IHARF
INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2013 Annual Report

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IHARF Annual Report 2013

Introduction

The Indian Head Agricultural Research Foundation (IHARF) is a non-profit, producer directed 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 2013 IHARF Directors included:

- Chad Skinner - President *(Indian Head)*
- Scott Bonnor - Vice President *(Sintaluta)*
- Terry Rein - Secretary / Treasurer *(Indian Head)*
- Keith Stephens *(Balcarres)*
- Gus Lagace *(Fort Qu'Appelle)*
- Barry Rapp *(Regina)*
- Cameron Gibson *(Kendal)*
- Ivan Ottenbreit *(Grayson)*
- Chris Brown *(Indian Head)*

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 include:

- David Gehl – Officer in Charge
- Dr. Guy Lafond – Research Scientist
- Bill May – Research Scientist
- Chris Omoth – Research Assistant

IHARF Staff

The 2013 team of IHARF staff included:

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

Dr. Guy Lafond Memorial Award

Our dear friend and colleague Dr. Guy Lafond peacefully passed away on April 26, 2013, at the age of 59. Guy had a passion for agricultural research, and was dedicated to the advancement of the industry. Guy was instrumental in establishing the Indian Head Agricultural Research Foundation, and passionately believed in IHARF's Mission, Mandate and the training of young agronomists.

A memorial scholarship in Guy's name has been set up with the College of Agriculture and Bioresources at the University of Saskatchewan. Eligible students must be entering or continuing a masters or PhD program within the college, with applications starting to be accepted in 2014. For more information, please visit www.iharf.ca.

Extension Events

Indian Head Crop Management Field Day

On July 23, 2013, IHARF hosted the annual Indian Head Crop Management Field Day. Close to 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)
- Bill May (AAFC Indian Head)
- Dr. John O'Donovan (AAFC Lacombe)
- Dr. Kelly Turkington (AAFC Lacombe)
- Dr. Randy Kutcher (University of Saskatchewan)
- Claude Durand (NorthStar Genetics)
- Pat Flaten (Sask Canola)
- Daryl Males (Agrisoma BioSciences)
- Dr. Rigas Karamanos (Viterra)
- Dr. Ron Palmer (IHARF)

Agri-ARM Research Update

On January 17, 2014, 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 research and demonstration programs. Presenters for the day included:

- Chris Holzapfel (IHARF)
- Bryan Nybo (Wheatland Conservation Area)
- Laryssa Grenkow (Western Applied Research Corporation)
- Garry Hnatowich (Irrigation Crop Diversification Corporation)
- Mike Hall (East Central Research Foundation)
- Lana Shaw (South East Research Farm)
- Stu Brandt (Northeast Agriculture Research Foundation)

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

IHARF Soil and Crop Management Seminar

On February 5, 2014, IHARF hosted its annual winter seminar held in Southey, SK, highlighting results of the 2013 season and current industry issues. Guests took in presentations delivered by:

- Chris Holzapfel (IHARF)
- Greg Johnson (Tornado Hunter)
- Kristen Podolsky (Manitoba Pulse Growers)
- Stu Brandt (Northeast Agriculture Research Foundation)
- Dr. Ron Palmer (IHARF)
- Warren Ward (Canola Council of Canada)
- Marlene Boersch (Mercantile Consulting Venture)

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

2013 IHARF Partners

Platinum

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

Gold

BASF
Canola Agronomic Research Program
Mosaic
Saskatchewan Flax Development Commission
Saskatchewan Pulse Growers

Saskatchewan Sunflower Committee
Syngenta

Silver

Agrisoma Biosciences
Agrium Advanced Technologies
Canola Council of Canada
Canaryseed Development Commission of Saskatchewan
Dow AgroSciences
Ducks Unlimited Canada
Engage Agro
FMC
FP Genetics
HCI Ventures
Markusson New Holland
NorthStar Genetics
Novozymes
Prairie Oat Growers Association
DuPont Pioneer
Quarry Seed
Town of Indian Head
University of Saskatchewan
Viterra

Bronze

BrettYoung
Delage Farms
Derkson Trailer Sales
DuPont
GPS Services
Monsanto / Dekalb
Nite Hawk Trucking
Saskatchewan Institute of Agrologists – Regina Branch
Wheatland Financial – Paul Kuntz

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

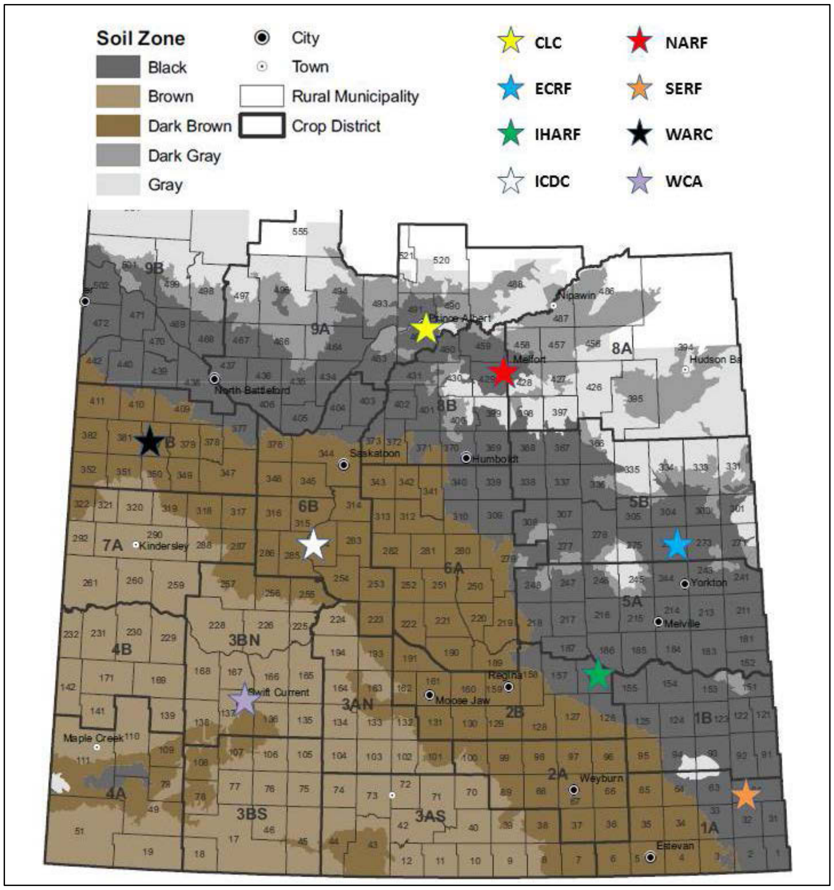

Figure 1. Saskatchewan Agri-ARM network

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].

Mean temperatures at Indian Head were highly variable for the 2013 growing season (Table 1). Seeding was late as a result of cold weather in April, while conditions were warm and dry during crop establishment. Conditions remained relatively dry throughout the growing season, with very little precipitation in August (Table 2). Cool overnight temperatures in July were beneficial for crop development, and low moisture during this stage also kept disease pressure low, resulting in above-average yields for most crops in 2013.

Table 1. Mean monthly temperatures for the 2013 growing season and long-term normals (1981-2010).

		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
		°C							
Indian Head	2013	-4.6	11.9*	15.3	16.3*	17.1	14.3*	2.6*	10.4
	normal	4.2	10.8	15.8	18.2	17.4	11.5	4.0	11.7
Melfort	2013	-3.9	12.0	15.4*	16.4	17.7	14.4*	2.8	10.7
	normal	2.8	10.7	15.9	17.5	16.8	10.8	3.3	11.1
Scott	2013	-2.6	12.6*	14.8	16.5	17.4	14.0	3.0*	10.8
	normal	3.8	10.8	15.3	17.1	16.5	10.4	3.3	11.0
Swift Current	2013	-0.9	12.6*	15.5*	16.8*	19.2*	15.2*	3.9	11.8
	normal	5.2	10.9	15.4	18.5	18.2	12.0	5.1	12.2

* = The value displayed is based on incomplete data

Table 2. Total monthly precipitation for the 2013 growing season and long-term normals (1981-2010).

		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
		mm							
Indian Head	2013	5.8*	17.1*	103.8	50.4*	6.1	14.8*	2.4*	200.4
	normal	22.6	51.7	77.4	63.8	51.2	35.3	24.9	326.9
Melfort	2013	3.0	18.0	112.3	100.0*	10.6	17.0*	4.3	265.2
	normal	26.7	42.9	54.3	76.7	52.4	38.7	27.9	319.6
Scott	2013	7.8	38.9*	113.5	26.1*	63.3	0.0	4.8*	254.4
	normal	21.6	36.3	61.8	72.1	45.7	36.0	17.9	291.4
Swift Current	2013	11.8	11.2*	103.0*	50.4*	13.5*	42.8*	1.1*	233.8
	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 research trials were located on rented land north of the AAFC-Indian Head Research Farm (SE 31-18-12 and NE 30-18-12), the IHARF Farm (NE and SE 31-18-12) and the AAFC-Indian Head Research Farm (NE 19-18-12). 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 to late-May, 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 $\alpha=0.05$ 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 (eg. 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^{-1} are shown in Table 4 with the corresponding values in bu/ac for each crop. Alternatively, multiplying the kg ha^{-1} by 0.8921 will provide the lbs/ac, making for an easy conversion to bu/ac.

Table 4. Conversion of kg ha^{-1} to bu/ac.

		kg ha^{-1}										
		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.

Seed treatment and seeding rate effects on winter wheat establishment, over winter survival, and grain yield

C. Holzapfel[1]

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

Description

In a collaborative effort between Ducks Unlimited Canada and IHARF, a winter wheat demonstration was initiated at Indian Head in 2012-13 with the objective of demonstrating the effects of seed applied fungicide and seeding rates on winter wheat establishment and grain yield. The treatments were two seeding rates, 200 seeds m^{-2} (65 kg ha^{-1}) and 400 seeds m^{-2} (130 kg ha^{-1}), and treated or untreated with Raxil MD Pro (325 mL kg^{-1} seed), for a total of 4 treatments.

Results

Wheat failed to emerge in the fall due to extremely dry weather conditions in the fall of 2012. Nonetheless, a strong response to both seed treatments and seeding rates was observed for all of the variables measured (Table 5). The responses to both seed treatment and rate were visually evident early in the spring (shortly after emergence) and persisted through the season to eventually affect both grain yield and test weight.

Table 5. Means for seed-applied fungicide and seeding rate effects on winter wheat plant density (plants m^{-2}), NDVI, height (cm), grain yield (kg ha^{-1}) and test weight (kg hL^{-1}) at Indian Head (2013).

Treatment	Plant Density *plants m^{-2}*	NDVI	Plant Height *cm*	Grain Yield *kg ha^{-1}*	Test Weight *kg hL^{-1}*
Untreated (UNT)	115 b	0.22 b	88 b	5567 b	81.9 b
Treated (TRT)	257 a	0.29 a	93 a	6426 a	83.8 a
200 seeds m^{-2}	127 b	0.23 b	90 a	5522 b	82.2 b
400 seeds m^{-2}	244 a	0.28 a	91 a	6471 a	83.5 a
UNT – 200	78 c	0.20	86 b	4913	81.0 c
UNT – 400	151 b	0.24	91 a	6220	82.9 b
TRT – 200	177 b	0.26	93 a	6131	83.6 ab
TRT – 400	337 a	0.31	92 a	6722	84.2 a

Averaged across both seeding rates, spring plant populations were increased by 123% with seed treatment. Doubling the seeding rate had a similar effect, increasing plant populations by 92%, when averaged across the two seed-applied fungicide treatments. It is worth noting that equivalent plant populations were achieved with 200 seeds m^{-2} of treated seed and 400 seeds m^{-2} of untreated seed. The normalized difference vegetation index (NDVI) of each plot was measured at the start of stem elongation. NDVI is an indirect measurement of canopy chlorophyll density and was increased with both seed treatment and seeding rate. Photographs taken approximately one week prior to the NDVI measurements illustrate the strong visual response to seed treatment which was evident at that time (Figure 2). Plant height was increased by approximately 8% with a seed treatment at the lower seeding rate but this effect was not observed at the higher seeding rate. Grain yields were increased both with seed treatment and increased seeding rates. The magnitude of the yield response to seed treatment tended to be greater at the low seeding rate (25% yield increase at 200 seeds m^{-2} versus 8% at 400 seeds m^{-2}) and the benefit to increasing seeding rate was greatest with untreated seed (27% yield increase with untreated seed versus 10% with treated seed). Test weight was increased by 3.2% with a seed treatment at the lower seeding rate and 1.6% at the higher seeding rate. Alternatively, doubling the seeding rate increased test weight by 2.3% with untreated seed but only by 0.7% when a seed treatment was used.

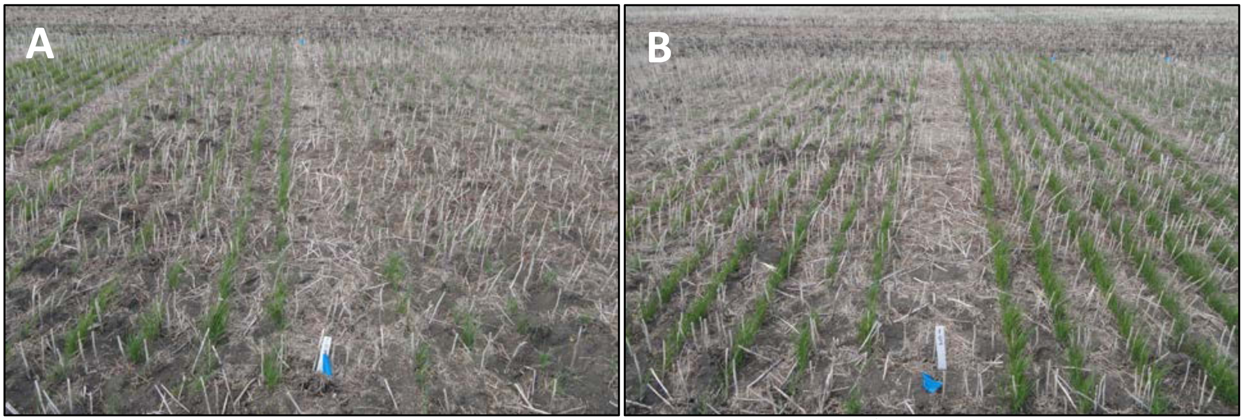

Figure 2. Photos taken on June 6, 2013: A) Winter wheat seeded at 200 seeds m^{-2}, treated seed on the left and untreated seed on the right; B) Winter wheat seeded at 400 seeds m^{-2}, untreated seed on the left and treated seed on the right.

Conclusions

While the overall yield potentials for winter wheat turned out to be high in 2013 despite the poor seeding conditions, both the use of a seed treatment and higher seeding rate played important roles in maximizing winter wheat yields and maintaining grain quality. It is important to recognize that the likelihood of seeing responses to seed treatments of this magnitude under a wide range of conditions is low. In our particular case, seed treatments alone resulted in an overall yield increase of 15%. Seed treatment should be looked at largely as insurance whereby their benefits may be questionable under ideal circumstances, but these results illustrate the potential benefits that can be seen under stressful conditions at planting that delay emergence.

Acknowledgements

Funding for this project was provided by Ducks Unlimited Canada, with in-kind support provided by Bayer CropScience.

Foliar fungicide application and timing effects on winter wheat grain yield and quality

C. Holzapfel[1]

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

Description

In collaboration with Ducks Unlimited Canada, a winter wheat demonstration was initiated with the objective of evaluating the yield and quality response of winter wheat to foliar fungicide applications at the flag leaf stage, early heading or both stages. The foliar fungicide treatments consisted of: 1) an untreated check, 2) a flag leaf application of Twinline (130 g L^{-1} pyraclostrobin + 80 g L^{-1} metconazole at 0.5 L ha^{-1}), 3) an early heading application of Prosaro (125 g L^{-1} prothioconazole + 125 g L^{-1} tebuconazole at 0.8 L ha^{-1}), and 4) both the flag leaf and early heading applications. A seeding rate of 300 seeds m^{-2} was used in this demonstration.

Severity of leaf disease was rated using the McFadden scale (Table 6) for ten plants per plot, while fusarium head blight was rated by recording the percent of spike area (0-100) affected in a total of 50 heads per plot (FHB 1) and also by estimating the overall percentage of affected heads at two locations per plot (FHB 2). Test weights were determined from the cleaned sample for each plot using CDC methods and are expressed in kg hL^{-1}.

Table 6. McFadden, W. 1991. Etiology and epidemiology of leaf spotting diseases in winter wheat in Saskatchewan. Ph.D. thesis, University of Saskatchewan, Saskatoon, 151 pp.

Leaf Level	0[Z]	1	2	3	4	5	6	7	8	9	10	12
Upper	0	0	0	0	0	0	0	0-1	2-5	6-10	11-25	26-50
Mid	0	0	0	0	0-1	2-5	6-10	6-10	11-25	26-50	>50	>50
Lower	0	0-1	2-5	6-10	11-25	26-50	>50	>50	>50	>50	>50	>50

[Z] Percentage of leaf area with lesions in the upper, middle and lower leaf canopies

Results

As expected, leaf disease was highest in the check and was significantly reduced with fungicide applications (Table 7). Of particular interest is the fact that similar protection against leaf disease was achieved with both fungicide application timings. This would not necessarily be the case in years where disease develops earlier in the season and it should be acknowledged that very little disease was observed at the time of the flag leaf applications. Leaf disease did develop later on in the season and, by the soft dough stage, severe damage to the flag leaf had occurred but was largely prevented with all fungicide applications (Figure 3).

