which indicates that there is some work to be done to determine the best agronomic practices and conditions to grow a profitable chickpea crop in this area; however, it must be taken into consideration that precipitation amounts were extreme in 2014. The results indicate that intercropping chickpeas with flax may be an effective agronomic practice to increase chickpea productivity, and this may be even more apparent in years with closer to average moisture. There was some evidence to indicate that chickpea yields increased with seeding rate, without having an adverse effect on flax yield, but the weak chickpea crop that was produced in this year would not have been competitive enough to have an effect on the flax crop, even at the highest seeding rate.

Acknowledgements

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Mid-Oleic and High-Oleic Sunflower Hybrids for Saskatchewan

B. May[1], S. Brandt[2], L. Shaw[3], B. Nybo[4]

[1]Agriculture & Agri-Food Canada, Indian Head, SK; [2]Northeast Agriculture Research Foundation, Melfort, SK; [3]South East Research Farm, Redvers, SK; [4]Wheatland Conservation Area, Swift Current, SK

Description

New sunflower hybrids are being bred that are suitable for production in Saskatchewan, and have oil profiles more desired by the market place. However, due to limited acreage in Saskatchewan (<10,000ac) these varieties are often not tested in the province by the organizations developing them. This project evaluated nine hybrids, and one conventional variety, typically seeded with no-till plot drills.

Results

Kernel moisture at harvest is very important for evaluating sunflowers as they can be slow to dry down in Saskatchewans climate. AC 60 consistently had the lowest kernel moisture across all locations, while AC Sierra and Honeycomb NS had moistures that were statistically similar to AC 60. Honeycomb NS appeared to be the highest yielding variety tested across all locations, at 116% of the check (63A21). AC 60 and AC Sierra were the earliest maturing varieties at many locations; however, fall frost injury was an issue at some locations and not all varieties tested are suitable for production in Saskatchewan. Results from Indian Head and Redvers in 2014 are presented below in Table 21.

Table 21. Hybrid sunflower trial results from Indian Head and Redvers, Saskatchewan, 2014.

	Indian Head	Redvers	Indian Head	Redvers	Indian Head	Redvers
	Yield (kg/ha)		**Kernel Moisture** (%)		**Maturity** (days)	
63A21 (11.1 plants m/2)	2035.7	1824.9	12.5	11.0	114.0	112.3
AC Sierra (11.1 plants m/2)	1287.6	1953.1	11.5	10.8	112.0	111.5
Talon (X4270)	2267.4	1666.7	16.6	14.2	119.8	114.5
8N 270	1856.2	1701.2	13.5	17.6	121.0	113.5
63A21 (8 plants m/2)	1913.1	1636.0	12.0	12.0	116.5	112.0
AC 60	1661.5	1957.3	11.0	9.2	112.0	109.8
Cobalt II	1224.9	1605.1	15.5	14.3	121.5	114.0
X320	1378.7	1759.2	11.2	9.6	117.5	112.5
Honeycomb NS (X713)	1984.3	2432.1	11.7	10.7	115.5	111.5
X716	1372.7	2172.4	11.5	9.3	115.3	111.8

Conclusions

Honeycomb NS and AC60 demonstrate that early hybrids can be developed for Saskatchewans climate, with no reduction in grain yield. If growers are looking to capture the non-traditional oil market, hybrids with this oil profile are still at risk of a delayed maturity and subsequent frost risk.

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Seeding Rates for Sunflowers in Saskatchewan

B. May[1], S. Brandt[2], L. Shaw[3], B. Nybo[4]

[1]Agriculture & Agri-Food Canada, Indian Head, SK; [2]Northeast Agriculture Research Foundation, Melfort, SK; [3]South East Research Farm, Redvers, SK; [4]Wheatland Conservation Area, Swift Current, SK

Description

Recommendations for the optimum seeding rate for sunflowers were developed in areas that have longer growing seasons, using row crop management practices. The current recommendation for early maturing hybrids is 24,000 plants/acre while for open pollinated cultivars it is 30,000 plants/acre. This project aimed to demonstrate the correct seeding rate to use when solid seeding sunflowers with a no-till drill. Two varieties, 63A21 and AC Sierra, were used along with seven different seeding rates (plants/acre).

Results

In this trial, a seeding rate above 30,000 plants/acre was required to consistently optimize yields. These findings support the recommendation of using a higher seeding rate in sunflowers when using a no-till drill instead of a row planter. Increasing the seeding rate delayed maturity at Redvers in 2014, but not at the other locations; while the kernel weight was consistently lowered by increasing the seeding rate.

Table 22. Effect of variety and seeding rate on grain yield at 4 locations in Saskatchewan, 2014.

	Swift Current		**Melfort**		**Indian Head**		**Redvers**	
	Yield (kg/ha)							
Cultivar/Hybrid								
AC Sierra	651	b	1554	b	956	b	1093.2	b
63A21	956	a	2290	a	1404	a	1450.1	a
Seeding Rate								
15,000	480	c	1547	c	766	c	923	c
20,000	715	bc	1894	abc	982	b	1146.7	b
25,000	778	ab	1544	c	1228	a	1368.4	a
30,000	892	ab	2240	ab	1239	a	1321.1	a
35,000	805	ab	1783	bc	1327	a	1472.1	a
40,000	1008	a	2316	a	1368	a	1312.5	ab
45,000	949	ab	2129	ab	1351	a	1357.6	a

Conclusions

Seeding rate had a large effect on the yield components, plant density and kernel weight, which in turn had a large effect on grain yield. From this data, the optimum plant density was higher when seeding with a no-till drill (30,000 plants/acre), than recommended for a row planter (24,000 plants/acre).

Acknowledgements

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Field Pea Input Study

L. Grenkow[1], C. Holzapfel[2], S. Phelps[3], E. Johnson[4], B. Nybo[5]

[1]Western Applied Research Corporation, Scott, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]Saskatchewan Ministry of Agriculture, Battleford, SK; [4]Agriculture & Agri-Food Canada, Scott, SK; [5]Wheatland Conservation Area, Swift Current, SK

Description

Yield responses to individual inputs are often measured in research or on-farm trials; however, it is less well understood how the combination of multiple inputs can interact and affect yields. Farmers need to determine not only which inputs will have the largest impact on harvestable yield but also provide the best economic return. This study began in 2012 and took place at multiple locations across Saskatchewan, with an empty input package and five additional inputs applied alone, and in combination with one another.

To determine field pea responses to higher seeding rate (SR), seed treatment (ST), granular inoculant (GI), starter fertilizer (Fz), and foliar fungicide (Fn), treatments were compared that included each of these components alone or in combination. The seed treatment was Apron Maxx RTA; the granular inoculant was Nodulator XL and liquid inoculant was Boost N; the starter fertilizer consisted of 46-0-0 side-banded at 15 kg N/ha; and the foliar fungicide application consisted of Headline EC applied at the beginning of flowering and Priaxor DS 7-14 days after the first application. From 2012 to 2014, 12 site years of data have been collected and analysed, with high yielding sites years and low yielding site years analysed separately.

Results

Treatments receiving the SR were close to the recommended plant population at low yielding sites (average 89 plants/m^2) and greater at high yielding sites (average 102 plants/m^2). ST and GI also increased plant populations under both environments, but to a lesser extent when compared to SR. Improved seedling vigour and disease resistance using a ST and/or GI may have increased the survival of the seedlings. In contrast, Fz significantly decreased plant population by 7-8 plants/m^2 on average. Averaged across all treatments, SR significantly increased disease ratings by 0.20 and 0.29 at low and high yielding sites, respectively. The higher amount of canopy associated with higher seeding rates early in the growing season likely caused the greater disease levels and provided a more conducive environment for disease development. Interestingly, disease levels decreased with GI application at high yielding sites, perhaps due to the improved nodulation and in turn, nitrogen nutrition provided by the granular inoculant. Averaged across low yielding sites, Fz also decreased disease levels which may have also been due to improved nitrogen nutrition or a slightly lower plant population.

Overall, SR and Fn significantly increased seed yields under both environments; however, average yield increases were higher when averaged across high yielding sites compared to low yielding sites. In addition, GI significantly increased yields at high yielding sites, but not low yielding site. Overall, ST and Fz did not affect seed yield under either environment.

When applied alone, SR significantly increased seed yields compared to the empty input package under both environments and resulted in yields that were not significantly different from the full input package, when averaged across the low yielding site years; therefore, yield was maximized using SR alone at these sites. In addition, Fn also significantly increased seed yield when applied alone, but only when averaged across high yielding site years, suggesting that there needs to be adequate yield potential of the crop to justify the application

Averaged over all high yielding sites, adding any one of GI, SR or Fn alone increased grain yield and decreased yield variability compared to the empty input package, while adding any two of these three inputs further decreased yield variability and increased grain yield. Interestingly, adding ST or ST and Fz did not further increase grain yields or decrease yield variability. Therefore, if applying two or three inputs in combination, each input will contribute the same relative yield increase as compared to if it was applied alone. Using four or five of the inputs, i.e. adding the ST and/or Fz, there is no additional yield increase from the additional input, likely because yield potential has already been maximized.

At the low yielding sites, the average ratio of all input combination treatments was lower than at high yielding sites; therefore, the input combinations are generally, with some exceptions, not behaving in an additive fashion. The interaction should not be described as antagonistic, instead there is likely something else at these sites which is limiting yield potential (root rot, drought, etc).