Table 7. Means for foliar fungicide effects on winter wheat leaf disease, head disease, grain yield (kg ha^{-1}) and test weight (kg hL^{-1}) at Indian Head (2013).

Treatment	**McFadden** *0-11*	**FHB 1** *%*	**FHB 2** *%*	**Grain Yield** *kg ha^{-1}*	**Test Weight** *kg hL^{-1}*
Check	10.2 a	15.2 a	14.6 a	6000 b	83.0 b
Flag Leaf (T1)	7.6 b	16.3 a	12.3 a	6747 a	83.2 b
Heading (T2)	7.5 b	10.5 a	5.5 b	6850 a	84.2 a
T1 + T2	6.8 c	7.2 a	3.8 b	7004 a	84.1 a

Figure 3. Significant leaf disease had developed in the untreated (left, no foliar fungicide) winter wheat plots by the late milk / soft dough stage, but foliar fungicide application at either timing (right) significantly reduced leaf disease at Indian Head in 2013.

Both the trends and overall magnitude of disease levels were similar for both measurements of FHB (Table 7). Fusarium head blight levels were reduced when foliar fungicide was applied at the early heading stage (T2), but were not affected by the T1 flag leaf application. The application of foliar fungicide increased winter wheat yield by an average of 14.5%, with no significant differences amongst individual fungicide treatments (Table 7). The dual fungicide application produced the highest yield of all individual treatments; however, the observed increase beyond either of the single applications was small and not statistically significant. Both the single flag leaf and early heading timings resulted in similar yield increases; however T2, fungicide application increased test weights over both the check and the T1 application, and test weights did not differ between the check and T1 applications. Thus, while the T1 application provided a clear yield benefit over the check, it did not provide the quality benefits of the delayed application, but there were no significant benefits of the dual application over the T2 application on its own.

Conclusions

This demonstration supports the use of a foliar fungicide application at the early heading stage (< 50% flowers open); however, the likelihood of seeing responses of this magnitude under all conditions is low. If a fungicide application to control fusarium head blight is planned, a flag leaf application may not be necessary for winter wheat unless disease levels are already moderate to high at this time. If fusarium head blight has affected previous cereal crops and moist, warm conditions exist at the start of heading and into anthesis, a fungicide application targeting this disease is likely warranted for winter wheat.

Acknowledgements

Funding for this project was provided by Ducks Unlimited Canada, with in-kind support provided by BASF and Bayer CropScience.

Nitrogen fertilizer management options for winter wheat

C. Holzapfel[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, 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-three N fertilizer treatments were evaluated where the rates, placement methods, timings and forms of N fertilizer were varied. The applied N rate was 0, 75 or 115 kg N ha^{-1} and the forms were untreated urea (46-0-0), ESN (44-0-0), NSN (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. The specific treatments that were evaluated are described in Table 8.

Table 8. Treatments evaluated in 2012/13 winter wheat nitrogen (N) demonstration for winter wheat at Indian Head (Urea – untreated urea; ESN – Environmentally Smart Nitrogen; NSN – Nutrisphere-N; UAN – urea ammonium nitrate; AN – ammonium nitrate).

N Rate *kg ha^{-1}*	**Fall**	**Spring**	**Split**
0	-	-	-
75	Urea ESN NSN UAN	AN Urea ESN NSN UAN	-
115	Urea ESN NSN UAN	AN Urea ESN NSN UAN	Urea ESN NSN UAN

Results

With the large number of treatments, contrast comparisons were useful in showing the overall effects of N fertilization, timing, and product on winter wheat establishment and yield.

Weather conditions in the fall of 2012 were extremely dry; therefore, no wheat emerged in the fall. Mean spring plant densities for all treatments were low, ranging from 29-80 plants m^{-2}. While plant populations in the 0-N check did not significantly differ from the combined fertilized treatments, and the 75 and 115 kg N ha^{-1} rates resulted in similar densities, there was a strong advantage to fall N fertilizer applications (Figure 4). Split application resulted in similar plant populations as the fall application and higher populations than spring application, indicating that applying 40% of the fertilizer in the fall was sufficient to achieve the improved stand establishment observed with side-banded. Yields were similar between the two N fertilizer rates used, indicating that the lower rate was sufficient to optimize yields under the conditions encountered. Similar to the results for plant density, grain yields for both fall application and split application were significantly higher than when the entire N requirements were applied in the spring.

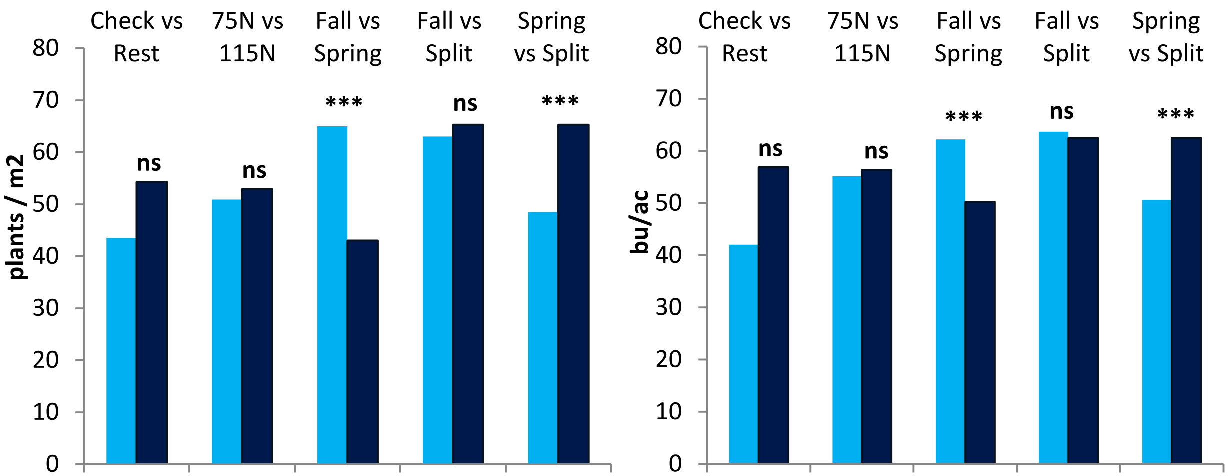

Figure 4. The effect of contrasting N fertilizer rates and timing on winter wheat a) establishment and b) yield (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

When fall versus spring applications were compared for individual products, establishment was better with fall-applied except for surface dribble banded UAN, which showed no difference between fall and spring applications (Figure 5). Significantly higher yields were achieved with fall application for all forms, including surface dribble-banded UAN, which is not normally recommended for winter cereals.

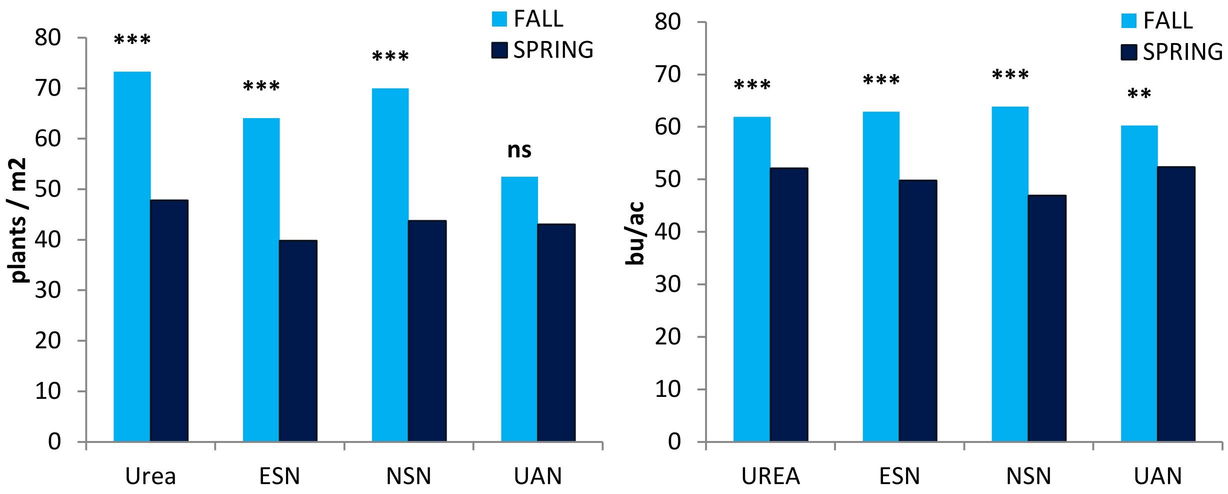

Figure 5. The effect of application time for different N products on winter wheat: a) spring plant establishment and b) yield (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

For fall and spring applications separately, all of the products performed similarly to untreated urea with the exception of fall-applied UAN on plant density (Figure 6).

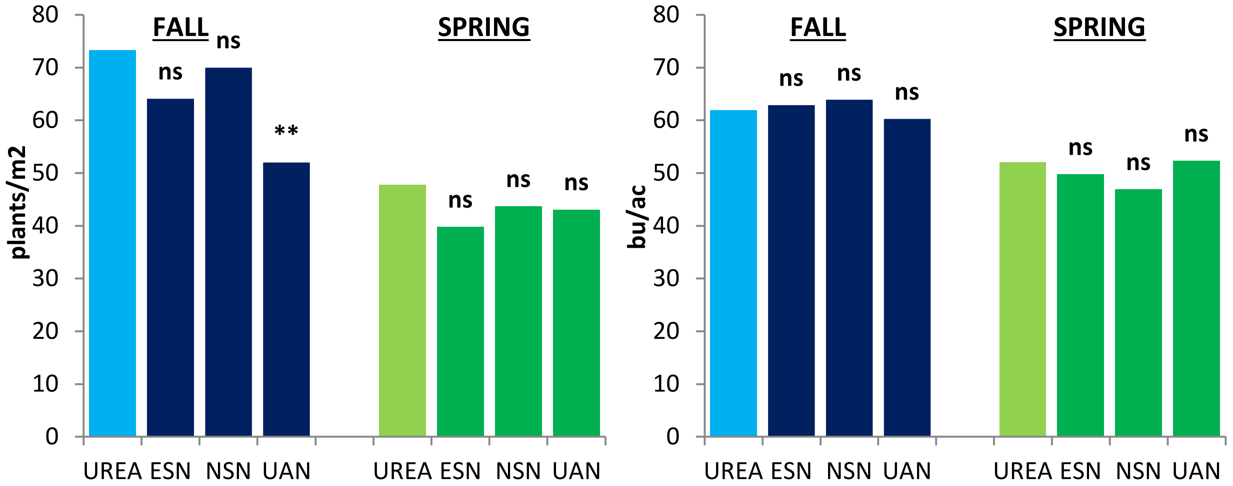

Figure 6. The effect of different N products relative to urea, applied in fall and spring, on winter wheat: a) spring plant density, and b) yield (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

Based on these results, it is recommended that at a portion of winter wheat N requirements be applied at time of seeding, particularly under dry conditions. The advantage to a fall N application would not be expected when soil moisture is high at the time of planting, and a split application gives growers the opportunity to fine tune total N rates in the spring according to crop establishment, soil test results and economic considerations. There was no observed advantage to the slow release N forms evaluated in this particular demonstration; however, in years where fall moisture levels are high, such products may be a good fit for winter wheat when applying high rates of N fertilizer in the fall or with surface broadcast applications.

Acknowledgements

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

Demonstrating optimal seeding rates for spring wheat

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Description

Previous research has shown that wheat yields can be increased by increasing seeding rates; however, there is a point where the benefits of higher plant population do not outweigh the costs of additional seed. Higher plant populations can lead to a reduction in tillering and, therefore, more uniform heading and flowering which may reduce the potential for fusarium head blight infection and orange blossom wheat midge damage while making it easier to time fungicide and insecticide applications. On the other hand, wheat growing at higher than optimal plant populations is more likely to lodge during heading which can result in both yield penalties and reduce harvest efficiency. The objective of this demonstration is to provide information on the agronomic risks and benefits associated with increasing seeding rate in wheat. The seeding rates evaluated were: 60, 120, 180, 240, 300, 360, 420, and 480 seeds m^{-2}.

Results

Estimated plant populations were similar to or slightly exceeding the targeted seeding rates. Similar to 2012 at Indian Head, significant lodging was observed at seeding rates of approximately 240 seeds m^{-2} and the lodging increased with seeding rates beyond this rate. In 2012, lodging did not become significant until seeding rates exceeded 300 seeds m^{-2}. The highest yields were achieved with relatively low seeding rates in both 2012 and 2013 at Indian Head. In 2013, the highest grain yields were observed at seeding rates ranging from 120-240 seeds m^{-2} and yields were depressed slightly as seeding rates fell either below or above this range. In 2012, seeding rates of 180-240 seeds m^{-2} resulted in the highest yields. The observed decline in grain yield at seeding rates of 300 seeds m^{-2} and higher is in contrast to most previous research, but can likely be explained by the relatively severe lodging observed at these rates in both 2012 and 2013 with the CWRS wheat variety Unity VB. Thousand seed weights were not significantly affected by seeding rate. In contrast, significant seeding rate effects on test weight were detected in both 2012 and 2013 (Table 9).

Table 9. Means for spring wheat seeding rate effects on various response variables at Indian Head in 2013. Means within a column followed by the same letter do not significantly differ

Seeding Rate	**Plant Density** *plants m^{-2}*	**Lodging** *Scale 1-9*	**Grain Yield** *kg ha^{-1}*	**1000 Seed Weight** *g*	**Test Weight** *g $0.5L^{-1}$*
60 seeds m^{-2}	78 g	1.0 f	5030 de	34.8 a	391.5 d
120 seeds m^{-2}	137 f	1.0 f	5441 a	35.7 a	400.0 c
180 seeds m^{-2}	214 e	1.5 f	5326 ab	35.8 a	404.2 b
240 seeds m^{-2}	272 d	2.3 e	5286 abc	35.8 a	406.1 ab
300 seeds m^{-2}	319 c	3.0 d	5261 bc	35.5 a	406.5 ab
360 seeds m^{-2}	391 b	3.6 c	5128 bc	35.1 a	406.9 ab
420 seeds m^{-2}	405 b	4.3 b	4928 e	36.0 a	407.4 a
480 seeds m^{-2}	508 a	5.1 a	4947 de	35.7 a	407.2 ab

The results suggest that the risks of higher than normal seeding rates could potentially outweigh the benefits when lodging is a concern due to either varietal characteristics or environmental conditions. While the effects of spring wheat seeding rate on grain yield at Indian Head in both 2012 and 2013 were considered somewhat unusual, they were consistent in that lodging always occurred at the higher seeding rates and yields were optimized at lower seeding rates than expected. However, lodging did not become an issue until plant populations exceeded the recommended range of 215-270 plants m^{-2}.

This study was also conducted in Scott and Swift Current in 2012 and 2013, and in Melfort in 2013. When all site years were combined, the yield response to seeding rate and plant density was quadratic as a result of the decline in yield at higher plant populations. It was concluded that with good growing conditions and low pest pressure, combined with other best management practices, higher than normal seeding rates may not be necessary to reach maximum yield potential.

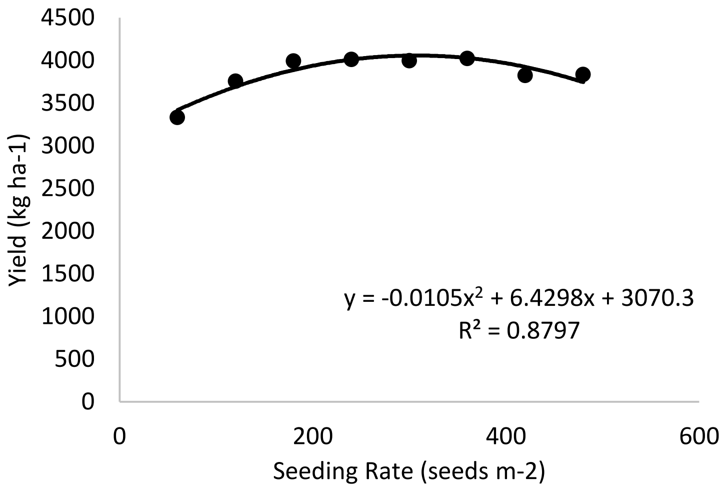

Figure 7. The relationship between seeding rate and grain yield (combined means of seven site years).

Acknowledgements

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

Application timing and fertility effects on spring wheat response to plant growth regulator

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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. In an unreplicated demonstration, the reductions in lodging associated with the application of a PGR were visually obvious (Figure 8). A follow-up study was initiated in 2013 in collaboration with Engage Agro 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, 1x rate; 3) Late application – start of stem elongation, growth stage Zadocks 31, 1x rate (recommended timing); and 4) Split application – early + late growth stage 21 and 31, 0.5x rate each time. Growth stage 21 corresponded to the start of tiller formation while growth stage 31 corresponded to the start of stem elongation, when the first node was just visible at the base of the plant. The fertility treatments were 100%, 125%, and 150% of a typical recommended fertility package for spring wheat in the thin Black soil zone (90-28-14-14 kg N-P_2O_5-K_2O-S ha^{-1}).

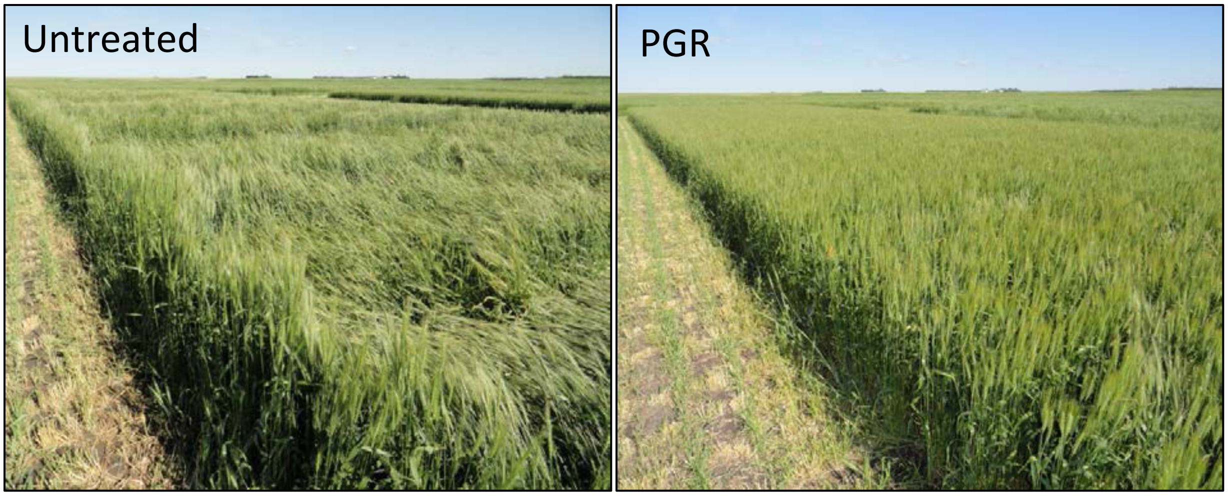

Figure 8. Visual response of effects of PGR application on spring wheat lodging in an unreplicated demonstration at Indian Head in 2012.

Results

An application of PGR at any time significantly decreased plant height relative to no PGR application; however, the later of the two timings was the most effective in reducing plant height. Fertility level did not have any effect on height for the ranges of fertilizer rates included in the study (Figure 9). An application of PGR also significantly reduced lodging relative to no PGR, but again, the late or split applications were more effective than the early application in reducing lodging (Figure 10). Lodging was more severe at higher fertility levels, and considerable lodging was observed even with an early application of PGR at the highest fertility level (Figure 10). Correspondingly, yield increased with any application of PGR relative to no PGR, but the late or split applications were more effective than the early application (Figure 11). Yield increased with fertility level, and the highest yields were observed in the 150% NPKS rates with a late or split application of PGR (Figure 11). It is probable that, in the split application, most of the observed benefits were associated with the PGR applied at growth stage Zadocks 31.

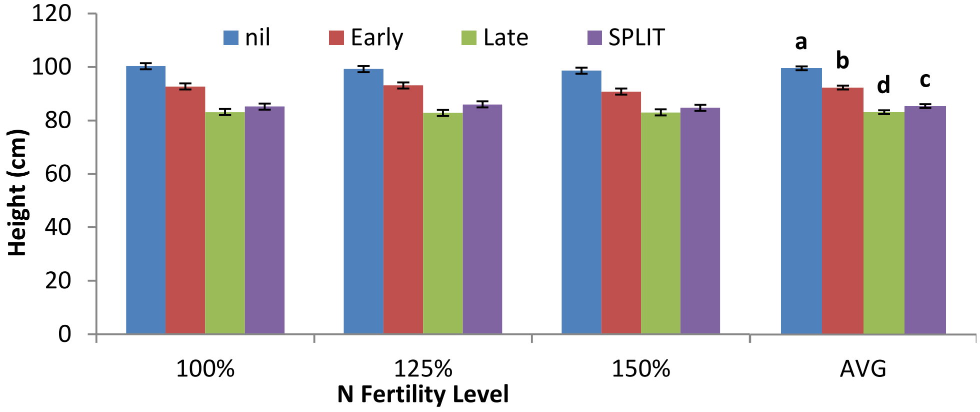

Figure 9. Effects of PGR application and timing on spring wheat plant height at different fertility levels.

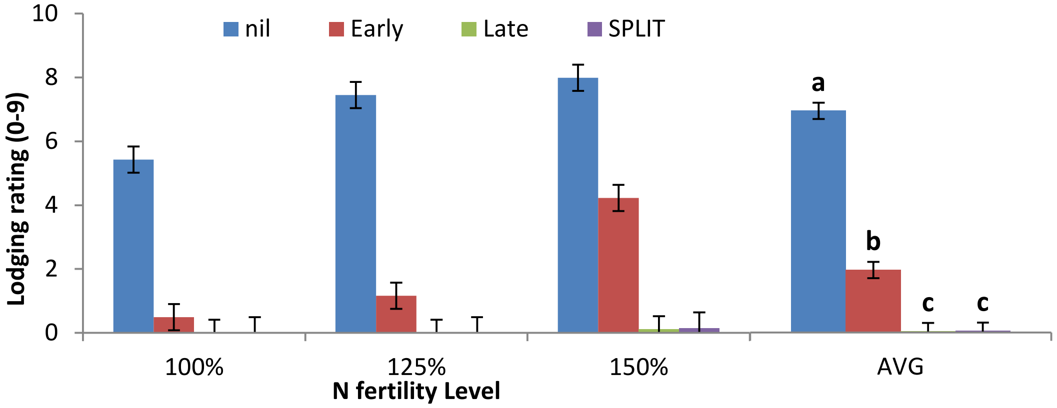

Figure 10. Effects of PGR application and timing on spring wheat lodging at different fertility levels.

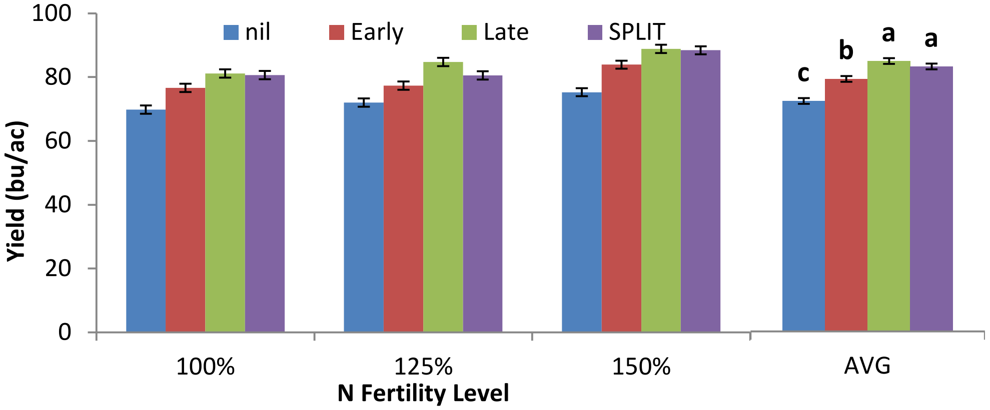

Figure 11. The effects of PGR application and timing on spring wheat yield at different fertility levels.

Results from Indian Head in 2013 show strong potential for PGR applications to reduce height and lodging while enhancing wheat yields, particularly when combined with high fertilizer rates. Tank-mixing with herbicides is a possibility but optimal timing for herbicide application may be earlier than for PGR if weed pressure is high and there is risk of reduced efficacy if PGR are applied too early. Questions on response in absence of lodging and with short varieties still need to be addressed; however, the same experiment was completed at Melfort in 2013 and no yield benefits to PGR application were detected in the absence of lodging (NARF; data not shown).

Acknowledgements

Funding for this project was provided by Engage Agro.

Effect of fungicide timing on disease in spring wheat

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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 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. Research has shown that fungicide application on cultivars with good leaf spot resistance will provide less of a benefit than the same fungicide applied on susceptible 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.

The study was conducted at Indian Head, Melfort, Scott, Swift Current and Prince Albert in 2013. Only the results from Indian Head are shown here as the sites were analyzed separately due to different responses between sites. Two different varieties were treated with one of seven fungicide treatments where the products and timings of application were varied (Table 10). Unity VB is rated F (fair) for both leaf spot and FHB resistance, while Shaw VB is rated P (poor) for leaf spot and FHB resistance. At each site, fungicide products were chosen to ensure that products with Group 11 chemistry were used at T1, and Group 3 chemistries were used at T2 and T3 to avoid stacking fungicides from the same group. At Indian Head, the T1 application consisted of Acapella (0.35 L/ac), and the T2 and T3 applications consisted of Caramba (0.405 L/ac). While the same fungicide products were used for T2 and T3 to avoid confounding treatment effects, two applications of the same product within a single growing season is not a recommended practice for producers and should be avoided.

Table 10. Treatments evaluating the effect of fungicide timing on spring wheat.

Unity VB	Shaw VB
1) no fungicide	8) no fungicide
2) T1	9) T1
3) T2	10) T2
4) T3	11) T3
5) T1+T2	12) T1+T2
6) T1+T3	13) T1+T3
7) T1+T2+T3	14) T1+T2+T3

Leaf disease ratings were conducted using the McFadden Scale (Table 6, above) at both the flag-leaf stage and the late milk/early dough stage. FHB infection incidence and average plot severity were calculated from ratings of 50 heads per plot at the late milk/early dough stage.

Results

Leaf disease levels were low at the time of flag-leaf fungicide application but were slightly higher for Shaw VB than for Unity VB (Table 11). Leaf spot disease was largely limited to the lower leave and was not observed in the upper canopy (i.e. flag leaf) for either variety at the time of the first fungicide application. By the time the crop had finished heading and flowering, leaf disease levels were higher with some spotting on the flag leaf, but were still relatively low overall with less than 5% of the flag leaf area affected in most cases. There appeared to be only a small reduction in leaf disease associated with the fungicide applications and disease levels at this time were similar for the two varieties. There was a tendency for higher FHB severity and incidence with Shaw VB. The T3 fungicide application (early flower) appeared to be more effective at reducing FHB than the T2 application time (75% head emergence).

Table 11. Average leaf spot disease ratings and fusarium head blight (FHB) ratings.

Application Timing	**Unity VB**	**Shaw VB**	**Avg.**
	Leaf disease (McFadden Scale 1-12)		
Initial Leaf Rating	3.8	4.7	4.2
Check	8.6	8.7	8.7
T1	7.5	7.7	7.6
T2	8.1	8.0	8.1
T3	8.1	7.9	8.0
T1 + T2	7.4	7.5	7.5
T1 + T3	7.5	7.4	7.5
T1 + T2 + T3	7.7	7.6	7.7
	FHB (Plot Severity (% Incidence))		
Check	2.6 (34%)	5.7 (68%)	4.1 (51%)
T1	1.7 (28%)	4.3 (54%)	3.0 (41%)
T2	1.9 (20%)	4.7 (46%)	3.3 (33%)
T3	0.8 (12%)	0.9 (22%)	0.8 (17%)
T1 + T2	1.9 (20%)	3.6 (44%)	2.8 (32%)
T1 + T3	0.9 (20%)	0.7 (12%)	0.8 (16%)
T1 + T2 + T3	0.3 (10%)	0.6 (12%)	0.4 (11%)

Grain yields at Indian Head differed between the two varieties and also amongst the fungicide treatments (Table 12), but the effects of fungicide on yield were similar for the two varieties (not shown). Shaw VB yielded 10% higher than Unity VB. Yields increased with later application timings and with increased number of applications, however only the treatments which included the T3 fungicide application significantly increased yields relative to the check. Thousand seed weight differed between the varieties but was not affected by fungicide treatment (Table 12). The thousand kernel weight was significantly higher on average for Shaw VB than for Unity VB. Test weight and percent fusarium damaged kernels were not affected by variety or fungicide treatment but percent blackpoint differed between varieties and between fungicide treatments (Table 12).

Table 12. Means and multiple comparisons tests for grain yield and grain quality measurements. Means within a column followed by the same letter do not significantly differ.

Source	**Grain Yield** *kg ha^{-1}*	**1000 Seed Weight** *g*	**Test Weight** *kg ha^{-1}*	**Fusarium Damage** *%*	**Blackpoint Damage** *%*
Variety					
Unity	5204 b	34.6 b	82.3 a	0.02 a	0.10 b
Shaw	5705 a	35.2 a	82.2 a	0.02 a	0.79 a
Fungicide					
Nil	5328 c	34.9 a	82.2 a	0.09 a	0.71 ab
T1	5243 c	34.7 a	82.2 a	0.03 a	1.28 a
T2	5383 bc	35.0 a	82.3 a	0.00 a	0.30 ab
T3	5576 ab	34.7 a	82.3 a	0.00 a	0.10 ab
T1 + T2	5410 abc	35.0 a	82.1 a	0.01 a	0.56 ab
T1 + T3	5617 a	35.0 a	82.3 a	0.01 a	0.17 ab
T1 + T2 + T3	5624 a	35.3 a	82.3 a	0.00 a	0.01 b

Conclusions

Reasonably strong fungicide responses were detected at three of the five sites, including Indian Head, Melfort and Scott. At Swift Current the climate is drier and the observed disease levels were low in 2013, thus there was no benefit to the foliar fungicide applications. At Prince Albert, yields were limited by excess moisture and there was no benefit to foliar fungicide applications detected under these circumstances either.

The final fungicide application (T3, early flower stage) provided the greatest and most consistent response at Indian Head, Melfort, and Scott and there were never any benefits to multiple applications over a single fungicide application. The probability of dual fungicide applications being economically viable for spring wheat in Saskatchewan is relatively low; however, it needs to be noted that we did not have any sites in 2013 where the potential for yield loss from both leaf and head disease was high. Fungicide applications targeting FHB will also provide protection against leaf spot disease that develops late in the season and gave the most consistent yield benefits, with the added potential of reducing the risk of grade reduction due to fusarium damaged kernels. However, even where FHB infection was observed in the plots, the severity was not high enough to result in grade reductions in 2013. In cases where leaf disease symptoms develop early on and have potential to cause significant damage to the flag leaf prior to head emergence, the earlier fungicide application may be warranted; but again, such conditions were not encountered at any of the locations in 2013.

Despite the contrasting disease packages of the two varieties chosen for this demonstration, the yield response to fungicide treatments did not differ between the two. While the magnitude of response was sometimes higher with Shaw VB, this result would suggest that at sites where disease pressure is moderate to high, fungicides were beneficial regardless of the genetic disease resistance. Similarly, in environments where disease pressure was low or other factors were limiting yield, the fungicides did not provide any benefits, regardless of the variety. One potential approach to managing disease in CWRS wheat might be to choose varieties with good resistance to leaf spot disease to limit the potential severity of early season infection and then to use foliar fungicides to control FHB when the potential for this disease to develop exists. While the later of the two FHB application times was more effective, there was only a 3-4 day difference between the T2 and T3 application times therefore it may be advisable to start spraying for FHB close to the stage where 100% of the heads have emerged in hopes of finishing prior to mid-bloom.

Acknowledgements

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

Spring wheat and canola response to side-banded ESN® fertilizer

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Description

Field trials were conducted in 2011-2013 in collaboration with Agrium Advanced Technologies. The study objectives were to evaluate the response of canola and spring wheat to varying rates of side-banded polymer coated urea (ESN®) and compare the response to untreated urea. The treatments consisted of a check where no nitrogen (N) fertilizer was applied, and six rates of side-banded N (60, 90, 120, 160 190 220 kg N ha^{-1}) where the source was either untreated urea (46-0-0) or a blend of 25% urea and 75% ESN® (44-0-0).

Results

Over the three year period during which these trials were conducted, a reasonably wide range of spring seeding conditions, growing season precipitation and overall yield potentials were encountered. Soils during seeding ranged from wetter than optimal in 2011 to relatively dry in 2013. Overall growing season precipitation levels were above average in both 2011 and 2012 and below average in 2013. Wetter than normal weather was encountered at some point during the season in each of the three years and these wet soil conditions likely provided periodic opportunities for N loss due to denitrification.

Spring wheat plant density was not affected by N fertilization, and did not differ between the two types of fertilizer. For canola, side-banded fertilizer resulted in significant reductions in plant density in 2011 and 2013 and these effects were mitigated with the blend of 75% ESN® and 25% urea (Figure 12).