The input combination with the highest observed versus expected relative mean yield ratio at both high and low-yielding sites was the combination of GI and ST. This may be due to the antagonistic effects between the liquid inoculant applied with the seed treatment resulting in relatively low seed yields, perhaps due to negative effects on nodulation even though the seed treatment and liquid inoculant are registered as compatible. The ST may have resulted in better yields when paired with a GI, as the pair are more compatible under a range of environments. In addition, combinations of GI and Fn, ST and SR, GI and Fn were also behaving in an additive fashion at low yielding sites.

Generally, the treatments with that resulted in the highest economic return at the high yielding sites contained some combination of GI, SR and Fn, with the combination with all three of these inputs resulting in the highest economic return.

Table 23. Actual and relative yield increase of each input applied alone or in combination at low yielding sites (LYS) and high yielding site (HYS) years.

Base Treatment	LYS Base Yield (bu/ac)	HYS Base Yield (bu/ac)	Added Input	Treatment	LYS Treatment Yield (bu/ac)	HYS Treatment Yield (bu/ac)	LYS Yield Increase (bu/ac)	HYS Yield Increase (bu/ac)
Empty	25.4	50.2	Fz	Fz	30.8	56.2	5.4	6
GI	26.6	56.5	Fz	Fz+GI	26.7	56.9	0.1	0.4
SR	35.1	58.8	Fz	Fz+SR	31.7	59.9	-3.4	1
Fn	28.3	58.1	Fz	Fz+Fn	30	62	1.7	3.9
ST	27.4	52.2	Fz	ST+Fz	28	55.4	0.6	3.2
ST+SR+GI+Fn	33.3	69.3	Fz	Full	35.9	68.6	2.6	-0.6
Empty	25.4	50.2	Fn	Fn	28.3	58.1	2.9	7.9
ST	27.4	52.2	Fn	ST+Fn	30.4	55.6	3	3.4
SR	35.1	58.8	Fn	SR+Fn	30.5	67.1	-4.6	8.3
GI	26.6	56.5	Fn	GI+Fn	29.4	63.9	2.8	7.4
Fz	30.8	56.2	Fn	Fz+Fn	30	62	-0.8	5.8
SR+GI	30.1	61.6	Fn	SR+GI+Fn	34.6	70.7	4.5	9.1
ST+GI	29.9	57.5	Fn	ST+GI+Fn	31.6	64.5	1.7	7.1
ST+SR	31.3	55.4	Fn	ST+SR+Fn	35.8	63.1	4.4	7.7
ST+SR+GI	30.6	65.9	Fn	ST+SR+GI+Fn	33.3	69.3	2.7	3.3
Empty	25.4	50.2	ST	ST	27.4	52.2	2	2
SR	35.1	58.8	ST	ST+SR	31.3	55.4	-3.8	-3.4
GI	26.6	56.5	ST	ST+GI	29.9	57.5	3.3	1
Fz	30.8	56.2	ST	ST+Fz	28	55.4	-2.8	-0.8
Fn	28.3	58.1	ST	ST+Fn	30.4	55.6	2.2	-2.5
GI+Fn	29.4	63.9	ST	ST+GI+Fn	31.6	64.5	2.2	0.6
SR+GI	30.1	61.6	ST	ST+SR+GI	30.6	65.9	0.6	4.3
SR+Fn	30.5	67.1	ST	ST+SR+Fn	35.8	63.1	5.3	-4
SR+GI+Fn	34.6	70.7	ST	ST+SR+GI+Fn	33.3	69.3	-1.2	-1.5
Empty	25.4	50.2	SR	SR	35.1	58.8	9.7	8.7
ST	27.4	52.2	SR	ST+SR	31.3	55.4	3.9	3.2
GI	26.6	56.5	SR	SR+GI	30.1	61.6	3.5	5.1
Fz	30.8	56.2	SR	Fz+SR	31.7	59.9	0.9	3.7
Fn	28.3	58.1	SR	SR+Fn	30.5	67.1	2.2	9
GI+Fn	29.4	63.9	SR	SR+GI+Fn	34.6	70.7	5.2	6.8
ST+GI	29.9	57.5	SR	ST+SR+GI	30.6	65.9	0.7	8.5
ST+Fn	30.4	55.6	SR	ST+SR+Fn	35.8	63.1	5.3	7.5
ST+GI+Fn	31.6	64.5	SR	ST+SR+GI+Fn	33.3	69.3	1.7	4.7
Empty	25.4	50.2	GI	GI	26.6	56.5	1.1	6.3
ST	27.4	52.2	GI	ST+GI	29.9	57.5	2.5	5.2
SR	35.1	58.8	GI	SR+GI	30.1	61.6	-5	2.8
Fz	30.8	56.2	GI	Fz+GI	26.7	56.9	-4.1	0.7
Fn	28.3	58.1	GI	GI+Fn	29.4	63.9	1.1	5.9
SR+Fn	30.5	67.1	GI	SR+GI+Fn	34.6	70.7	4.1	3.6
ST+Fn	30.4	55.6	GI	ST+GI+Fn	31.6	64.5	1.2	9
ST+SR	31.3	55.4	GI	ST+SR+GI	30.6	65.9	-0.7	10.5
ST+SR+Fn	35.8	63.1	GI	ST+SR+GI+Fn	33.3	69.3	-2.4	6.1

Conclusions
We recommend all farmers use adequate seeding rates to target the recommended plant population to maximize field pea yield potential. Under situations where the farmer expects relatively high yields, we also recommend using a granular inoculant to ensure nodulation and nitrogen fixation to provide sufficient levels of nitrogen to the crop. If the crop develops a thick canopy and/or disease develops, adding a foliar fungicide will protect and maintain the yield potential of the crop. We do not expect to see a yield response using starter nitrogen fertilizer, except potentially when residual N is extremely low or when there are extreme cases of late season root rot or moisture limitations which limit yield potential and nitrogen fixation. Seed treatments did not result in consistent yield improvements in field peas and therefore the reasons for this should be further investigated.

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Fungicide Application and Seeding Rate Effects on Disease Levels and Yield in Field Pea and Lentil

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description
Diseases such as white mold in lentil and mycosphaerella blight in field pea are frequently associated with reduced yield and quality in southeast Saskatchewan. While there are many fungicide products on the market, producers may not always see the potential benefits of applying a fungicide. Increased seeding rates in peas and lentils have the potential to increase yield and decrease weed competition, but a dense crop canopy can often increase disease incidence and severity.
The treatments evaluated included a combination of three seeding rates (low, medium, and high) with two fungicide treatments (check or fungicide applied) for each of the two crops: lentils and field peas, for a total of 12 treatments. The low, medium, and high seeding rates consisted of 130, 260, and 520 seeds/m^2 for lentils and 50, 100, and 200 seeds/m^2 for field peas. The fungicide application consisted of Headline EC at the start of flowering and an application of Priaxor DS one week later. The trial was conducted at Indian Head in 2013 and 2014. Results from 2013 were included in the 2013 Annual Report.

Results
Significant crop damage and yield loss occurred in 2014 as a result of excess moisture received in June. Lentil yields were well below average and field pea yields were lower than the previous year. Under lower yielding conditions in 2014, seeding rate had a stronger impact on both lentil and field pea yields with and without a fungicide, relative to 2013 (Figure 27). Fungicide application did not have a significant effect on yield in 2014 and there was no consistent trend in either lentil or field pea yields. This is in contrast to the yield response to fungicide in 2013, where fungicide application significantly increased pea yield by 28%.

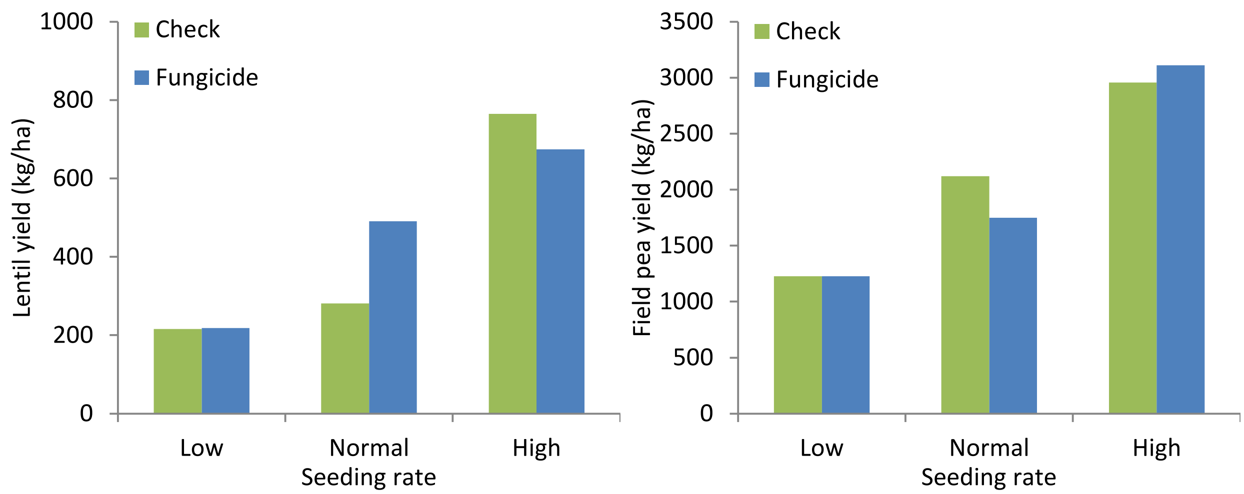

Figure 27. The effect of seeding rate and fungicide on lentil and field pea yield at Indian Head in 2014.