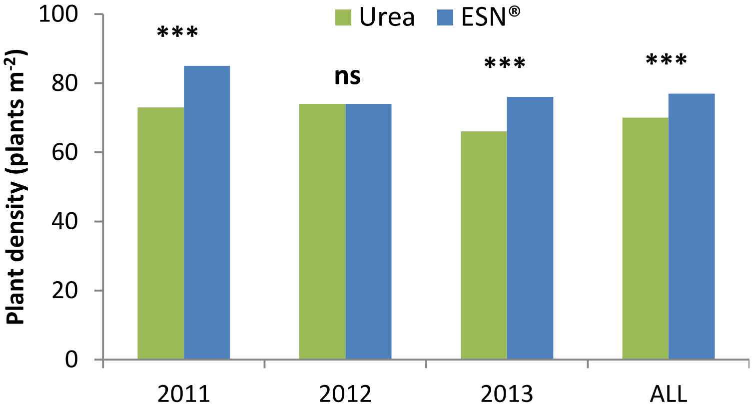

Figure 12. Contrasts comparing canola plant densities in all urea treatments to all ESN treatments from 2011-2013 (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

When all years were combined, it was determined that canola spring plant populations decreased linearly with N rate, and that plant density overall was lower with urea than with ESN (Figure 13). It is important to note that this is an average response that was not observed in every year of our study. We observed that the response appeared to be highly dependent on the environmental conditions encountered in the early growing season.

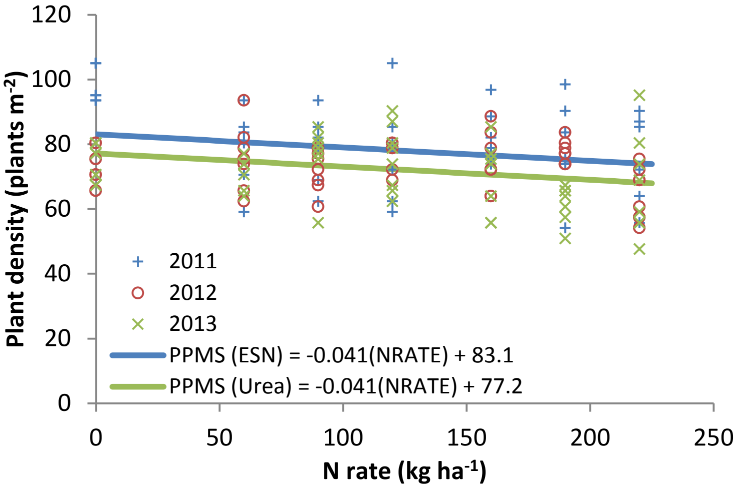

Figure 13. Canola plant density response to side-banded N rate and fertilizer type in all years combined.

In terms of yield, ESN® did provide statistically significant advantages in some, but not all cases for both crop types. In 2011 individually and in all years combined, yields were higher with ESN® for both crops, when averaged across N rates (Figure 14).

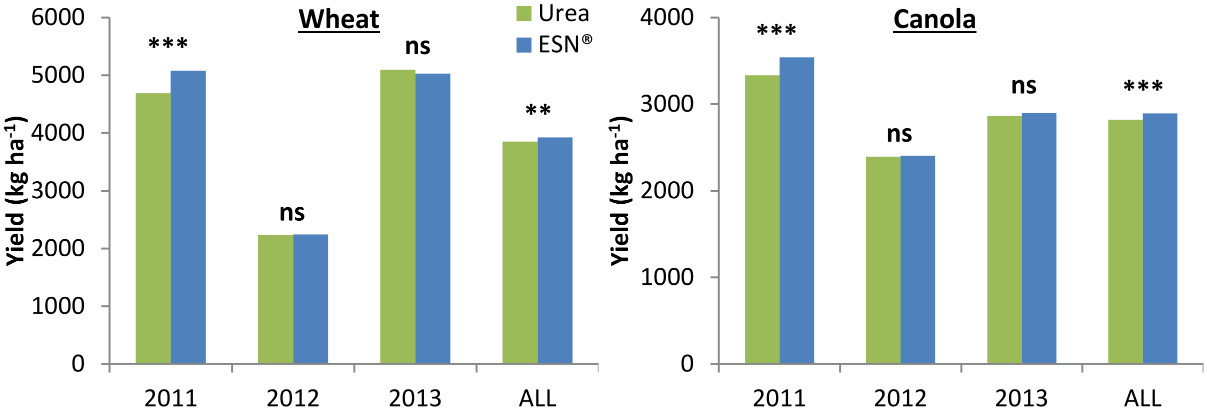

Figure 14. Contrasts comparing spring wheat and canola yields in all urea treatments to all ESN treatments from 2011-2013 (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

With the N rate treatments kept separate but averaged across years, spring wheat yield showed a quadratic response to N rate, but there was no difference in yield response between urea and ESN (Figure 15). The scatter plot shows the unusual yield response in 2012, where lodging had a negative effect on wheat yield at higher N-rates and fusarium head blight was a limiting factor.

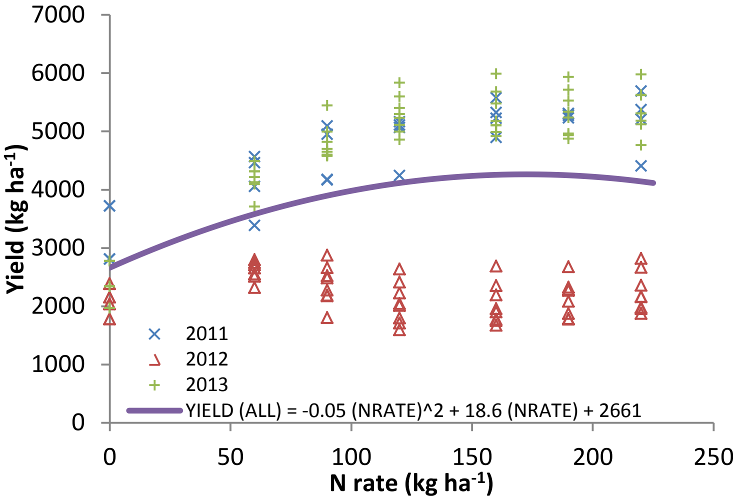

Figure 15. Spring wheat yield response to N rate in all years combined. There was no difference in yield between ESN and urea when data from all years were combined across N rates.

Similarly for canola, with the N rate treatments kept separate but averaged over all years, yields showed a quadratic response to N rate but did not differ between the two types of fertilizer (Figure 16). In 2013 for canola, while the overall average yields achieved did not differ between the two N forms, the response to ESN® appeared linear while the untreated urea was quadratic, and yields at the top N rates tended to be slightly lower with untreated urea than with ESN (not shown). Furthermore, it was observed that in years where there was a strong yield response to increasing N rates, the separate yield response curves of urea and ESN for both wheat and canola became increasingly divergent with increasing N rates, with ESN showing a slight yield advantage at the highest rates.

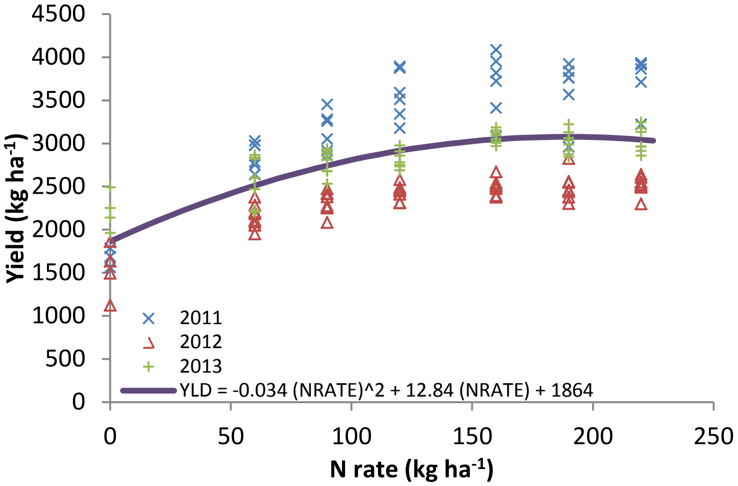

Figure 16. Canola response to N rate in all years combined. There was no difference in yield between ESN and urea when data from all years were combined across N rates.

Overall, it would appear that the greatest potential for yield benefits to be realized with side-banded ESN® blends relative to untreated urea will occur when the overall crop response to N is strong and when wet weather increases the potential for N losses to occur during the growing season.

Acknowledgements

Funding for this project was provided by Agrium Advanced Technologies.

Long-term soil quality and economic benefits of no-till in spring wheat and canola production

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Description

This study is an extension of a study that was initiated in 2002 to determine the cumulative and on-going effects of no-till practices on nitrogen (N) fertility management, by comparing two sites differing in the length of time under no-till. The adjacent sites had been converted to no-till 34 years (LTNT) and 11 years (STNT) previously, and a range of N fertility rates were applied for the duration of the study. The current project's objectives were to provide concrete approaches for producers to increase crop production with on-going no-till continuous cropping practices with optimal rates of nitrogen fertilizer, and concurrently determine the economic impact at the farm gate. The project consisted of three components with separate activities and objectives.

Component I: Economic benefits of long-term no-till cropping in central Saskatchewan

This study utilized an extensive data set including the initial 10 years of yield data to quantify the economic benefits of maintaining fields under no-till management over an extended period of time and managing nitrogen fertility in such a way that more is utilized by the crop rather than lost to the environment. The economic analysis took into account gross margins, net income variability, optimum nitrogen fertilizer rates, and a range of nitrogen fertilizer and grain price scenarios. It was found that the accrued economic advantage of the LTNT was \$120 ha^{-1} relative to the STNT system. The longer term system also provided lower down side yield risks. This study clearly shows the agronomic and financial benefits of maintaining LTNT management practices. It would appear that fewer soil disturbance operations encourage soil organic matter to reach a level where it can assist the release of nitrogen to the plants which increases yield and reduces yield variability.

Component II: Impact of long- and short-term no-till on the soil organic N pool and soil N dynamics

This study examined the soil organic N (SON) pool as a function of length of no-till and N fertilizer rates using various measures of N mineralization potential (i.e., chemical and biological assays). The study was undertaken by sampling soils in 2012 and 2013 from the existing study site to determine if soil N availability differed in two adjacent fields. A biological aerobic incubation study revealed that soils from LTNT were able to supply approximately 20 more kg NO_3-N ha^{-1} during the early phases of the incubation and that the ability of STNT to supply NO_3-N slowed relative to the LTNT during the course of the incubation. It was concluded that the LTNT had a greater pool of readily-available N than the STNT, and was able to supply N over a sustained period. These results underscored the importance of no-till practices in building soils that are capable of sustained nutrient supply and productivity.

Component III: Soil building effects of long-term no-till

This study examined the cumulative and on-going changes occurring as length of time under no-till increases by comparing the long-term impact of N management on N uptake by the crop and crop yields, by comparing two adjacent sites differing in length of time under no-till. The amount of time required for no-till fields to attain a higher productivity (as measured by N uptake and crop yield) is the "soil-building" period, and this effect will likely be mediated by long-term N fertility management practices. It was determined that growing season plant N availability was higher in LTNT than STNT, and that mineralizable N increased with past N application rates.

With the vast majority of fields now being managed under no-till and many having been converted upwards of 20 years ago, many producers and experts question whether past fertilizer research is still applicable and whether we need to more accurately account for potential mineralization of organic N when making fertilizer rate recommendations.

Acknowledgements

Funding for this project has been provided by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaptation Program (CAAP). In Saskatchewan, this program is delivered by the Agriculture Council of Saskatchewan. Additional funding for this project was provided by the Canola Agronomic Research Program, administered through the Canola Council of Canada.

Seeding rates for precision seeded canola

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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 marketed to help lower seed requirements by more evenly spacing the seed 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^{-2} applied with both the traditional Valmar fluted roller and SeedMaster's UltraPro roller.

Results

Seeding rate was the only factor to significantly affect plant density, maturity (data not shown) and seed yield. The two rollers generally did not differ in plant density in spring or fall, seed yield or maturity at any level of seeding rate. Although there appeared to be more uniform distribution of seedlings, on average, with the UltraPro roller than the Valmar at 10-40 seeds m^{-2} seeding rates (data not shown), this did not translate into improvements in seed yield (Figure 17). Differences in uniformity generally disappeared at the fall plant population assessment, likely due to the self-thinning nature of canola.

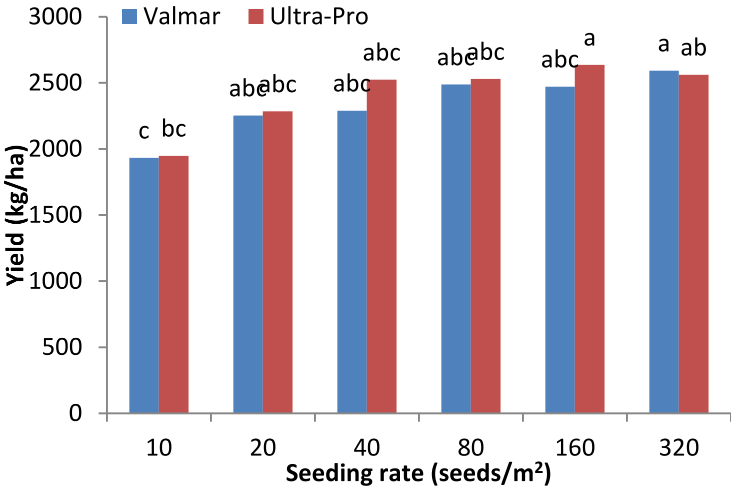

Figure 17. 2013 yield response to different seeding rates with either the Valmar or Ultra-Pro canola rollers.

Acknowledgements

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

Shattering resistance in canola varieties

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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 and Swift Current in 2011 and 2012, and the 12 canola hybrids evaluated were: 1) 5440, 2) L130, 3) L150, 4) 45H29, 5) 45H31, 6) 73-75, 7) 73-45, 8) 6060, 9) 9553, 10) 46H75, 11) 2012 and 12) 5525. In 2013, the trials were expanded to include a location at Melfort and, while L150, 45H31, 73-45, 6060 and 9553 were removed, they were replaced by the newer hybrids L140P, 45H32, 74-44BL, 6050 and 1012.

Results

Yield losses resulting from straight-combining and delayed harvest are shown, averaged across sites for varieties evaluated in 2011-2012 (Figure 18), and averaged across sites for varieties evaluated in 2013 (Figure 19). As expected, the observed yield losses due to pod drop and pod shatter generally increased as harvest was postponed past the optimal crop stage; however, the extent to which these losses increased varied depending on the specific conditions encountered. Averaged across sites, total losses observed with straight-combining were typically less than 5% for all hybrids and unlikely to have much impact on yield relative to swathing, provided that combining was not excessively delayed. With delayed harvest, the losses were extremely variable and, depending on the hybrid and site, average total losses could exceed 10%, and for individual hybrids under extreme conditions sometimes exceeded 30%.

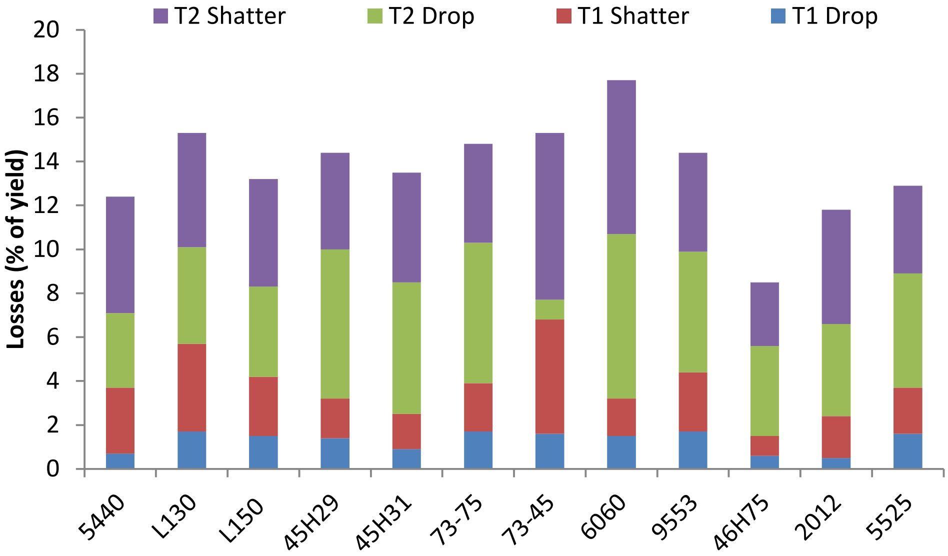

Figure 18. Yield losses as a result of straight-combining (T1) and delayed harvest (T2), averaged across sites in 2011-2012.

While yield losses due to pod drop were typically negligible with early harvest, these losses frequently exceeded those due to pod shatter when harvest was delayed by 3-4 weeks and pod drop appears to be a factor of increasing importance as straight-combining is delayed. Overall, the two new shatter tolerant hybrids (L140P and 45H32) performed well; however the losses were low at all sites in 2013 and these conditions were not ideal to assess whether the new cultivars were a substantial improvement over the others evaluated. For all of the hybrids evaluated in 2013 the lowest total losses were observed for L140P followed by 74-44BL, 6050, 5440 and then L130 and 45H32.