Conclusions

In 2014, with significant crop injury early in the season, plant populations above those normally recommended did provide significant yield benefits for both crop types and regardless of whether fungicides were applied, but this was not the case in 2013 under more desirable growing conditions. In 2014, although the fields dried off in July and the crops had time to recover, the field pea plants remained very small and were unable to compensate for the extra space at lower populations. Increasing seeding rates tended to be more beneficial with field peas than with lentils but, in all cases (both crop types in either year), yields declined when plant populations were below optimal. In general, these results suggest that fungicide recommendations should not necessarily be changed based on plant populations, as the effect of fungicide application did not change with seeding rates.

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Field Pea, Lentil, and Soybean Response to Rhizobial and Mycorrhizal Inoculation

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Benefits associated with including pulses in crop rotations are primarily due to their ability to form symbiotic relationships with Rhizobium bacteria (*Rhizobium leguminosarum*) and utilize N_2 in the soil air, which is normally not available to plants. To ensure adequate root nodulation, growers are advised to use rhizobial inoculants that are either applied directly to the seed or in the seed furrow as a liquid, granular or peat-based product. For soybeans in Saskatchewan, inoculation is even more critical since the bacteria that infect soybean roots are of a different strain than field pea or lentil; therefore, native populations in the soil are likely to be low in most fields. Arbuscular mycorrhizal inoculants (*Glomus intraradices*) are relatively new to western Canadian farmers and are not specific to pulse crops. These organisms form symbiotic relationships with most plants to effectively increase their root areas and thereby enhance their ability to utilize soil resources. This study includes both rhizobial and mycorrhizal inoculants to distinguish between the effectiveness of these two types of products. Four inoculant treatments (no inoculant, rhizobial inoculant only, mycorrhizal inoculant only, rhizobial and mycorrhizal inoculant) were evaluated in field pea, lentil, and soybean. The rhizobial inoculants used were Nodulator XL for pea and lentil, and Cell Tech for soybeans, while the mycorrhizal inoculant was MykePro for all three crop types. The trial was conducted at Indian Head in 2013 and 2014.

Results

Responses to inoculant treatments in each crop were similar in 2013 and 2014, thus the average of both years is shown. There were no statistical results or trends to suggest that field pea yields were increased with any inoculants. In 2013, there was an overall trend of higher lentil yields with rhizobial inoculant but this was not the case in 2014 where yields were lower and other factors (i.e. excess precipitation) were more limiting, and the average for both years showed no effect of inoculant (Figure 28).

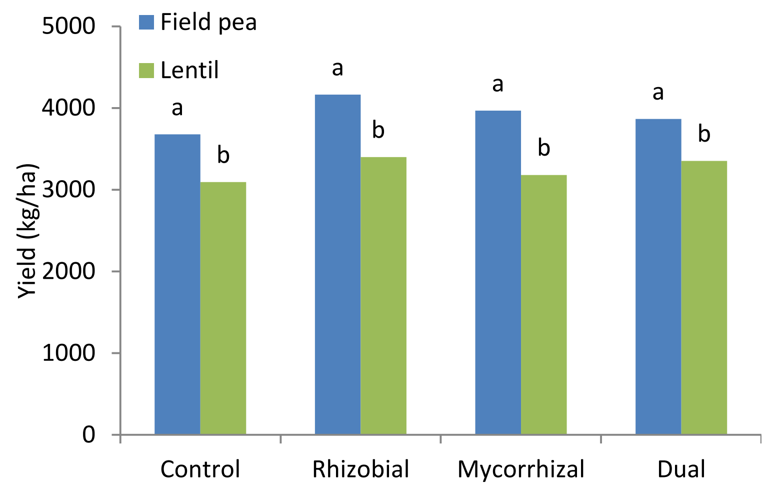

Figure 28. The effect of rhizobial and mycorrhizal inoculants on field pea and lentil yields at Indian Head in 2013 and 2014.

In soybeans, there was a consistent and significant yield increase with rhizobial inoculant, alone or combined with a mycorrhizal inoculant, in both years individually and averaged (Figure 29).

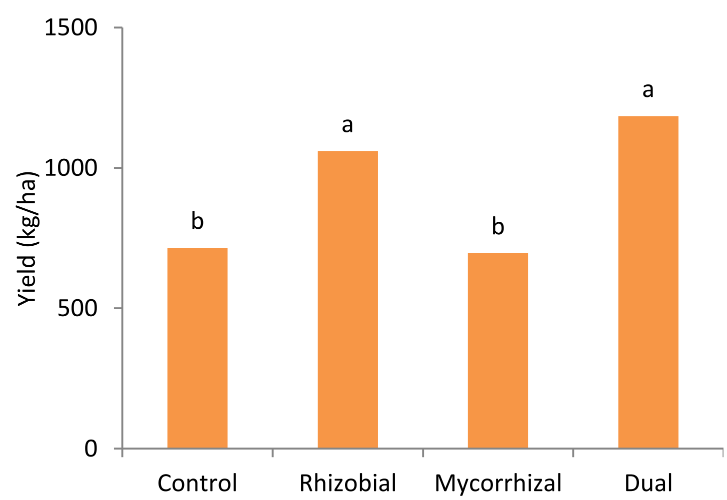

Figure 29. The effect of rhizobial and mycorrhizal inoculants on soybean yield at Indian Head in 2013 and 2014.

Conclusions

This trial did not show a significant crop response to the inoculant treatments on field peas or lentils; however, rhizobial inoculation is recommended for these crops to maximize potential N fixation and seed yields. It is also important to note that these fields have a history of field peas in rotation and native populations of rhizobium may have been sufficient for adequate nodulation. Soybeans have not historically been grown in the region and require a different strain of bacteria, thus a significant benefit to rhizobial inoculation in both years. The agronomic benefit of mycorrhizal inoculation under normal field conditions is less well understood; however, there was no significant benefit to mycorrhizal inoculation for field pea, lentil or soybean in this trial. The benefits of mycorrhizal fungi are not exclusive to pulse crops and the product used in this trial may also be used with cereals and oilseeds such as flax. The potential benefits of mycorrhizal inoculants are likely affected by management factors such as crop rotation, tillage practices and seeding equipment. Benefits to inoculation would be most likely following non-host crops such as canola and when tillage or high-disturbance seeding equipment damages existing mycorrhizal networks and hyphae. At Indian Head, the trial was conducted in long-term no-till fields following a host crop (spring wheat or barley).

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Soybean Response to Starter Nitrogen and Phosphorus Fertilizer Application

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Soybean acres have recently seen rapid growth in Saskatchewan, but growers and agronomists have relatively little experience with this crop in our environment. Soybeans are legumes and can fix atmospheric N, but are large nutrient users so often require more N than they can produce through biological fixation. Research in more traditional soybean regions has shown that N responses are most likely when either yield potential is high or under stressful conditions (when nodulation is poor or soils are cool, dry and/or low in residual N). While data from Saskatchewan and Manitoba are limited, N fertilizer application has not been recommended for soybeans in Saskatchewan. With respect to phosphorus, soybeans prefer soils with high levels of residual P; however, response to fertilizer applications can be inconsistent. While soybeans will likely benefit from P fertilizer application when soil residual levels are low, they are sensitive to fertilizer placed in close proximity to the seed and therefore in-furrow placement is not generally recommended, unless relatively low rates are used. The objective of this project was to demonstrate the yield response of soybean to side-banded urea and side-banded versus seed-placed phosphorus fertilizer applications, and the effect of fertilizer on inoculant. The treatments evaluated are outlined in Table 24.

Table 24. Treatments evaluating the effect of N and P fertilizer and inoculant on soybeans.

$N\text{-}P_2O_5$ Rate (kg/ha)	Phosphorus Placement	Granular Inoculant*
0-0	n/a	yes
55-0	n/a	yes
2-20	side-band	yes
2-20	seed-placed	yes
4-40	side-band	yes
4-40	seed-placed	yes
55-20	side-band	yes
55-20	seed-placed	yes
55-20	side-band	no
55-20	seed-placed	no
55-40	side-band	yes
55-40	seed-placed	yes

* Cell-Tech 4.1 kg/ha

Results

There was no significant effect of P placement on emergence at the rates evaluated and under the environmental conditions experienced at Indian Head in 2014 (data not shown). Yield response to side-banded and seed-placed P fertilizer were similar at all rates. P fertilizer tended to increase yield relative to no P fertilizer, but there was not much difference between the two rates of P fertilizer. The largest increase in yield was seen with N fertilizer application, and N fertilizer did not negate the effect of granular inoculant (Figure 30).