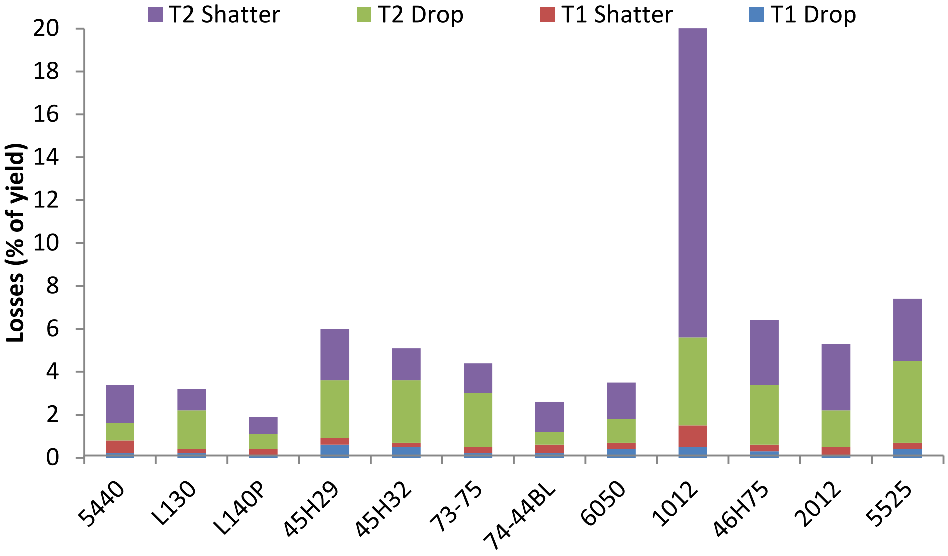

Figure 19. Yield losses as a result of straight-combining (T1) and delayed harvest (T2), averaged across sites in 2013.

All things considered, while varietal differences in resistance to pod drop and pod shatter were frequently detected within individual sites, the differences amongst hybrids were typically much smaller than the differences observed between harvest dates or from one site to the next. Furthermore, the observed differences were not always consistent from year to year or site to site. The results to date would suggest that, while genetic differences in resistance to environmental seed losses do exist, all of the hybrids evaluated could be straight-combined successfully provided that harvest is completed in a reasonably timely manner, disease pressure is low and extreme weather is not encountered during the critical crop stages. Consequently, factors such as overall yield potential, days to maturity and herbicide system are likely at least, if not more, important to consider when choosing a canola hybrid with the intention of straight-combining.

Acknowledgements

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

Demonstrating foliar fungicide options for canola

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Description

Disease levels in canola have been relatively high in recent years and have resulted in considerable yield losses for many growers, yet the economics of an annual fungicide application to canola are questionable in many areas. An increasing number of producers are including a fungicide application when determining the costs of growing canola, due to wet conditions and high canola prices in the last few years. There is a wide variety of foliar fungicide products registered for canola with several different modes of action, thus providing growers with various options for fungicide group rotations. In addition, biological control methods are available which are also registered for organic production; however, these products are relatively new in the marketplace and many growers question their efficacy. A total of 8 treatments were evaluated which included a selection of products registered for control of sclerotinia, as well as two treatments where Headline was applied at the time of herbicide application (Table 13). The trial was conducted at Indian Head and Melfort in 2013.

Table 13. Description of treatments in canola fungicide demonstration. Headline was applied at the 4-6 leaf stage while all other applications were done at 20-50% bloom.

Trade Name	Description - Application Rate
Untreated check	-
Headline EC	250 g L^{-1} pyraclostrobin - 0.40 L ha^{-1}
Lance WDG	70% boscalid - 351 g ha^{-1}
Headline + Lance	142 g ac^{-1} and 0.30 L ha^{-1}
Proline 480 SC	480 g L^{-1} prothioconazole - 0.37 L ha^{-1}
Astound	37.5% cyprodinil and 25% fludioxonil - 976 g ha^{-1}
Vertisan	200 g L^{-1} penthiopyrad - 1.24 L ac^{-1}
Serenade ASO	QST 713 strain of dried Bacillus subtilis, min. 1.0 x 10^9 CFU/g - 4.00 L ha^{-1}

Results

At Indian Head in 2013, overall sclerotinia pressure was very low and, at the time of the disease assessments, less than 1% of the plants in the check plots were infected (data not shown) and therefore further ratings were not completed. Blackleg ratings were completed at Melfort and did not appear to be affected by treatment (data not shown). Despite the wet weather at both locations in June and early July (as the canola was going into flowering), we speculate that the cool conditions through flowering prevented sclerotinia stem rot from infecting the canola to any significant extent. As a result, there was no significant effect of fungicide treatment on canola seed yields at either Indian Head or Melfort (Table 14). Within-site variability was high at Melfort due to environmental conditions and the results are not considered conclusive, however the lack of response at Indian Head is consistent with previous results where sclerotinia levels were low; including Indian Head in 2011, Swift Current in 2011 and 2012 and Melfort and Scott in 2012 (refer to previous years' annual reports). At Indian Head in 2012, when sclerotinia incidence exceeded 70% in the checks, fungicide applications at the 20-50% bloom stage (specifically targeting sclerotinia) resulted in an average yield increase of 420 kg ha^{-1} or 21%.

Table 14. Canola fungicide treatment effects on seed yield at Indian Head and Melfort in 2013.

Fungicide Treatment	Indian Head	Melfort
	Seed Yield (kg ha^{-1})	
Check	3525 a	1690 a
Headline	3587 a	1275 a
Lance	3682 a	1338 a
Headline + Lance	3669 a	1390 a
Proline	3585 a	990 a
Astound	3713 a	1532 a
Vertisan	3590 a	1470 a
Serenade	3604 a	1374 a

In light of negative results at Indian Head and Melfort in 2013, results from previous field trials confirmed that fungicides are an effective measure for minimizing the impact of sclerotinia stem rot on canola. However, economic benefits will only be realized when disease levels are sufficiently high to cause significant yield reductions. Thus, annual, preventative applications of foliar fungicides to control sclerotinia stem rot in canola may not be economically viable over the long-term, because sclerotinia pressure has not been consistently high over the years and locations where the demonstrations have been conducted.

An important factor for determining the extent to which sclerotinia stem rot develops in canola is the temperature and humidity within the crop canopy through flowering and during the early pod filling stages. Consequently, the weather conditions encountered during this period are critical. A good disease forecasting checklist for assessing sclerotinia risks in canola along with a scouting guide is available online from the Canola Council of Canada. Sclerotinia tolerant canola varieties are also currently being assessed in separate research trials. While such varieties are not completely resistant and cannot eliminate the disease or the potential need for foliar fungicide, they may be an appropriate first line of defence particularly in areas where canola responses to fungicide application are inconsistent.

Acknowledgements

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The effects of genetic sclerotinia tolerance and foliar fungicide applications on the incidence and severity of sclerotinia stem rot infection in canola

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Description

Sclerotinia stem rot causes significant yield loss for canola in western Canada each year; however, the degree to which this disease affects individual fields is highly variable depending on the specific environmental and weather conditions that are encountered. Sclerotinia stem rot and many other important crop diseases are difficult to manage because this disease requires specific combinations of soil conditions, weather and crop staging to cause significant infection. Foliar fungicides have proven to be 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. Combining tolerant hybrids with foliar fungicides provides the additional benefit of minimizing the potential for pathogens to develop resistance, as experience has shown that relying heavily on any single technology can be risky and unsustainable. This project aims to enhance our current understanding of the potential benefits and limitations that might 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.

Results

At the sites where sclerotinia was observed, a total of 100 plants per plot were rated on a scale of 1-5 where 5 denotes a lower stem lesion with potential to affect the entire plant. The values derived from these ratings were mean disease incidence (MDI) of infected plants, and the overall mean disease severity (MDS) rating for the plot. Only the results for Indian Head in 2013 are presented in this report; however, the full report which includes results from all five locations is available upon request

The overall average sclerotinia incidence was only 1.0% and did not significantly differ between hybrids; however, the levels were slightly lower in the tolerant variety (45S54). There was a significant difference in MDI between fungicide treatments, however both hybrids responded similarly. On average with the two hybrids, MDI was 2.75% in the untreated check, tended to be lower with the T1 fungicide application (1.63%), and was significantly lower at the T2 application and with a dual application (0-0.13%). Contrasts provided evidence of a stronger overall reduction in MDI with fungicide for 45H29 than for 45S54 (not shown). The multiple comparisons suggested that the later fungicide application (40-50% bloom) was more effective for reducing MDI than the early application (20-30% bloom), but the contrasts did not detect any benefits to dual fungicide applications for either hybrid (not shown).

Table 15. MDI with fungicide treatment in each hybrid canola cultivar at Indian Head in 2013.

Treatment	Susceptible (45H29)	Tolerant (45S54)	Both
	Mean Disease Incidence (%)		
Untreated	3.75 a	1.75 ab	***2.75 A***
20-30% bloom (T1)	2.00 ab	1.25 ab	***1.63 AB***
40-50% bloom (T2)	0.25 b	0.00 b	***0.13 B***
T1 + T2	0.00 b	0.00 b	***0.00 B***

Treatment effects on MDS largely paralleled those of MDI at Indian Head in 2013 (Table 16). There was a tendency for higher MDS with 45H29 (0.062) than with 45S54 (0.026), though the difference was not statistically significant. The susceptible 45H29 showed a significant decrease in MDS with the later fungicide application, however this response was not observed with the tolerant 45S54. With relatively low disease pressure overall in 2013, there was no significant effect of fungicide on yield, and the two hybrids yielded similarly (not shown). Though not statistically significant, there was a slight increase in yield with fungicides, however it was only 4% on average for 45H29 and 2.5% for 45S54.

Table 16. MDS with fungicide treatment in each hybrid canola cultivar at Indian Head in 2013.

Treatment	Susceptible (45H29)	Tolerant (45S54)	Both
	Mean Disease Severity (0-5)		
Untreated	0.165 a	0.058 b	***0.111 A***
20-30% bloom (T1)	0.078 ab	0.048 b	***0.063 AB***
40-50% bloom (T2)	0.005 b	0.000 b	***0.003 B***
T1 + T2	0.000 b	0.000 b	***0.000 B***

In general across all sites, conditions were cool through flowering and sclerotinia incidence and severity was low, while yields were typically above average. Nonetheless, preliminary results suggest that under these conditions, disease levels were frequently lower in the tolerant hybrid 45S54, thus foliar fungicides tended to provide less consistent benefits with this hybrid. Foliar fungicides reduced sclerotinia incidence and severity for the susceptible hybrid at locations where disease was observed, but only significantly increased seed yield at one site. Furthermore, no benefits to a dual fungicide application over a single application were detected in any cases for either the disease ratings or effects on seed yield. Results may differ under higher disease pressure and this trial will be repeated in 2014 and 2015 at all five locations.

Acknowledgements

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Field-scale evaluation of foliar-applied fungicide options for various crops

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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. For example, in 2012 producers encountered unprecedented levels of both fusarium head blight in cereals and sclerotinia stem rot in canola, resulting in dramatically reduced yields and quality. 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 (Table 17) 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 17. General summary of all field-scale fungicide trials conducted to date.

Crop Type	# of Years	Response Frequency [Z]	Check Yield	Treated Yield	Yield Increase
		%	--------- *kg ha^{-1}* [Y]	-------	*%*
Spring Wheat	6	33	3887	4046	4.4
Barley [X]	5	60	4819	5294	11.3
Oat [X]	5	50	5236	5545	5.9
Canaryseed	6	100	1747	2152	23.2
Field Pea	8	38	3298	3644	11.7
Canola [X, W]	6	33	2482	2571	4.3

[Z] Percentage of years where a 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

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 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. For a full report on individual crops, visit www.iharf.ca.

Acknowledgements

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

Investigating wider row spacing in no-till canola: Implications for weed competition, response to nitrogen fertilizer, and seeding rate recommendations

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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. The greatest potential advantage to wider row spacing is expected to arise from reduced equipment maintenance costs and reduced fuel consumption during the seeding operation. 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 ongoing project are 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 (25 cm, 30 cm, 36 cm, 41 cm and 61 cm or 10”, 12”, 14”, 16”, and 24”) with 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) and 3) weed control (no in-crop herbicide compared to a single in-crop herbicide application). Field trials were initiated at Indian Head in 2012 and are to be continued through 2015.

Results

1) Implications for side-banded nitrogen fertilizer

While side-banded N did result in a significant reduction in canola plant densities, there was no evidence that the effect differed across row spacing levels. Small but significant reductions in plant densities with side-banded N were observed at all row spacing levels; however, plant populations were considered adequate for all row spacing and N rate combinations (Table **18**).

Table 18. Means for the effect of row spacing, N rate, and their interaction on canola plant density.

	0 kg ha^{-1}	**50 kg N ha^{-1}**	**100 kg N ha^{-1}**	**150 kg N ha^{-1}**	**All N rates**
			plant density (plants m^{-2})		
25 cm (10”)	89 a	82 ab	80 ab	62 bcd	***78 A***
30 (12”)	87 ab	94 a	76 abc	73 abcd	***82 A***
36 cm (14”)	77 abc	71 abcd	70 abcd	72 abcd	***72 A***
61 cm (24”)	79 ab	62 bcd	52 cd	48 d	***60 B***
All row spacings	***83 A***	***77 B***	***69 BC***	***64 C***	

A strong yield response to side-banded N was detected and yields continued to increase up the highest N rate (150 kg ha^{-1}) in all row spacings; however, the response differed between the row spacings where yields appeared to be maximized with less N at the 24” row spacing level and the response to higher N rates was magnified at narrower row spacings (Figure 20).

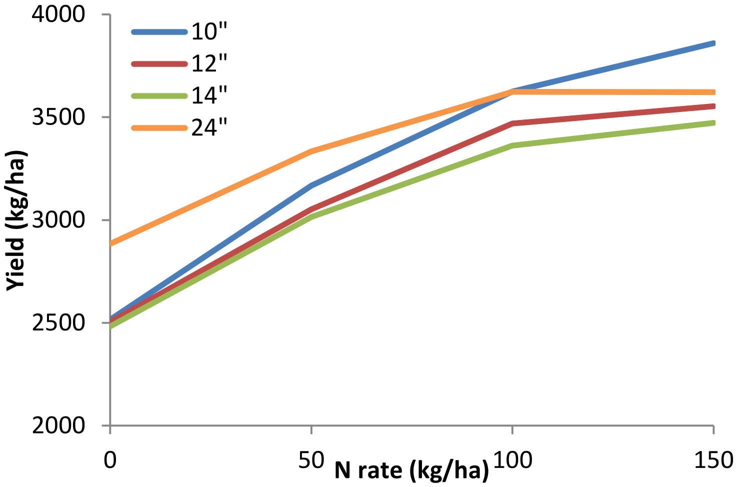

Figure 20. Canola yield response to varying N rates at different row spacings.

2) Implications for seeding rates

As expected, increasing seeding rates resulted in higher plant populations at all row spacing levels. Plant density decreased with wider row spacing at seeding rates above 3.0 kg/ha, and especially so at the highest seeding rate (Figure 21). Based on the plant densities observed, there was no evidence to suggest that seeding rates should be reduced at wider row spacing.

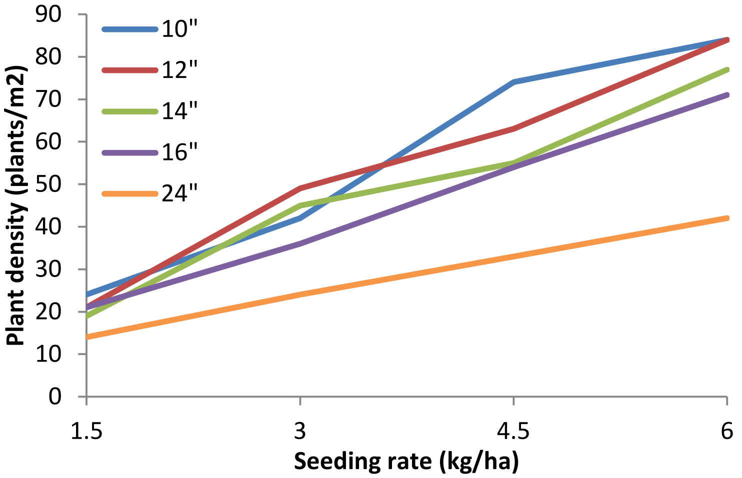

Figure 21. Canola spring plant density response to varying seeding rates at different row spacings.

In terms of yield, for all row spacing levels there were no differences between seeding rates ranging from 3-6 kg ha^{-1} while yields were reduced at 1.5 kg ha^{-1} seeding rates. Though yields were highest at 10" and 24" row spacing, the yield response with different seeding rates was similar for all row spacings, indicating that similar seeding rates should be used regardless of row spacing level.

Table 19. Means for the effect of seeding rate, row spacing, and their interaction on canola yield.

	1.5 kg ha^{-1}	**3.0 kg ha^{-1}**	**4.5 kg ha^{-1}**	**6.0 kg ha^{-1}**	**All N rates**
			seed yield (kg ha^{-1})		
10"	3251 abcdef	3527 a	3482 ab	3517 a	***3444 a***
12"	2980 fg	3191 cdefg	3258 abcde	3298 abcde	***3182 c***
14"	3062 efg	3227 bcdef	3196 cdefg	3262 abcde	***3187 c***
16"	2920 g	3209 bcdef	3189 cdefg	3292 abcde	***3152 c***
24"	3111 defg	3435 abc	3293 abcde	3383 abcd	***3306 b***
All row spacings	***3065 b***	***3318 a***	***3284 a***	***3351 a***	

3) Implications for weed control

With respect to competitiveness with weeds, when no in-crop herbicide was applied there was an increase in weed biomass when expressed as percent of crop biomass; however, weeds were adequately controlled with herbicides at all row spacing levels (not shown).