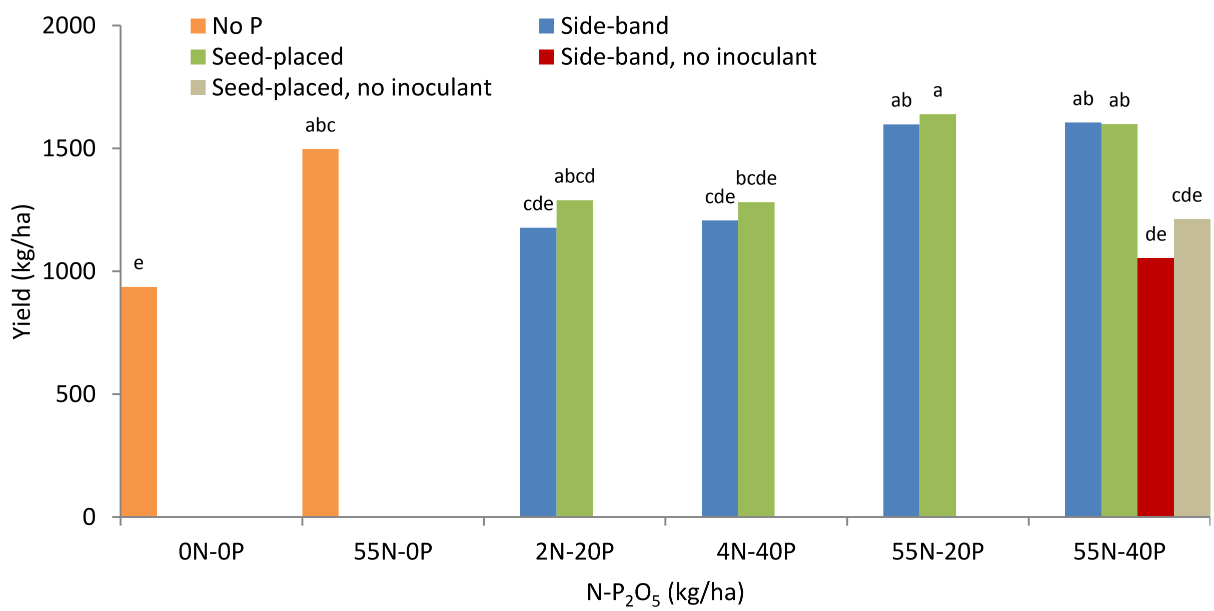

Figure 30. The effect of N and P fertilizer and inoculant on soybeans at Indian Head in 2014.

Conclusions

Further research would be required to evaluate the effects of P placement at higher application rates and under a broader range of soil and environmental conditions. Contrary to our expectations, there was a strong response to side-banded N fertilizer. While high mineral N levels can reduce nodulation by *Bradyrhizobium*, there was still a strong response to granular inoculant even when combined with starter N. While we are hesitant to recommend N fertilizer applications on N fixing crops such as soybeans, these results justify a more in-depth evaluation of interactions between granular inoculant rates and N fertilizer applications for soybeans in Saskatchewan. Again, previous research has shown that responses to N are not uncommon when soil residual levels are extremely low or when cool or dry conditions reduce nodulation and N fixation early in the season.

Acknowledgements
This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Inoculant and Foliar Fungicide Effects on Soybeans

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

Soybeans have not traditionally been grown in Saskatchewan, thus proper inoculation is required to ensure adequate nodulation and biological N fixation. There is general acceptance that double inoculating (full rates of both liquid and granular inoculant) is beneficial for land where soybeans have not previously been grown and further evidence that granular inoculant rates exceeding those on the product labels may be warranted. On the other hand, high rates of granular inoculants add considerable costs to seeding soybeans. With regard to fungicide application, it has generally been recommended that soybean growers in Saskatchewan can avoid foliar applications since disease has not typically been a limiting factor in this environment. Furthermore, unnecessary use of fungicide is expensive and could result in unnecessary delays in soybean maturity. Certain conditions may be conducive to the development of disease, and growers may be tempted to apply a fungicide, but the probability of such conditions occurring in Saskatchewan is relatively low. The objective of this project was to demonstrate the effects of high rates of granular inoculant and foliar fungicide on the maturity and seed yield of soybeans at Indian Head. Five rates of inoculant (0, 0.5, 1, 2, and 4x the recommended rate of 4.0 kg/ha for Cell-Tech granular) were applied with or without a foliar fungicide (Headline EC at 0.4 L/ha), for a total of 10 treatments. Granular inoculant was applied in the seed row and all seed was treated with Cruizer Maxx Vibrance and Primo CL liquid inoculant.

Results

As expected, soybean yield was not affected by fungicide. Soybean seed yields were increased by up to 116% with granular inoculant (Figure 31). The curved response was a function of diminishing returns of increasing the inoculant rate beyond approximately two times the label recommendation. There was no significant difference in yield between the 2x and 4x rates.

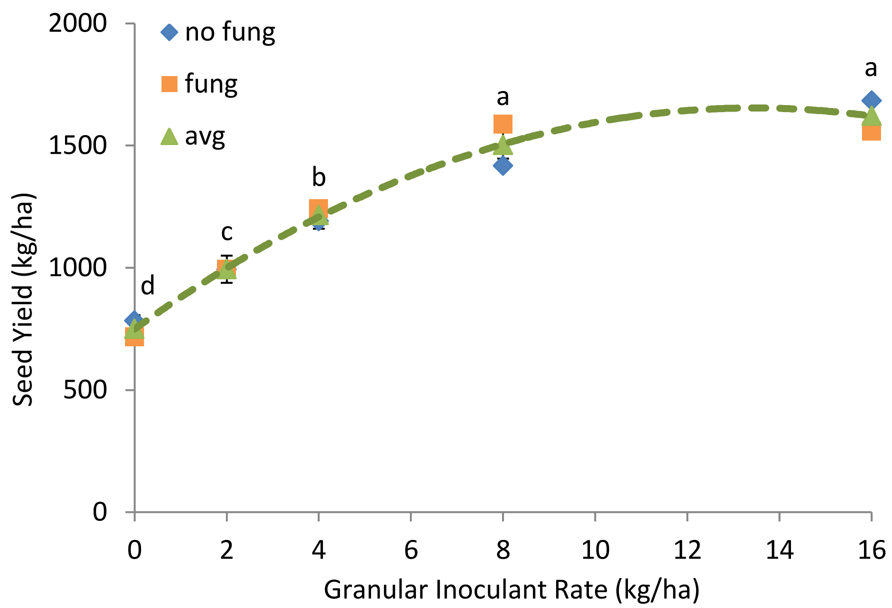

Figure 31. The effect of different rates of inoculant on soybean seed yield at Indian Head in 2014, the 1x inoculant rate is 4 kg/ha.

Conclusions

Under the soil and weather conditions encountered, soybeans responded well to granular inoculant applications, beyond the effect of the seed-applied inoculant (Figure 32). For this particular demonstration, the crop was direct seeded into barley stubble on land which had never previously been seeded to soybeans. While conditions were reasonably warm at planting, it was a cool growing season overall and frost terminated the soybeans prior to maturity. The environmental conditions encountered resulted in relatively low yields; however, the response to inoculant was strong. Saskatchewan soybean growers, particularly under no-till, are advised to apply 2-2.5x the label recommended rate of granular inoculant in furrow, even when using seed that has been treated with a liquid inoculant.

Figure 32. Visual differences were easily apparent between plots with no granular inoculant (left) and plots with 4x the recommended rate of granular inoculant (right).

A second objective was to evaluate the potential response of fungicide application on soybeans in Saskatchewan. It is typically recommended that soybean growers in this province need not worry about applying a foliar fungicide because disease has not yet been an issue with this crop and fungicides may cause unnecessary delays in maturity. In the current demonstration, the first killing frost occurred before any pods had started to turn colour and therefore it is unknown whether the fungicide application would have had any effect on maturity. These results confirm the current recommendation that foliar fungicide applications will not likely be beneficial for soybeans in this area at this time.

Acknowledgements
This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Adaptation and Development of Soybean Compared to Other Crops under No-Till Management in Saskatchewan

C. Holzapfel[1], C. Catellier[1], B. Nybo[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Wheatland Conservation Area, Swift Current, SK

Description
Producers in Saskatchewan require access to information on the risks associated with growing modern, early-maturing soybean varieties under no-till in Saskatchewan relative to more traditional broadleaf crops. This trial was conducted at Indian Head and Swift Current where soybeans, canola, field peas and faba beans were each planted on three different seeding dates. The targeted seeding dates were T1) Early (first two weeks of May), T2) Normal (10-14 days after the 1st seeding date and T3) Late (10-14 days after the 2nd date). The crop/variety treatments were 1) Canola (46H75 CL), 2) Field pea (CDC Golden), 3) Faba bean (Snowbird), 4) Soybean (NSC Tilston RR2Y), 5) Soybean (TH33003R2Y), and 6) Soybean (P002T04R). The intent of multiple seeding dates was to assess whether the relative performance of the different crops changes as seeding is delayed and to broaden the range of environmental conditions encountered. The intent of multiple soybean treatments was to ensure that our results would be applicable to the range of early maturing material available. Results from Indian Head only are presented here as the sites were analyzed separately.

Results
At Indian Head in 2014, the soybeans developed relatively slowly with the cool weather and, at all three seeding dates, froze prior to physiological maturity which may have reduced yields by upwards of 20%. However, the wet weather also negatively impacted the field peas, and soybean yields were similar to field pea yields at all three seeding dates. Canola consistently out-yielded soybeans and field peas at all three dates but, for the first two seeding dates, faba beans performed relatively well and yielded substantially higher than all other crops. At the final seeding date in early June, yields tended to be lower for all crops and were dramatically reduced for faba beans, which also did not mature (Figure 33).

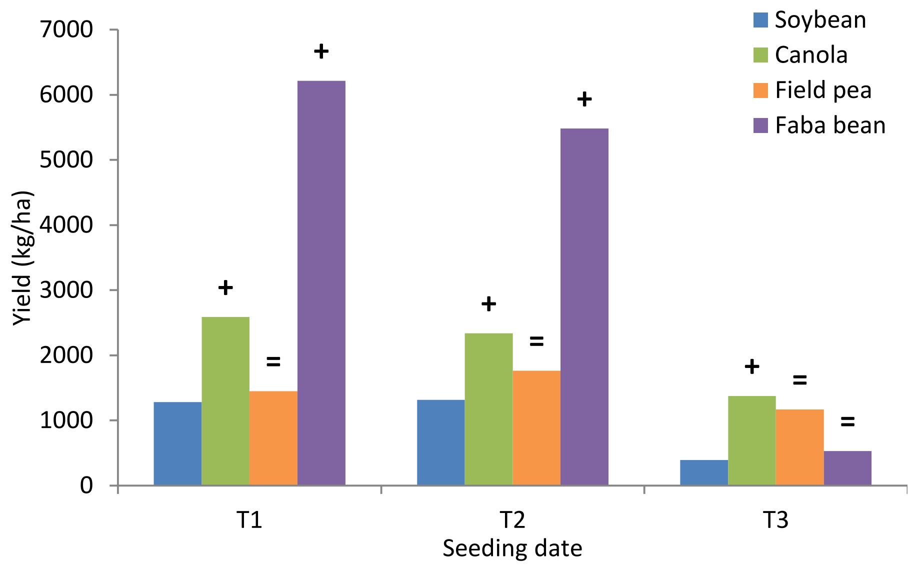

Figure 33. Yield of canola, field pea, and faba beans, relative to average soybean yield when seeded on three different dates at Indian Head in 2014. "+" indicates yield was significantly higher than soybean, and "=" indicates yield was not significantly different from soybean on that seeding date.

Conclusions

As more data is accumulated (the trial will be repeated in 2015 and 2016), economic analyses will be completed to take into account the costs of production and gross revenues of the various crop types as a function of seeding date.

Acknowledgements

Support for this project was provided by the Saskatchewan Pulse Growers and Agriculture and Agri-Food Canada, through the AgriInnovation Pulse Cluster 2 program.

Seeding Rate and Depth Effects on Soybean Establishment, Maturity, and Yield under No-Till Management in Saskatchewan

C. Holzapfel[1], C. Catellier[1], B. Nybo[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Wheatland Conservation Area, Swift Current, SK

Description

As more producers in Saskatchewan opt to include soybeans as an alternative to other crops in their rotation, it will be necessary to improve recommendations for the successful establishment of soybean in this relatively cool environment. The objective of this study was to evaluate soybean response to seeding rates and depths. The treatments evaluated were a combination of two seeding depths (~20 mm versus ~40 mm) and seven seeding rates ranging from 15-85 seeds/m^2 and was conducted at Indian Head and Swift Current.

Results

Excellent emergence was achieved at both locations; however, spring plant densities were slightly lower with deep seeding. Plant density increased linearly with increasing seeding rates for both shallow and deep seeding at both locations (Figure 34).

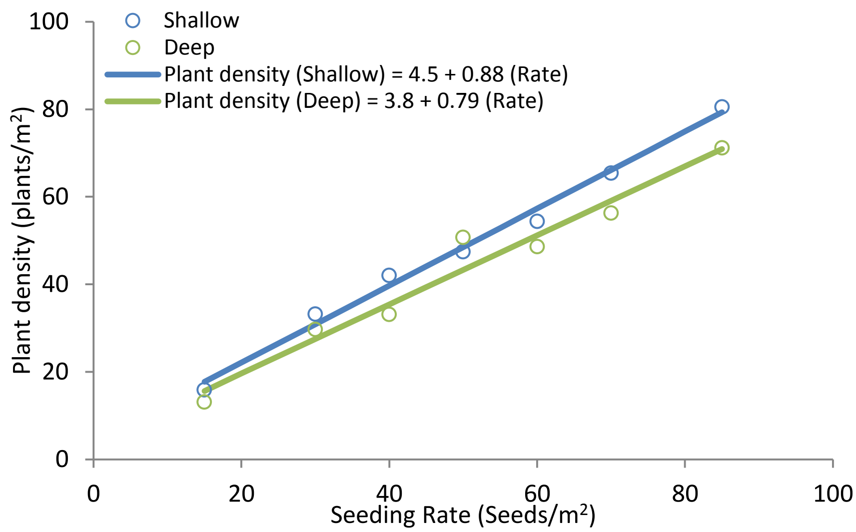

Figure 34. Seeding rate by depth effects on soybean plant density for Indian Head and Swift Current combined.

When combined with shallow seeding, seed yields continued to increase with higher seeding rates than expected with a linear increase detected at both locations. With deep seeding, the seed yield response to increasing seeding rates was curved, though yields were higher overall with shallow seeding and continued to respond to seeding rates beyond where yields appeared to be levelling off with deep seeding (Figure 35). This may have been due to delayed maturity in the deep seeded treatments, which would especially be apparent because of the short, cool growing season and early frost.

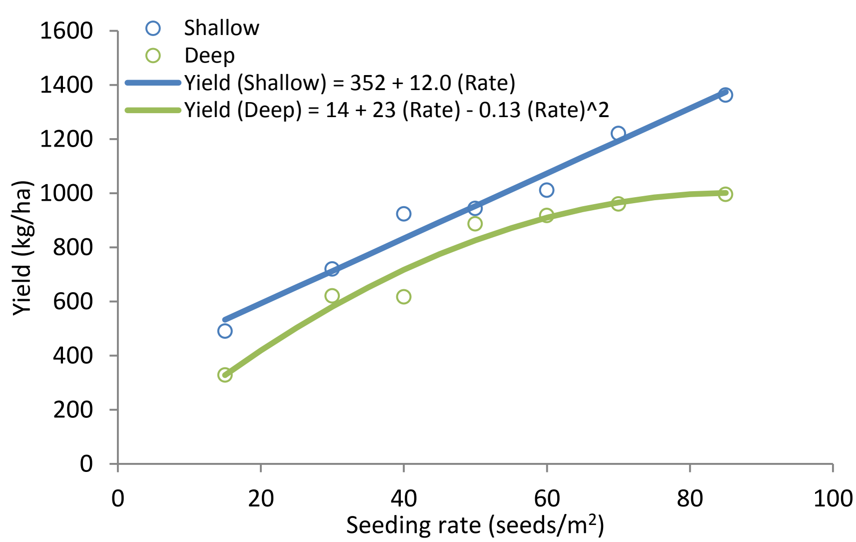

Figure 35. Seeding rate by depth effects on soybean yield at Indian Head and Swift Current combined.

Conclusions

Preliminary results confirmed our expectations that soybeans do not need to be seeded as deep as other pulse crops such as field pea or faba bean and that depths of 38 mm or deeper negatively affect emergence and yield. It is uncertain whether deeper seeding had an impact on maturity since all treatments froze prior to any pods changing colour. Smaller seed size with deep seeding suggested that this may have been the case (data not shown). Results also suggest that optimal seeding rates for soybeans in Saskatchewan may be higher than traditionally recommended; however, the observed results may have been atypical and largely due to the early frost. In addition, the higher costs associated with increasing seeding rate must be taken into consideration when determining the economically optimum rate. The trial will be repeated in 2015 and 2016.

Acknowledgements
Support for this project was provided by the Saskatchewan Pulse Growers and Agriculture and Agri-Food Canada, through the AgriInnovation Pulse Cluster 2 program.

Row Spacing Effects on Soybean Establishment, Maturity, and Yield under No-Till Management in Saskatchewan

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description
As more producers in Saskatchewan opt to include soybeans as an alternative to other crops in their rotation, it will be necessary to improve recommendations for the successful establishment of soybean in this relatively cool environment. The objective of this study was to evaluate soybean response to varying row spacing levels that are common amongst modern no-till drills, and to examine any interactions with seeding rate. This study was only conducted at Indian Head in 2014. The treatments were a combination of five row spacing levels (25, 31, 36, 41 and 61 cm) and three seeding rates (40, 50 and 60 seeds/m^2).

Results
As expected, spring plant densities decreased with wider row spacing and increased with seeding rate, though there was no interaction between the two factors, indicating that the rate of increase with seeding rate was the same for all row spacings (data not shown).
Despite the reduction in plant populations with increasing row spacing, yields increased with wider row spacing but appeared to level off at close to the maximum spacing of 61 cm (24”). There was no interaction between row spacing and seeding rate which indicates that the response to seeding rate was similar at all row spacings.

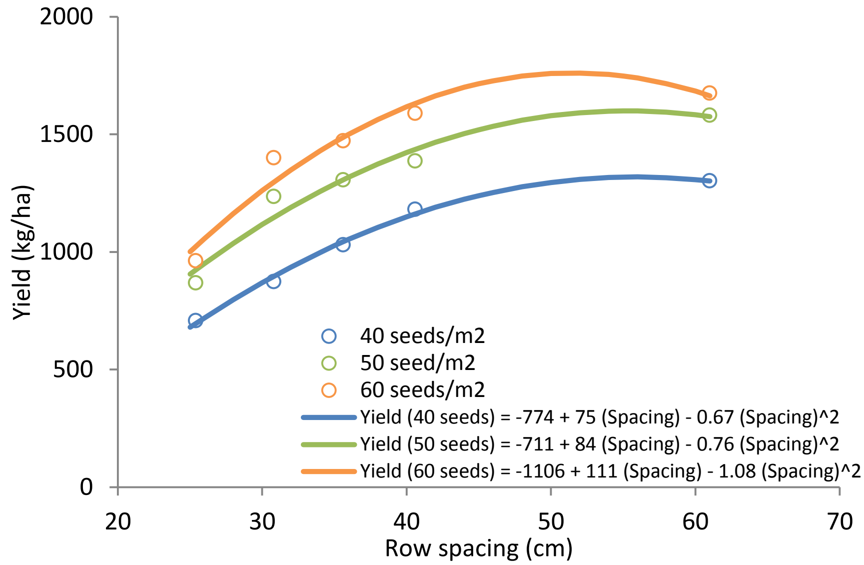

Figure 36. The effect of row spacing on soybean yield at different seeding rates at Indian Head in 2014.