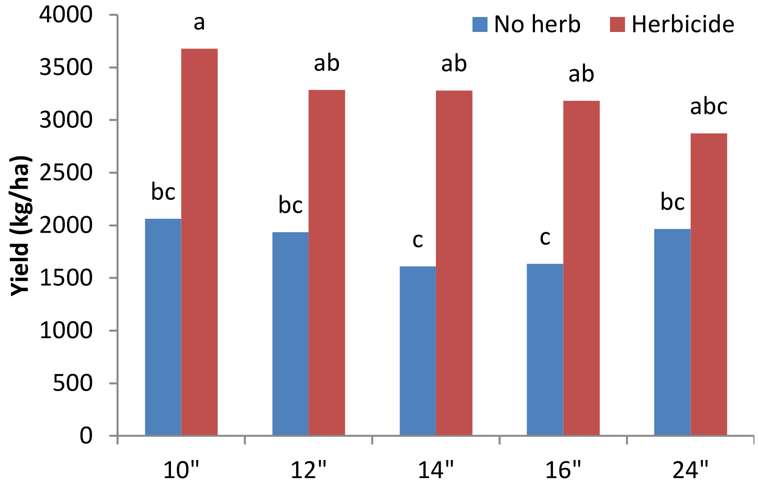

Figure 22. Canola yield response to herbicide application at different row spacings.

Discussion

In general, canola plant densities tended to decline as row spacing was increased, presumably due to increasing within-row competition amongst seedlings as row spacing increased. The reductions were typically too small to be of much concern and no significant differences in plant density were detected amongst row spacing ranging from 25-36 cm (10-14”). Effects on seed yield were also minimal for the row spacing levels evaluated and, in many cases, not statistically significant. While there were tendencies for higher yields at the lowest and highest row spacing levels, row spacing ranging from 30-41 cm (12-16”) consistently resulted in similar seed yields and the observed higher yields at 25 cm (10”) and 61 cm (24”) levels are difficult to explain and may have been a result of experimental biases which will be addressed going forward. Overall, increasing row spacing from 25 cm (10”) to as wide as 61 cm (24”) did result in a slight but significant extension of flowering and a small delay in maturity (< 2 days; data not shown). This was presumably due to the need for canola plants at wider spacing to grow larger and branch more to utilize the extra canopy space. A copy of the detailed 2013 annual report on this project is available upon request.

Acknowledgements

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Straight-combining canola demonstration

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Description

There are many risks associated with growing canola in Saskatchewan, and one of the greatest concerns is crop losses at harvest. Canola swaths are subject to being blown about by high winds, which in extreme cases can result in yield losses exceeding 50% in the blown swaths. Canola can be left standing and straight combined, but there is also the risk that pods will shatter or whole pods will fall off the plant and be lost, again resulting in substantial yield losses. On the other hand, larger seed sizes frequently observed with straight-combining can occasionally result in slight increases in canola seed yield. Canola cultivars with improved shatter resistance have been identified in recent years, but yield losses with these can still be high under certain conditions. Even with cultivars with relatively good shattering resistance, many growers are reluctant to straight-combine canola, in part due to a lack of good information about the risk relative to swathing. An improved understanding of both the risks and potential benefits of these two harvest options will allow growers to make better informed decisions about when and where to utilize each harvesting option.

The objective of the project was to demonstrate the risks and benefits of straight-combining Argentine canola compared with the traditionally recommended practice of swathing followed by combining with a pickup header. The treatments evaluated, swathing, and combining dates are shown in Table 20. The hybrid canola variety, InVigor® 5440 was used for this study. The project was conducted at multiple locations but only the results from Indian Head in 2013 are presented in this report.

Table 20. Treatments evaluated, swathing and harvest dates in the canola straight-combining demonstration.

Harvest Method	Targeted Timing	Swathing Date	Harvest Date
Swathed	20-30% seed color change	Aug 21	Sep 1
Swathed	50-60% seed color change	Aug 27	Sep 5
Straight-Combined	T1 (10-12% seed mc; < 2% green seed)	n/a	Sep 12
Straight-Combined	T2 (approximately 1 week after T1)	n/a	Sep 21
Straight-Combined	T3 (approximately 2 weeks after T1)	n/a	Sep 28

Results

Swathing at 20-30% resulted in the lowest seed yield and postponing the operation by less than a week increased canola yields by nearly 9% (Figure 23). Swathing canola produced yields that were similar to but generally not higher than those that were obtained with straight-combining. Interestingly, the highest yields with straight-combining were observed at the final harvest date, and were higher than those observed at the earlier straight-combining dates. While the purpose of the later straight-combined treatments was to demonstrate the risks of pod shatter and subsequent yield loss with delayed straight-combining, shattering and pod drop losses were negligible in the 2013 growing season. Furthermore, pod and seed moisture content was higher at the time when the final treatment straight-combined and may have resulted in reduced header and mechanical seed losses during the harvest operation. The final harvest operation at Indian Head in 2013 was completed after two days of light showers and humid conditions.

As expected, thousand seed weights were lowest with swathing at the 20-30% seed colour stage, and postponing swathing by only 6 days resulted in a 10.5% increase in seed weight, which resulted in higher yields at the later swathing date (Figure 23). Seed size was increased by an additional 3% going from the later swathing date to straight-combining and no differences in seed size were detected amongst the straight-combined treatments. These small but significant increases in seed size with straight-combining canola relative to swathing have been previously observed and are often sufficient to offset minor shattering losses.

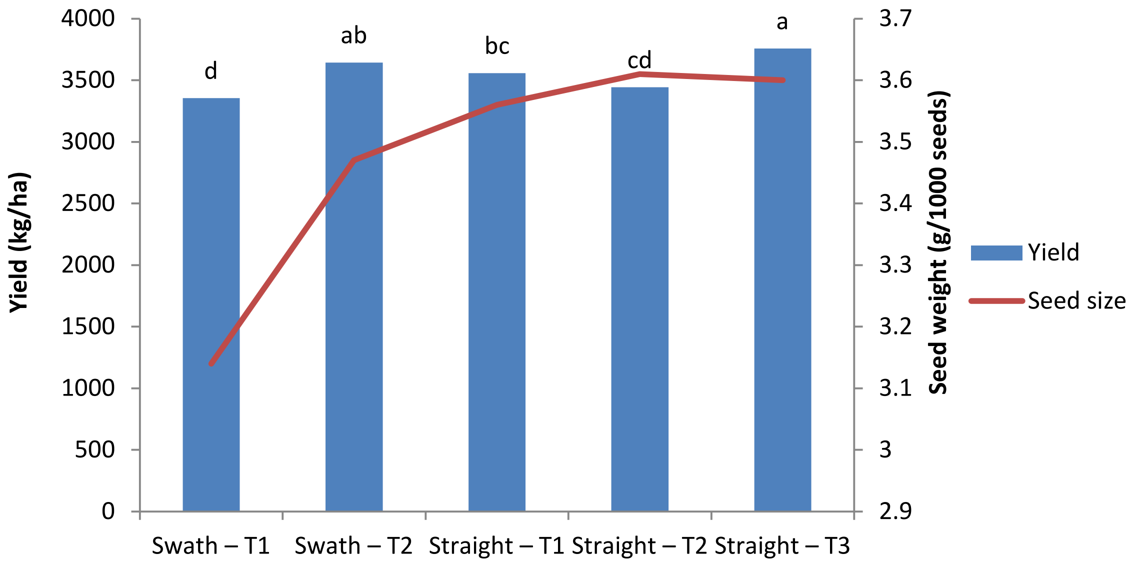

Figure 23. Grain yields in swathed relative to straight-combined canola.

With good crop establishment, above average yield potential and low sclerotinia pressure, 2013 was considered an ideal year for straight-combining canola at Indian Head. There was a substantial yield penalty associated with swathing too early, and straight combining typically provided similar yields relative to swathing at an optimal stage. We expected yields to decline as straight-combining was delayed as a result of the increased potential for environmental seed losses; however, the final straight-combining date produced the highest mean yields overall. Nonetheless, the potential for shattering and pod drop losses to occur as straight-combining is delayed is high and it is recommended to harvest as soon as possible after the crop has reached maturity (i.e. 10-12% seed moisture and less than 2% green seed).

Acknowledgements

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

Carinata advanced yield trial

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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 areas. This project was implemented in collaboration with Agrisoma Biosciences to evaluate the relative performance of 14 experimental *Brassica carinata* lines relative to commercial varieties.

The trial was seeded into wheat stubble on May 15, 2013. A pre-emergent application of StartUp was applied on May 17, with Edge broadcast over the trial area prior to seeding. Urea (46-0-0) and a special blend (14-20-10-10) were side-banded at seeding to target 122-30-15-15 kg ha^{-1} of N-P_2O_5-K_2O-S. In-crop herbicides included Equinox and Muster Toss N Go with Agral 90 applied at the 4-5 leaf stage, and Lance was applied at flowering.

Results

Mean plant densities, days to first and last flower, days to maturity, plant height lodging and yield for the various B. carinata lines evaluated are presented in Table 21.

Table 21. Performance of 12 experimental lines of B. carinata relative to 2 commercial varieties.

Variety	Plant Density *Plants m^{-2}*	Days to First Flower	Days to Last Flower	Days to Maturity	Height *cm*	Lodging *1-5*	Yield *Kg ha^{-1}*
AAC A100	70 a	49.1 a	89.6 a	115.2 a	121.3 a	2.3 a	3410 ab
AAC A110	73 a	49.9 a	88.5 a	114.5 a	117.8 a	2.5 a	3577 ab
110910EM	64 a	50.0 a	90.3 a	115.0 a	117.3 a	2.4 a	3413 ab
110994EM	66 a	50.3 a	87.9 a	114.8 a	112.8 a	2.3 a	3595 ab
110996EM	63 a	50.6 a	90.0 a	116.2 a	117.3 a	2.1 a	3671 ab
110998EM	94 a	50.1 a	87.1 a	113.5 a	117.0 a	2.4 a	3736 a
110999EM	65 a	50.1 a	89.8 a	115.8 a	123.6 a	2.5 a	3480 ab
111000EM	40 a	49.8 a	89.6 a	115.3 a	112.8 a	2.3 a	3036 b
111010EM	64 a	51.3 a	89.1 a	115.3 a	118.4 a	2.0 a	3168 ab
111011EM	47 a	50.8 a	91.1 a	115.5 a	114.6 a	2.2 a	3483 ab
3118	48 a	49.4 a	88.5 a	113.6 a	124.9 a	2.1 a	3443 ab
5228	65 a	49.2 a	91.2 a	116.0 a	115.9 a	2.6 a	3530 ab
5231	68 a	51.5 a	93.5 a	118.3 a	118.4 a	1.8 a	3377 ab
5259	48 a	51.3 a	91.8 a	117.0 a	109.3 a	1.8 a	3115 ab

There were no significant differences in plant density, flowering period, maturity, height, or lodging amongst varieties. While the effect of variety was significant, none of the experimental lines yielded significantly higher or lower than the two checks. As in previous years, yields were more or less similar to canola yields 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 preceeding canola, field pea, and flax

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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. In fact, 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

The observed effects of fall applications of high rates of 2,4-D amine at Indian Head were unexpected in that no significant reductions in emergence, seedling injury or negative impacts on seed yield were observed for canola, flax or field pea, even at the highest rate. This demonstration was conducted at several Agri-ARM locations and the results were consistent at all sites in 2013. Nonetheless, these results should not be considered as conclusive evidence that such applications are safe for these sensitive crops, even in heavy soils or under good moisture conditions. Previous research has shown that fall applications of 2,4-D preceding these crops can cause significant injury and yield reduction, particularly at the high rates required for effective perennial weed control. The combination of excellent soil moisture, early snow cover and relatively fine-textured soils likely reduced the potential for herbicide injury at Indian Head in 2013. This demonstration will be continued at multiple locations in 2014 to provide a better understanding of the risks of fall 2,4-D applications preceding sensitive crops and hopefully generate information demonstrating that, even though injury may not always be observed, this is a risky practice that should be avoided.

Acknowledgements

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

Broadleaf herbicide options for flax

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Description

There are relatively few broadleaf herbicide options for flax and those that are available have distinct modes of action and also vary in their ability to control specific spectrums of weeds. While there are important benefits to rotating modes of action, growers must also consider the specific weed populations they are aiming to control when selecting herbicides. The objective of this study was to demonstrate the herbicide options that are currently registered for flax in Saskatchewan and discuss advantages and disadvantages of the different products. Five different broadleaf herbicide treatments were assessed against a check with no broadleaf herbicide applied: 1) 0.34 L/ac MCPA Ester 600; 2) 119 mL/ac Authority pre-seed; 3) 119 mL/ac Authority pre-seed plus 0.4 L/ac Buctril M; 4) 0.4 L/ac Buctril M; and 5) 0.8 L/ac Curtail M. In-crop herbicides were applied at the 2-6” crop stage. The entire plot area was over sprayed with a graminicide to control weedy grasses such as volunteer wheat and wild oats.

Results

Predominant weed species at the site were wild buckwheat, wild mustard, volunteer canola, prickly lettuce, and lamb's quarters, and the density of weeds in each treatment is shown in Figure 24. Authority does not control wild mustard or volunteer canola but greatly reduced incidence of wild buckwheat and lamb's quarters relative to the check. MCPA on its own did not provide long term control of wild buckwheat but provided adequate control of most other weed species.

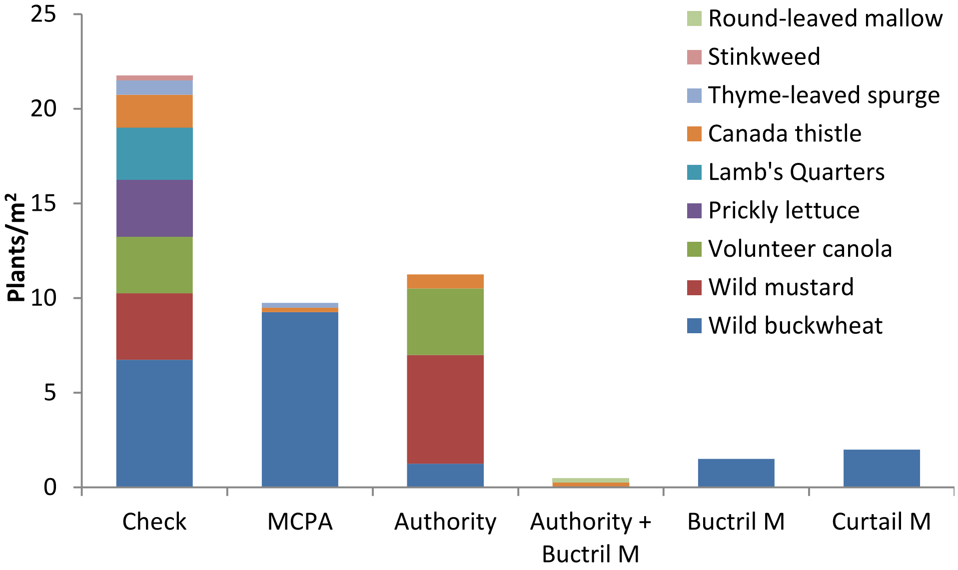

Figure 24. Identity and density of weed species found in each of the herbicide treatments.

Average seed yield and dockage in each of the treatments is shown in Figure 25. Dockage was significantly higher in the check than in all other treatments, and Authority on its own resulted in significantly more dockage than all other treatments where a broadleaf herbicide was applied. The treatment with Authority and Buctril M resulted in the highest yield overall, though not significantly higher than Authority, Buctril M, or Curtail M on their own.

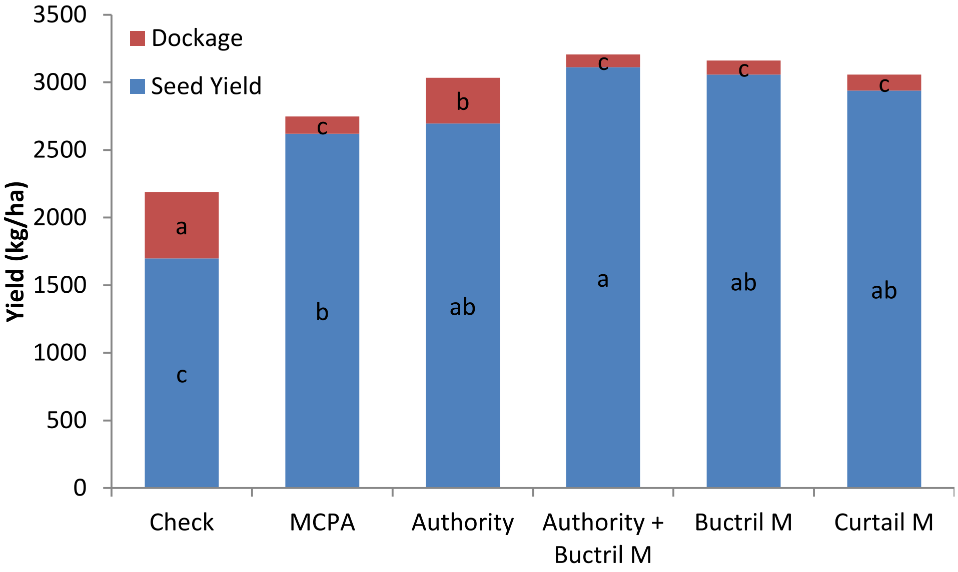

Figure 25. Broadleaf herbicide effects on dockage and yield.