Conclusions

Soybeans are considered to be well adapted to wider row spacing and, in traditional soybean growing regions, are frequently seeded with planters at up to 76 cm row spacing. In short-season regions such as western Manitoba and southeast Saskatchewan where very early maturing varieties are required, relatively narrow rows (≤ 38 cm) are typically recommended, thus the observed increase response was not expected. Based on results from adjacent field trials, it is likely that the granular inoculant rate used in this trial was not sufficient to maximize yield and, as such, may have become less limiting as row spacing was increased and biased our results in favour of wider row spacing. To minimize the possible impact of this potential bias in future years of the project, a higher rate of granular inoculant will be used for all treatments. The trial will be repeated in 2015 and 2016.

Acknowledgements

Support for this project was provided by the Saskatchewan Pulse Growers and Agriculture and Agri-Food Canada, through the AgriInnovation Pulse Cluster 2 program.

Soybean Variety Trial for Southeast Saskatchewan

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description

This study was initiated in collaboration with NorthStar Genetics to evaluate the performance and adaptation of commercial soybean cultivars at Indian Head.

Results

The varieties evaluated covered a range of very early to early maturing varieties, and all were glyphosate tolerant and managed in a no-till, continuous cropping system. Yields were relatively low at Indian Head in 2014, likely a result of cooler temperatures and excess moisture early in the season, and an early frost before most varieties reached maturity. However, several significant differences amongst varieties were detected (Table 25).

Table 25. Performance of 8 commercial soybean varieties at Indian Head in 2014.

Variety	Plant Density (plants/m^2)		Pod Height (cm)		Maturity (% pods turned before frost)		Yield (bu/ac)	
P001T34R	48	a	1.4	d	85.0	a	8.2	d
Moosomin	59	a	4.2	b	6.3	c	21.5	c
Reston	59	a	4.1	b	30.0	b	21.2	c
DK2310	51	a	3.0	c	3.5	c	24.8	ab
Anola	50	a	4.1	b	2.8	c	22.6	bc
Vito	55	a	3.9	b	2.8	c	22.3	bc
Gladstone	46	a	3.1	c	2.0	c	22.6	bc
Tilston	52	a	5.6	a	3.5	c	26.4	a

Acknowledgements
Funding for this project was provided by NorthStar Genetics.

RR2 Soybean Yield, Inoculant, Fertility, Seeding Rate and Seed Treatment Trials

C. Holzapfel[1], C. Catellier[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK

Description
Soybean production has recently expanded too many parts of Saskatchewan. This crop has not historically been cultivated under dryland no-till production, and it is not known specifically what the best management practices are for soybeans in Saskatchewan, or which varieties are most suited to local environmental conditions. Three separate trials were initiated in collaboration with Quarry Grain to: 1) test Quarry (Thunder Seeds) soybean varieties against competitive varieties to observe differences in days to maturity and gather relative yield performance data; 2) to test different rates and application methods of inoculating soybeans; 3) to test the effects of different rates of P and K fertilizer on soybeans; and 4) to test different seeding rates and several soybean seed treatments.

1) *Variety trial*

A total of ten varieties were evaluated for relative maturity and yield. None of the varieties were mature at the time of the first killing frost, and only a few varieties had started changing colour. This likely had an effect on yield, which was relatively low in 2014 (Figure 37).

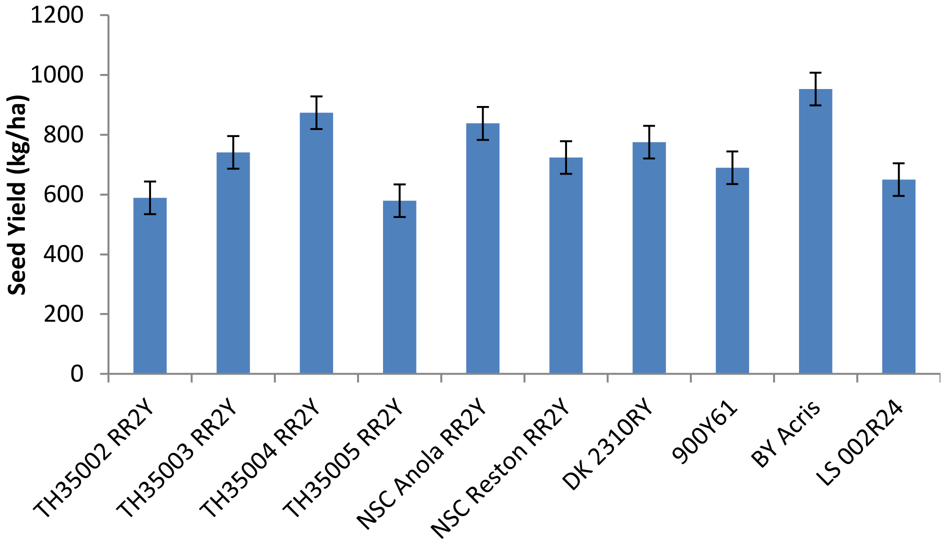

Figure 37. Yield of 10 commercial soybean varieties at Indian Head in 2014.

2) Inoculant trial

The variety for this trial was TH 33003 R2Y and liquid inoculant SoyRhizo was applied to all treatments. Various rates of the granular inoculant, NROW, were assessed for their effect on soybean yield (Figure 38).

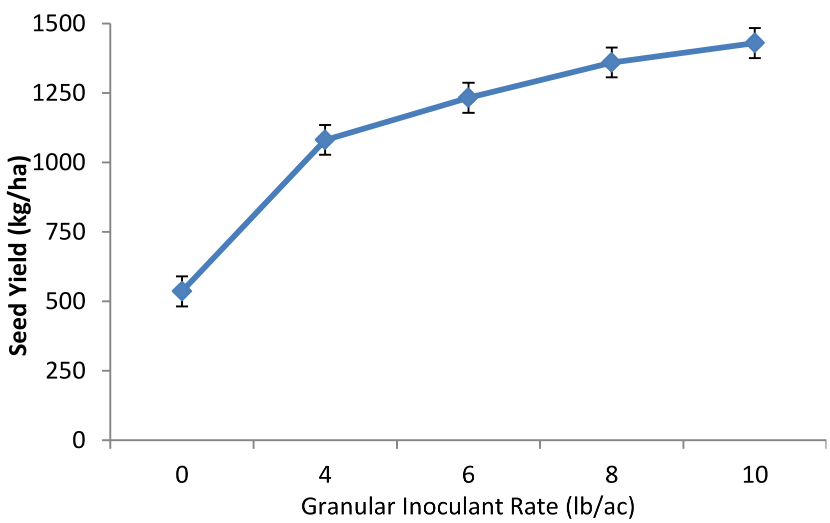

Figure 38. Yield response of soybean to different rates of granular inoculant at Indian Head in 2014.

3) Fertility trial

Eight different fertility treatments were compared which differed in rates of side-banded P (11-52-0) and K (0-0-60) fertilizers (Figure 39).

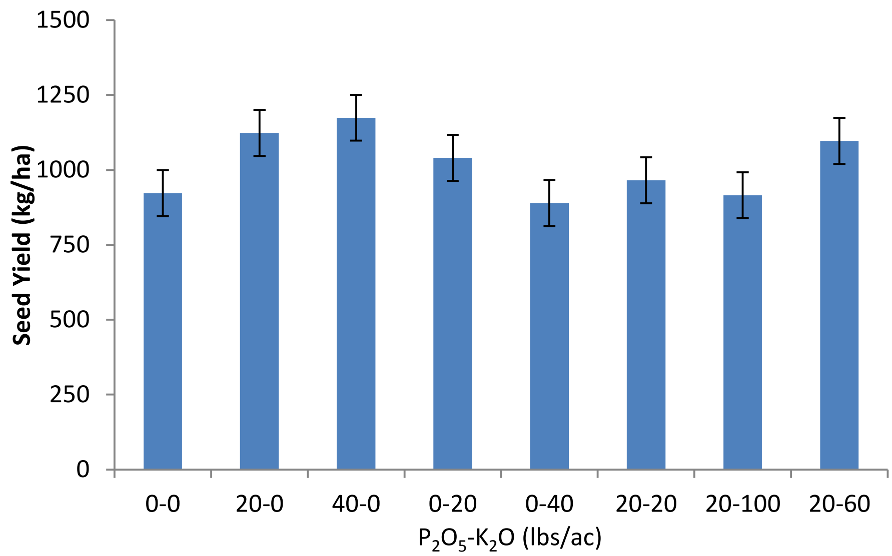

Figure 39. Soybean yield response to different rates of P and K fertilizer at Indian Head in 2014.

4) Seeding rate and seed treatment

Soybeans treated with three different seed treatments, and an untreated control, were each sown at five different seeding rates to determine the effect on soybean yield.

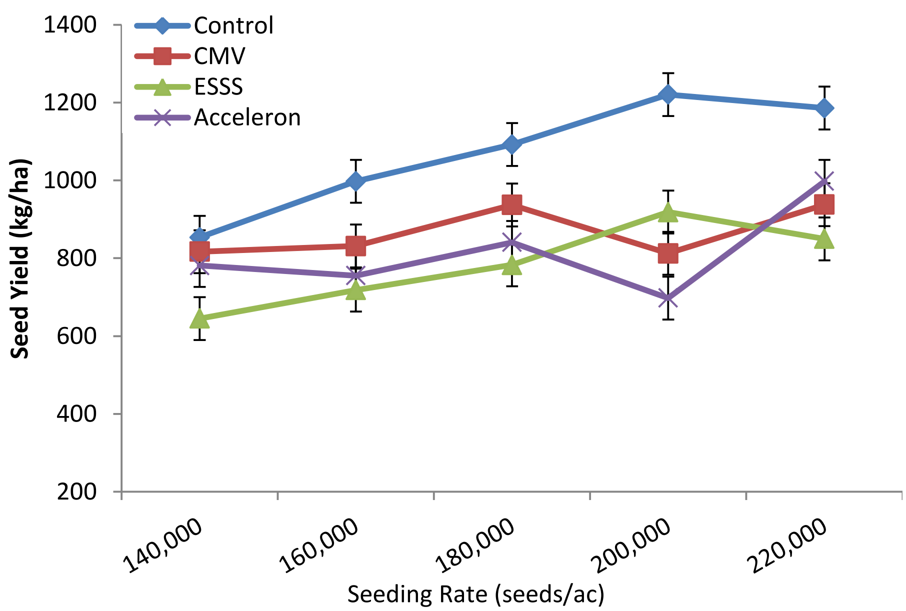

Figure 40. Soybean yield response to different seed treatments at a range of seeding rates at Indian Head in 2014.

Acknowledgements

Funding for these projects were provided by Quarry Seed.

Natural Air Grain Drying

R. Palmer[1], D. Petty[1], C. Catellier[1], C. Holzapfel[1], C. Omoth[2], B. May[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Agriculture & Agri-Food Canada, Indian Head, SK

Description

The recommended management strategy for natural air grain drying is to run the fan continuously after harvest until the temperature of the stored crop has been cooled or dried down. However, producers are interested in knowing whether there is a more efficient way to cool and dry grain without running the fan unnecessarily. The objectives of this project were to develop a fan control strategy using natural air that 1) resulted in the safe storage of grain, 2) is efficient and results in less fan running time, and 3) dries the grain sufficiently for imminent sales.

The study consisted of completing measurements of freshly harvested grain from different crops including field peas, barley, and spring wheat, in typical farm-sized bins. The bins were instrumented with temperature (T) and relative humidity (RH) sensors that measured the ambient (in-coming) air, and the T and RH of the out-going air at the top of the bin. The velocity of air entering the bin was measured and multiple T sensors were installed at different heights inside the bin. The bins were also equipped with a specially designed sampling tube in order to allow grain samples to be collected at four different levels in the bin, accessible from the ground, for monitoring the actual grain MC through the use of a Labtronics Model 919 Moisture Metre. Grain samples from these sampling tubes were collected at the same time every day that the fans were in operation, allowing for 24 hour comparisons of the MC of the grain.

A run consisted of filling the bin with freshly harvested field peas, barley, or wheat that was physiologically uniform, and running the aeration fan while logging hourly data (as above) and monitoring grain MC until it was considered dry.

Six bins were paired to compare the effects of running the fan continuously to different experimental fan control strategies. For each run, each bin pair was filled simultaneously with the same lot of grain at the same time.

Table 26. Bin pairing, size and fan operation (2012-2014).

		Fan Operation	**Fan Size**	**Bin Size** (bu)
Pair 1	Bin 9	continuous	5 hp	2250
	Bin 10	controlled	5 hp	2250
Pair 2	Bin 16	continuous	3 hp	3500
	Bin 17	controlled	3 hp	3500
Pair 3	Bin 18	controlled	5 hp	3500
	Bin 19	continuous	5 hp	3500

Results

From 2007 to 2015 (one run in the winter of 2015), 33 trial runs were conducted in total. All bin runs from 2007 to 2013 with continuous fan operation were examined to determine the average rate of drying on an hourly basis. It was observed that there was consistently a significant amount of drying occurring in the first 24 hours of all continuous runs. Thus, we suggest that it is important to have the fan on immediately as the grain comes in from the field.

Most importantly, it was observed that after the first day, there was a daily cycle of drying and wetting appearing to repeat every 24 hours (Figure 41) as a daily or diurnal cycle, and that in general, drying occurred at night and occasionally during cool days.

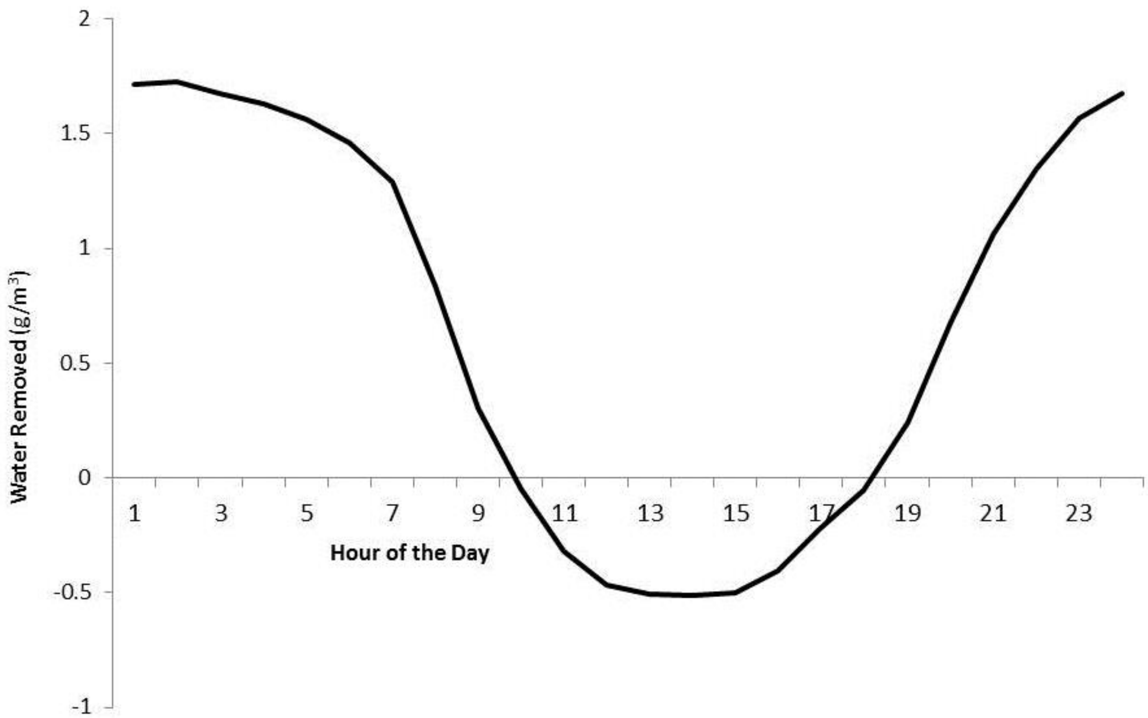

Figure 41. Daily drying cycle of 21 bin runs from 2007 to 2013 under continuous fan operation

With further exploration of the data, it was observed that drying was correlated with air and grain T, such that drying was occurring whenever the grain T was decreasing (Figure 42).

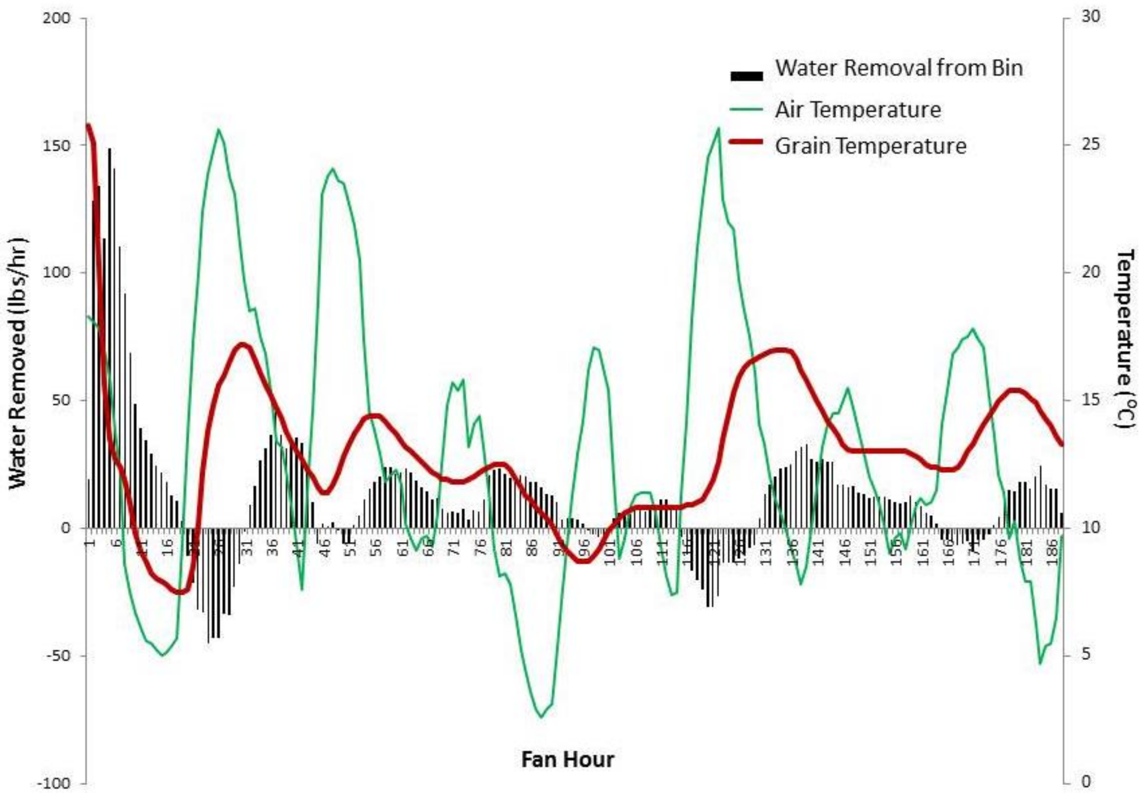

Figure 42. Sample of a continuous bin run with wheat in 2012 showing the correlation of air temperature, grain temperature and hourly drying rate.