In general, flax yields were significantly reduced with excessive weed competition and increased with all individual herbicide treatments. Authority applied on its own controls only a narrow spectrum of weeds and additional in-crop broadleaf herbicide applications are generally recommended. MCPA on its own did not provide season long control of buckwheat, but was effective against many of the weeds present.

Acknowledgements

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

Foliar fungicide options for flax

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

Description

Currently, Headline EC is the only foliar fungicide product registered for control of pasmo, the most common disease affecting flax in southeast Saskatchewan; however, producers frequently question the potential return on investment for fungicide application on this crop. Field trials completed in recent years near Indian Head have shown a consistent response to fungicide applications on flax and producer testimonials suggest that with a fungicide application, lodging may also be reduced. The objective of this study was to demonstrate the effects of a fungicide application on flax yield in the thin Black soil zone. There were two treatments evaluated, a check where no foliar fungicide was applied, and an application of Headline EC (99 g pyraclostrobin ha^{-1}).

Results

At Indian Head in 2013, the yields in the check (3040 kg ha^{-1}) and Headline (3158 kg ha^{-1}) treatments were not significantly different. However, when combined with trial results from 5 site years at Indian Head and Swift Current, the response at Indian Head in 2013 was significant (Figure 26). In general, foliar fungicides do not provide a significant yield benefit in the absence of disease, but there is a consistent tendency for higher yields with a fungicide application on flax.

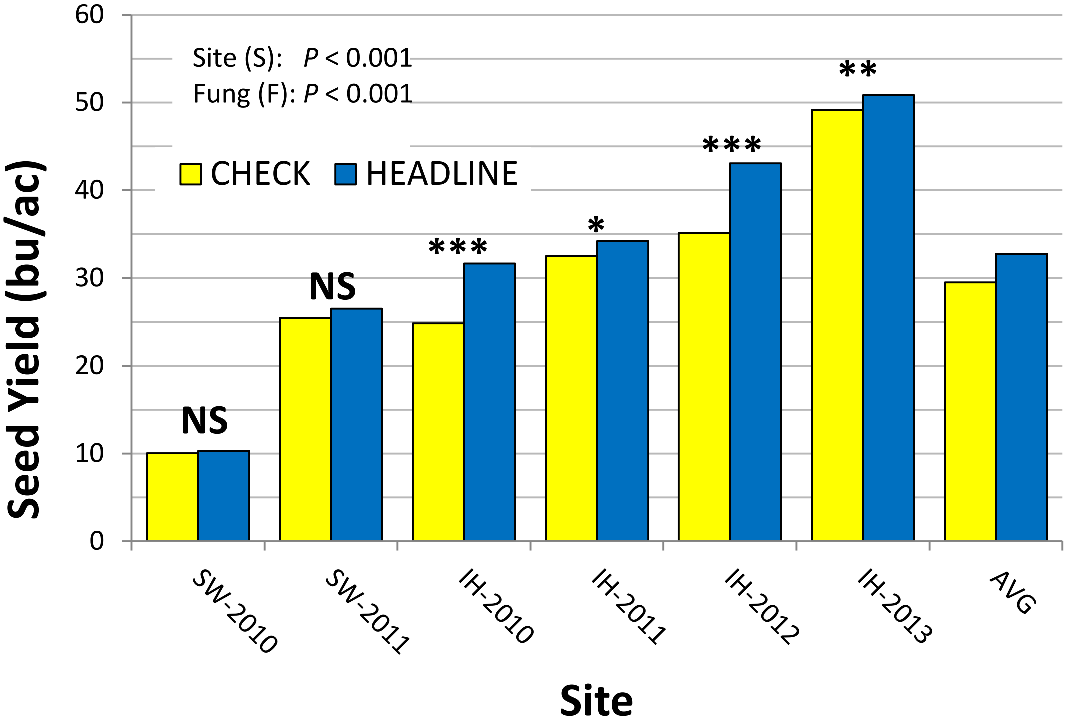

Figure 26. Flax response to fungicide application in 2010 and 2011 at Swift Current and 2010-2013 at Indian Head (‘ns’ = not significant, ‘*’ = P ≤ 0.10, ‘**’ = P ≤ 0.05, and ‘***’ = P ≤ 0.01).

Acknowledgements

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement, and the Saskatchewan Flax Development Commission in 2013 and by IHARF in previous years.

Optimal fertilizer management for flax production

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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^{-1}, 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, including 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 P_2O_5 ha^{-1} 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.

Table 22. Fertilizer treatments assessed for flax at Indian Head in 2013.

Rates Applied (kg ha^{-1})				**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	15	0	0	✔	✔
90	15	7.5	7.5	✔	✔
90	30	0	0	✔	✔
90	30	15	15	✔	✔

Results

The measured plant populations were below the recommended minimum of 300 plants m^{-2}; potentially because the measurements were done fairly early in the emergence period and hence, some emergence may have occurred after the measurements were completed. Populations were significantly affected by fertilizer treatment with the highest densities achieved in the unfertilized check and the lowest when 30 kg P_2O_5 ha^{-1} was applied in the seed-row (data not shown). According to contrast comparisons of specific treatments, flax densities were not affected at the 15 kg P_2O_5 ha^{-1} rate of seed-applied fertilizer but seed-placing 30 kg P_2O_5 ha^{-1} significantly reduced plant populations. Additional K and S fertilizer did not appear to result in further reductions in plant populations but it should be noted that these fertilizer rates will also need to be accounted for when determining the safe rate of total seed-placed fertilizer (Table 23). Increasing the rate of side-banded N from 45 kg N ha^{-1} to 90 kg N ha^{-1} did not further affect plant densities (Table 23).

Table 23. Contrast comparisons for effects of selected groups of flax fertilizer treatments ('ns' = not significant, '*' = P ≤ 0.10, '**' = P ≤ 0.05, and '***' = P ≤ 0.01).

Contrasts (A vs B)		**Group A**	**Group B**	
		----- plants m^{-2} -----		Significance level
Check	vs fertilized	266	206	**
45 N	vs 90 N	222	201	ns
90-15-0-0	vs 90-30-0-0	201	195	ns
90-30-0-0	vs 90-30-15-15	194	196	ns
15 P_2O_5, side-band	vs 15 P_2O_5, seed-placed	189	236	ns
(N)-15- 8-8, side-band	vs (N)-15-8-8, seed-placed	221	202	ns
30 P_2O_5, side-band	vs 30 P_2O_5, seed-placed	267	120	***
(N)-30-15- 15, side-band	vs (N)-30-15-15, seed-placed	202	145	**

Excellent overall flax yields were achieved with the check yielding 2,269 kg ha^{-1} (36 bus/ac) and a strong response to granular fertilizer with an overall yield increase of 36% to 3139 kg ha^{-1} (50 bus/ac) when averaged across all fertilized treatments (Figure 27). Flax yields achieved with 45 kg N ha^{-1} were significantly lower than with 90 kg N ha^{-1}. Yields with 30 kg P_2O_5 ha^{-1} tended to be higher than when only 15 kg P_2O_5 was applied but the increase was not significant. At the high N and P rates, additional K and S fertilizer also tended to result in further increases in yield, although again, the increase was not quite significant. No differences in flax yield were observed between side-banded versus seed-placed P, K and S fertilizer, even at the high rates where significant reductions in plant populations were observed.

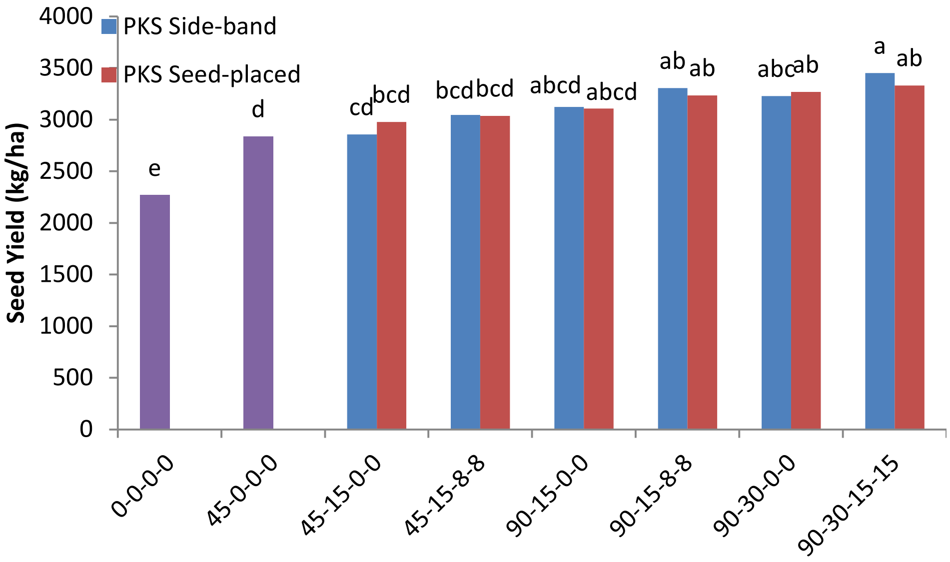

Figure 27. The effect of different rates and placement of N-P-K-S fertilizer on flax yields.

Acknowledgements

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

Relative performance of current and upcoming flax varieties

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[1]Indian Head Agricultural Research Foundation, Indian Head, 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 10 varieties were tested in 2013.

Results

Measurements of plant density, height, maturity, and yield for each of the varieties are shown in Table 24. Plant densities were within the desired range of approximately 300-400 plants m^{-2} for all varieties except AC Nugget where an average of 210 plants m^{-2} were measured. There were significant differences in height and maturity between the varieties, but all had similar yields. No lodging was observed for any plots at any point during the growing season.

Table 24. Plant densities, heights, days to maturity, and seed yield for 10 flax varieties.

Variety	**Plant Density** *plants m^{-2}*	**Plant Height** *cm*	**Maturity** *days from planting*	**Seed Yield** *kg ha^{-1}*
CDC Bethune	373 a	59 bc	106.5 cd	3377 a
CDC Flanders	355 a	54 cd	107.9 ab	3358 a
AC Norlin	325 a	61 ab	107.1 bcd	3119 a
AC Nugget	210 b	58 bcd	108.8 a	2983 a
AC Prairie Thunder	294 ab	58 bcd	107.5 abcd	3405 a
VT 50	356 a	53 d	108.0 ab	3338 a
VT 2325	297 ab	65 a	107.1 bcd	2944 a
FP 2347	266 ab	56 cd	107.8 abc	3385 a
FP 2388	314 ab	54 cd	106.3 d	3128 a
FP 2390	315 ab	55 cd	107.8 abc	3392 a

Acknowledgements

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

Seeding rate and seeding date effects on flax establishment and yield

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

Description

For optimal flax yields, the typical recommended minimum plant population is 300 plants m^{-2}. Past research has shown that this minimum threshold was only achieved 60% and 73% of the time with early and late plantings, respectively. This provides evidence that flax producers need to pay close attention to emergence with their seeding practices and that further flax agronomic research focussing on how management affects flax emergence is required. 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. Thus, 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, yields can be compromised if seeding is delayed too long and it is typically recommended that flax be seeded by mid-May. This project was intended to help producers see the potential benefits of using higher seeding rates, particularly when seeding early into cool soils. The treatments included low, medium, and high flax seeding rates in combination with early and late seeding dates.

Results

Plant densities were affected by both seeding date and rate, and the seeding rates response was similar for the two seeding dates (Table 25). Overall higher plant populations were achieved with delayed seeding, likely due to warmer soils and timely rainfall events after seeding; however, plant density measurements were completed quite early for the first seeding date and more plants may have emerged after the counts were done.

Flax maturity was affected by both seeding date and rate, and the effect of seeding rate differed between the two seeding dates (Table 25). Early seeded flax took significantly longer to mature than late seeded flax due to cooler conditions during emergence and lower plant populations. The number of days to maturity was unaffected by seeding date in the early seeded flax but decreased linearly with increasing seeding rate with delayed planting.

Seed yield for flax was not significantly affected by seeding date but did respond to seeding rate, and the response to seeding rate was the same for both seeding dates (Table 25). Early seeding was slightly favoured with a mean yield that was 6% greater than with delayed seeding. Averaged across dates, yields at the highest seeding rate were significantly higher than those achieved with 40-55 kg ha^{-1} seeding rates; however, the observed yield increase with higher seeding rates was less than 5%.

Table 25. Effect of seeding rate, seeding date, and their interaction on flax plant density, maturity, and seed yield.

	Plant Density *plants m^{-2}*	**Maturity** *days from planting*	**Seed Yield** *kg ha^{-1}*
Seeding Date			
Early (May 11)	342 b	107.9 a	3012 a
Late (May 29)	490 a	100.4 b	2846 a
Seeding Rate			
Low (40 kg ha^{-1})	336 c	104.7 a	2867 b
Medium (55 kg ha^{-1})	411 b	104.1 b	2923 b
High (70 kg ha^{-1})	501 a	103.8 b	2998 a
Date x Rate			
Early – Low	239	108.1 a	2965
Early – Medium	338	107.9 a	3002
Early – High	449	107.8 a	3069
Late – Low	431	101.3 b	2769
Late – Medium	485	100.3 c	2844
Late – High	553	99.8 d	2927

Flax performed well at both seeding dates. While better emergence was achieved with later seeding, the early seeded flax was ready to harvest at an earlier date and tended to yield slightly higher (not statistically significant). Yields increased significantly and linearly with increasing seeding rate at both seeding dates; however, the magnitude of the increase was small (less than 5%) in all cases.

Acknowledgements

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

Nutrient and seed treatment effects on the emergence and yield of various crops

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[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Northeast Agriculture Research Foundation, Melfort, SK

Description

This trial was initiated in collaboration with Viterra (now Crop Production Services) to evaluate the response of field pea, flax, and soybeans to nutrient and fungicide seed treatments. The nutrient seed treatment Awaken, and the fungicide seed treatment Vitaflo, were tested both alone and in combination on each of the three crops, and compared to a check which had no seed treatment applied. The study was conducted in Indian Head and Melfort.

Results

At both Indian Head and Melfort, flax spring plant density was higher with the two treatments that included the fungicide seed treatment, Vitaflo. However, seed treatment did not affect spring plant density in field peas and soybeans. Seed treatment did not have a significant effect on seed yield in flax, field pea, or soybeans; however, there was a slight tendency for higher yields with a fungicide seed treatment in flax. At Indian Head, the trial site was situated in a relatively low area of the field and the crops were subjected to very wet soils for extended periods through the month of June. Only the results from Indian Head are presented in this report (Table 26), a full report of all sites involved is available upon request.

Table 26. Seed treatment effects on flax, field pea, and soybean plant density and yield at Indian Head in 2013.

	Flax		**Field pea**		**Soybean**	
			plant density (plants m^{-2})			
No seed treatment	234	ab	87	a	44.7	a
Awaken	193	b	79	a	45.1	a
Vitaflo	281	a	87	a	44.9	a
Awaken + Vitaflo	281	a	79	a	40.2	a
			seed yield (kg ha^{-1})			
No seed treatment	2668	a	3031	a	1135	a
Awaken	2664	a	2842	a	1291	a
Vitaflo	2918	a	3275	a	1199	a
Awaken + Vitaflo	2953	a	3369	a	1267	a

Acknowledgements

Funding for this project was provided by Viterra and Crop Production Services.

Field pea input study

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Description

Most previous research on field pea production in Saskatchewan has focused on only one aspect of production practices, such as inoculant type or seeding rate, rather than investigating the effects of combining several different inputs. Combining agronomic practices or inputs may bring about positive interactions that result in a greater benefit than would be found for the individual factors. The objective of this study was to determine which inputs or combinations of inputs have the largest effect on harvestable field pea yield, thus providing insight into the factors that are currently limiting the yield potential of field pea in Saskatchewan.

To determine field pea responses to seeding rate, seed treatment, granular inoculant, starter fertilizer, and foliar fungicide, treatments were compared that included each of these components alone or in combination, as summarized in Table 27. 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^{-1}; 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. The study was conducted at 4 locations in 2012 and 2013.

Table 27. Treatments evaluating field pea response to different combinations of agronomic practices including seeding rate (SR), seed treatment (ST), granular inoculant (GI), starter fertilizer (Fz), foliar fungicide (Fn).