Also under continuous fan operation, the bottom half of the bin dries quickly and even over-dries while the top half remains at basically the same MC, leaving a large spread in dryness from the top to the bottom. The controlled bins had less drying on average, but the layers are more consistent in MC, meaning drying occurred throughout the entire bin rather than from the bottom-up (Table 27).

Table 27. Comparison of the effectiveness and efficiency of a fan control strategy from a paired bin run in 2014.

	Bin 19 (3500 bu)	**Bin 18** (3500 bu)
Fan Operation	Continuous	Controlled
Start MC (%) (bin average)	17.3	16.9
End MC (%) (bin average)	13.6	15.6
End Range of MC (%) (top to bottom of bin)	1.5	0.1
End Grain T (°C)	11	1.2
Fan Running Time (hours)	621	134
Electricity @ 0.10/kwh (5HP fans)	$229	$49
Spoilage Index (higher indicates greater risk of spoilage)	97	56

It has been suggested that with grain aeration there is often a drying-front that starts from the bottom and works its way to the top of the bin. We did not find evidence of this; however, we did see a drying gradient, where more drying occurred in the bottom of the bin, and there was a gradient in drying towards the top of the bin, under continuous fan operation. It was also suggested that if grain was constantly cooled, as with the controlled fan strategy, the energy required to expel moisture from the grain would be expired. Thus, it is possible that the grain needs to be heated for further drying to occur. When the fan is running continuously, the grain is warmed with higher T air during the day and also as a result of the heat created through the compression of the air entering the bin. The problem with heating the grain this way is that it also results in re-wetting of the grain. Our data indicates that cold grain with the fan not operating will slowly warm up, approximately 1^{o}C per week, by conduction and convection. Since the mean T of the outside air is much higher than the grain, a certain amount of energy will be transferred through the walls of the bin to the grain, and to the air pocket at the top of the bin, and will create a convection current in which the air moves downward, through the lid and out of the bin through the still fan. This is good in the sense that energy is added without adding water. Furthermore, we found that cold air, even freezing air, can dry grain. In many of our trial runs, the ambient air T was below freezing and drying was still occurring, though at a slower rate.

Conclusion

Producers often have conflicting objectives for grain aeration. Most want their grain dry, but they also want safe storage with no spoilage, and they would like to do this with a minimum of fan operation time. There are limitations to what natural air grain drying can accomplish, but even the modest demands require special attention in adjusting the control strategy. The worst thing a farmer can do is to harvest warm tough grain, put it into a bin and leave it. It is important to get the fans turned on immediately, to get the T of the grain down as quickly as possible. After the first day, there are some options. There are some producers that are intuitively following a control practice of only running the fans on hot days. This does result in drying the grain, but it also keeps the grain hot which in turn keeps the number of safe days of storage down, which could lead to spoilage. The common practice of running the fans continuously also works, but it needlessly cycles the grain through hot wet conditions which encourages spoilage. There are many days that the fan is running and is actually damaging the grain, by warming it up and adding moisture to the bin. Cool air fan operation is a better option. The grain is conditioned to be cooler and safer. Even further, would be to have the fans operating only on cold clear nights. This would result in more efficiency, with less fan time, and colder, safer grain. This would be especially applicable for the storage of dry or slightly tough grain. This project will be continued and enhanced during the 2015 through 2017 growing seasons.

Acknowledgements

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Field-Scale Evaluation of Foliar Applied Fungicides for Various Crops

C. Holzapfel[1], C. Omoth[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Agriculture & Agri-Food Canada, Indian Head, SK

Description

There has been an increase in disease pressure for most crops in the thin Black soil zone over the past number of years, primarily due to above average precipitation. Since 2004, IHARF has been conducting field-scale evaluations of a variety of fungicide products and crop types. This data, acquired over a large number of years and a wide range of conditions, provides valuable insights into the frequency and magnitude of yield responses to annual fungicide applications for a variety of crops. While annual, preventive fungicide applications are likely to result in higher mean yields over the long-term, it is not certain whether the average gains experienced in this region are sufficient to increase long-term profits for many crops.

Results

Large yield increases (15-30%) with fungicide application were detected occasionally with all of the crops, and failure to apply a fungicide in these years resulted in substantial losses of both grain yield and in some cases, quality. Spring wheat and canola tended to be the least responsive to fungicide with significant yield increases detected only 33% of the time and mean yield increases of only 4.3-4.4% over the long-term. While field pea yield increases were only statistically significant 38% of the time, there was a consistent trend for higher yields with fungicide which, over seven growing seasons, averaged nearly 12%. Both barley and oat responded positively to fungicide application with reasonable consistency, with yield increases detected in 50-60% of the years where trials were conducted; however, the magnitude of response tended to be higher for barley with an overall average increase of 11% compared to 6% for oats. Canaryseed yield increases with fungicide application were detected each year since 2008 when trials with this crop were initiated, with an average yield increase of 23%.

Table 28. General summary of field-scale fungicide trials from 2004 to 2013 at Indian Head.

Crop Type	**# of Years**	**Response Frequency [z]**	**Check Yield**	**Treated Yield**	**Yield Increase**
		%	bu/ac		%
Spring Wheat	6	33	57.8	60.2	4.4
Barley [x]	5	60	89.6	98.4	11.3
Oat [x]	5	50	137.4	145.5	5.9
Canaryseed	6	100	31.2	38.4	23.2
Field Pea	8	38	49.0	54.2	11.7
Canola [x, w]	6	33	44.3	45.9	4.3

[z] Percentage of years where the check vs treated contrast was statistically significant

[y] Averaged across years and products

[x] Weighted averages used to avoid counting multiple trials within the same year twice

[w] Products / application timings targeting sclerotinia stem rot only

Due to other field-scale trial commitments, the number of crops and products evaluated in 2014 were fewer than in past years (Figure 43). Of the evaluations, only the barley and canaryseed yields were significantly affected by the application of the fungicide. In canola, there were no statistically significant differences in the products applied from the check; however, sclerotinia levels in the Indian Head area were generally low in 2014.

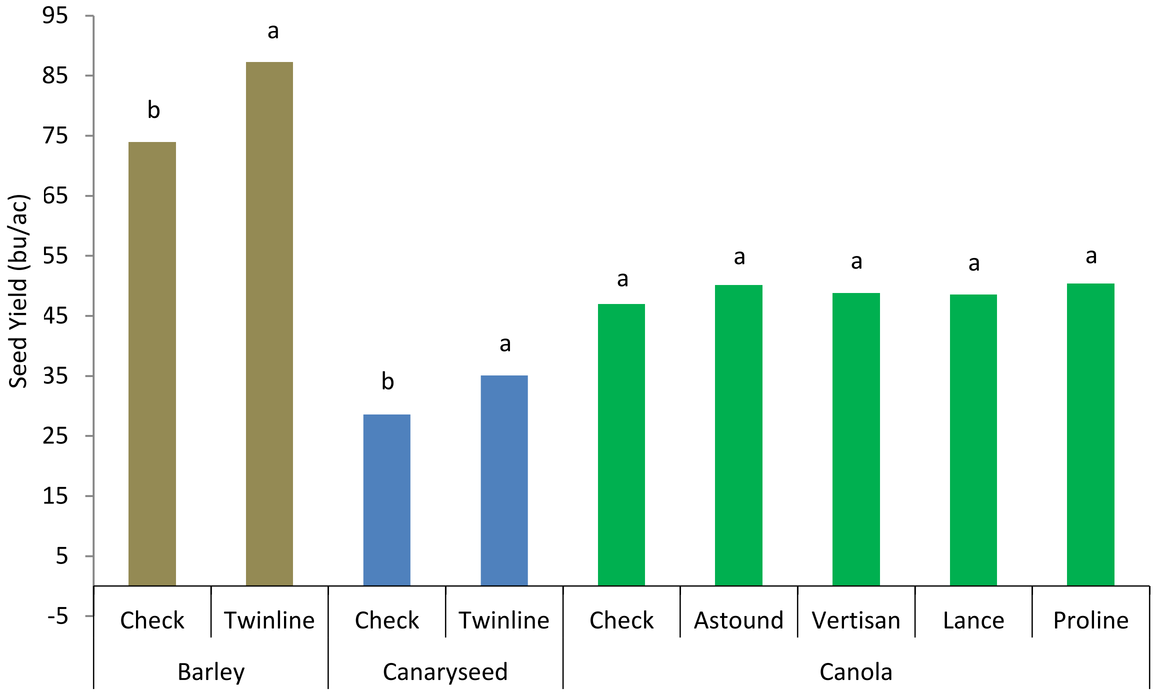

Figure 43. 2014 field-scale evaluation of foliar fungicides on various crops at Indian Head.

Conclusions

With wet weather and relatively high disease levels for much of Saskatchewan in recent years, fungicides should be recognized as important tools for maximizing crop yields and maintaining grain quality. However, because responses do not occur under all conditions, growers are strongly encouraged to monitor their crops closely and base their decisions to spray on the actual risk of disease, past disease issues, the crop's overall yield potential and economic considerations such as current grain prices and the cost of the fungicide application.

Acknowledgements

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