Treatment	SR	ST	GI	Fz	Fn
Empty	60 seeds m^{-2}	No	Liquid	No	No
Full	120 seeds m^{-2}	Yes	Granular	Yes	Yes
ST	60 seeds m^{-2}	Yes	Liquid	No	No
SR	120 seeds m^{-2}	No	Liquid	No	No
GI	60 seeds m^{-2}	No	Granular	No	No
Fz	60 seeds m^{-2}	No	Liquid	Yes	No
Fn	60 seeds m^{-2}	No	Liquid	No	Yes
ST + SR	120 seeds m^{-2}	Yes	Liquid	No	No
ST + GI	60 seeds m^{-2}	Yes	Granular	No	No
Fz + GI	60 seeds m^{-2}	No	Granular	Yes	No
Fz + SR	120 seeds m^{-2}	No	Liquid	Yes	No
SR + Fn	120 seeds m^{-2}	No	Liquid	No	Yes
Fz + Fn	60 seeds m^{-2}	No	Liquid	Yes	Yes
GI + Fn	60 seeds m^{-2}	No	Granular	No	Yes
ST + Fz	60 seeds m^{-2}	Yes	Liquid	Yes	No
SR + GI	120 seeds m^{-2}	No	Granular	No	No
ST + SR + GI + Fn	120 seeds m^{-2}	Yes	Granular	No	Yes
SR + GI + Fn	120 seeds m^{-2}	No	Granular	No	Yes
ST + GI + Fn	60 seeds m^{-2}	Yes	Granular	No	Yes
ST + SR + GI	120 seeds m^{-2}	Yes	Granular	No	No
ST + SR + Fn	120 seeds m^{-2}	Yes	Liquid	No	Yes

Results

In general, increasing seeding rate and applying a granular inoculant consistently increased plant density (on average 39 and 13 plants m^{-2}, respectively). Seed treatments did not consistently improve plant density and starter N fertilizer generally decreased plant density by 7 plants m^{-2}. Higher seeding rates resulted in significantly higher disease ratings, both before and after fungicide application, likely due to a denser crop canopy. Foliar fungicide applications effectively reduced leaf disease compared to the untreated plots, as well as significantly increased the days to maturity. High seeding rates reduced days to flower and days to maturity, while starter N had the opposite effect. The remaining inputs had somewhat inconsistent effect on maturity at individual site years and no effect when averaged across sites.

High seeding rates and the application of a foliar fungicide consistently increased seed yields (5 of 7 site years) by an average of 329 and 417 kg ha^{-1} respectively, compared to the low seeding rate or no fungicide application. Increasing the seeding rate had a larger effect on yield when applied alone as compared to when applied with other inputs; therefore, we suspect that an intermediate seeding rate may provide yield improvements and be more economical when combined with other inputs. In contrast, fungicide application had a greater effect on yield when combined with other inputs, essentially "protecting" the higher yield potential. Granular inoculants and seed treatments had inconsistent effects on seed yield at individual site years; however, averaged across sites granular inoculant did result in slightly higher yields than seed-applied liquid inoculant. Starter N never had a beneficial effect on seed yield. Combining inputs generally did not increase yields in a synergistic or sequentially additive fashion. While the combination of granular inoculant, high seeding rate and foliar fungicide resulted, on average, in the highest yields and highest net returns, applying only the high seeding rate to the empty input package had significant yield increases on average compared to the empty input package, and had the second highest net return at high grain prices (\$8.46 bu^{-1}) and the highest net returns when grain prices are low (\$5.83 bu^{-1}). Growers should focus on seeding rate, granular inoculant and fungicide in order to maximize yield potential and economic return. Mean yield responses for all 22 treatments combined across 7 site-years (Melfort in 2013 was not included) are shown in Figure 28.

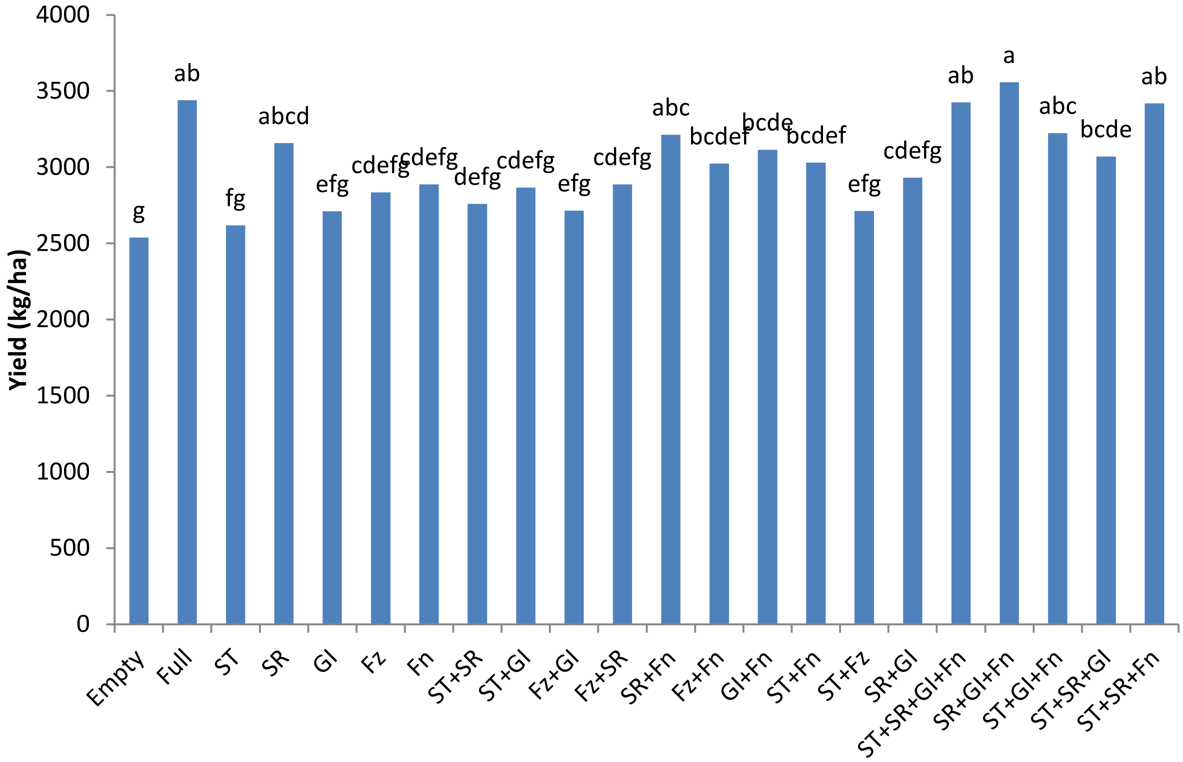

Figure 28. Mean seed yield in each of the treatments combined across 7 site-years.

Acknowledgements

Funding for this project was provided by the Saskatchewan Pulse Growers, with in-kind support provided by BASF and Syngenta.

Effects of fungicide application and seeding rate on disease levels in field peas and lentils

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[1]Western Applied Research Corporation, Scott, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK; [3]Wheatland Conservation Area, Swift Current, SK; [4]Conservation Learning Centre, Prince Albert, 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 (untreated and 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.

Results

Conditions during the 2013 growing season at Indian Head were well-suited for evaluating the effects of seeding rate and fungicide application on pea and lentil performance. A wide range of plant populations was achieved with the seeding rates that were used, and plant densities were considered below optimal at the low seeding rate, close to optimal at the normal rate and above optimal at the high seeding rate (data not shown). When averaged across crop types and fungicide treatments, yields increased linearly with increasing seeding rates (data not shown). When averaged across seeding rates, fungicide application provided a yield benefit in field pea but not lentil (Figure 29).

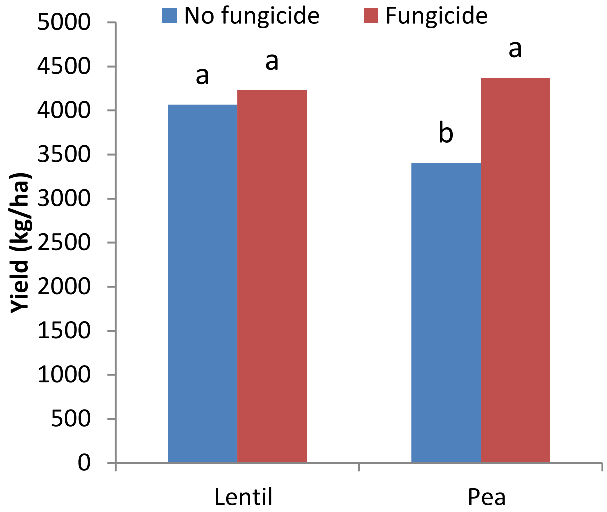

Figure 29. Effect of fungicide application on lentil and field pea yields across all seeding rates at Indian Head in 2013.

While significant interactions between seeding rate and fungicide application were not detected, the results suggest that the greatest benefit was derived from increasing seeding rates when fungicides were also applied (Figure 30). At least for field pea, fungicides provided similar benefits at all seeding rates, and it appeared that using higher seeding rates were most beneficial when combined with a fungicide application (data not shown).

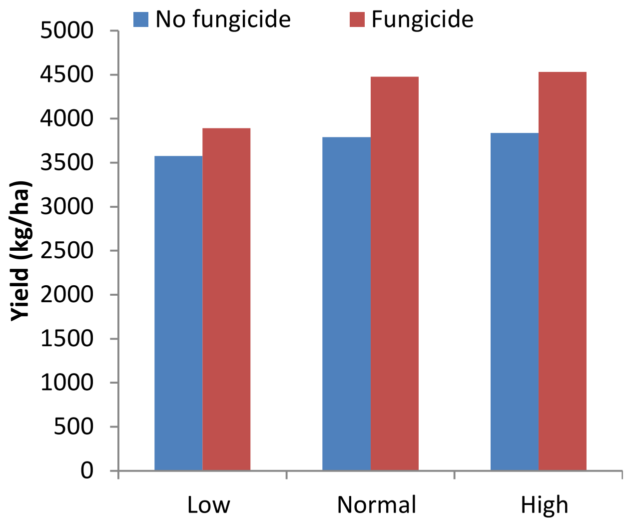

Figure 30. Effect of fungicide at low, normal, and high seeding rates in lentil and field pea combined at Indian Head in 2013.

Considering the cost of higher seeding rates and relatively small yield benefit, it is unlikely that seeding rates exceeding those used in the 'normal' treatments would be economically advantageous. While there was no significant yield increase with fungicide for lentil at Indian Head in 2013, the yield advantage observed with field pea was more than adequate to cover the costs of this application, even at low grain prices.

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

Field pea, lentil, and soybean response to rhizobial and mycorrhizal inoculation

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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 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. While the economic returns that are realized with rhizobial inoculation can be inconsistent depending on field history and environmental conditions, inoculating remains a recommended and accepted practice to ensure that seed yields and the rotational benefits of pulse crops are maximized.

Arbuscular mycorrhizal inoculants (*Glomus intraradices*) are relatively new to western Canadian farmers and are not specific to pulse crops. The benefits of arbuscular mycorrhizal fungi in agricultural systems are widely recognized. 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 these two types of products while providing a familiar benchmark, rhizobial inoculant, for which to compare the impact of the mycorrhizal inoculants on seed yield. 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 Nodulator for soybeans, while the mycorrhizal inoculant was MykePro for all three crop types.

Results

Inoculant effects on seed yield were not statistically significant but yields tended to be lowest in the check (no inoculant) and highest when rhizobial inoculants were used, except for field pea, where overall yield variability was high due to root disease (Figure 31).

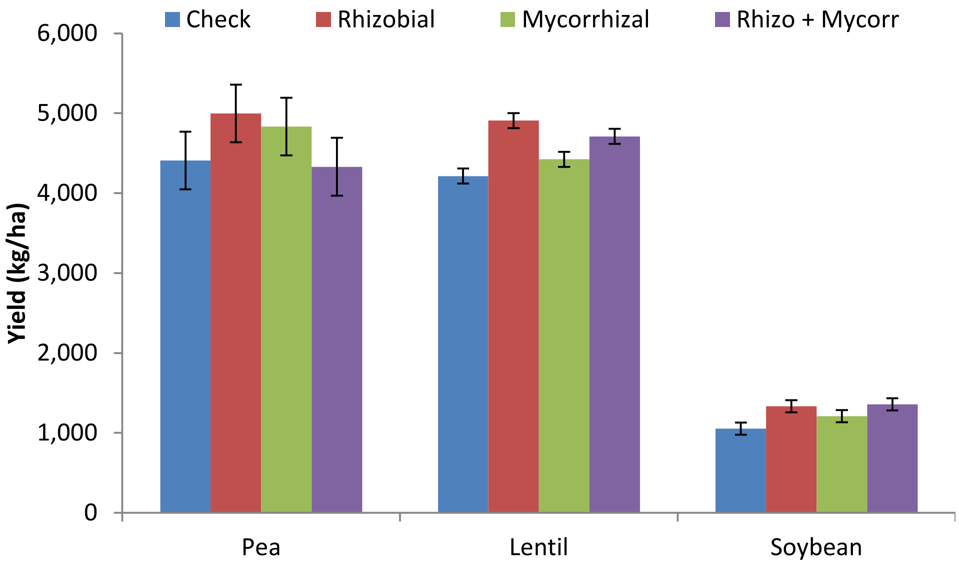

Figure 31. The effects of rhizobial and mycorrhizal inoculants on field pea, lentils, and soybeans.

It is not uncommon to see inconsistent benefits to rhizobial inoculants in fields that have a rich history of field pea and lentil production in their rotations; however, inoculants are still recommended to ensure both optimal yield and rotational N benefits. Since they have not been historically grown in Saskatchewan, soybeans typically respond well to rhizobial inoculants. In the current demonstration, soybean yields tended to be higher with rhizobial and, to a lesser extent, mycorrhizal inoculants, but the response was not statistically significant.

The potential benefits of mycorrhizal fungi are not exclusive to pulse crops and the mycorrhizal product used in this demonstration may also be used with cereals and certain oilseeds (i.e. flax). Furthermore, the potential effectiveness of mycorrhizal inoculants may be affected by different management factors such as crop rotation, tillage practices and seeding equipment. Benefits to inoculation would most likely be seen following non-host crops such as canola and when tillage or high-disturbance seeding equipment damages existing mycorrhizal networks and hyphae.

Acknowledgements

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

Soybean variety trial for southeast Saskatchewan

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Description

This study was initiated in collaboration with NorthStar Genetics to evaluate the performance and adaptation of 10 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 (Table 28). Overall, yields were below those measured in 2012, likely as a result of dry and cool conditions later in the growing season at Indian Head in 2013; however, several significant differences amongst varieties were detected (Figure 32).

Table 28. Performance of 10 commercial soybean varieties at Indian Head in 2013.

Variety	**Plant Density** *plants m^{-2}*	**Pod Height** *cm*	**Relative Maturity** *days to 10% yellow*
DK 23-10	53.3	5.85	110.5
NSC Anola RR2Y	57.8	7.33	114.3
NSC Elie RR2Y	48.0	8.00	114.5
NSC Gladstone RR2Y	51.7	7.70	116.3
NSC Libau RR2Y	47.6	8.25	114.3
NSC Moosomin RR2Y	51.7	8.48	108.3
NSC Reston RR2Y	42.2	8.30	111.3
NSC Reston RR2Y + Rootex	47.6	7.10	111.8
NSC Tilston RR2Y	57.8	8.50	109.5
NSC Vito R2	64.0	6.75	114.5
TH 33003	47.2	7.15	110.0

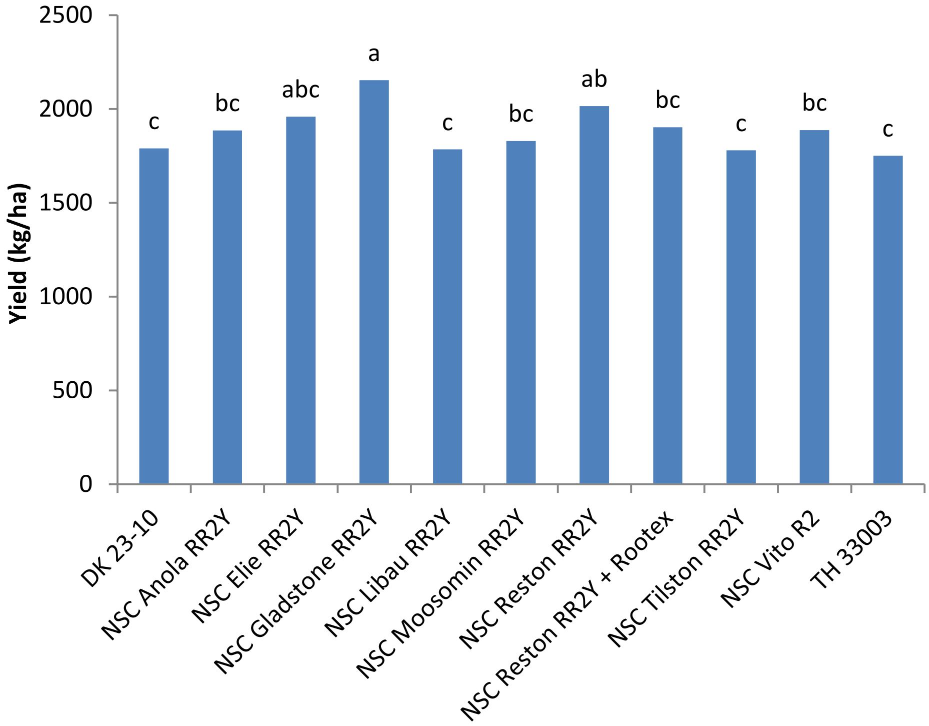

Figure 32. Relative yields of 10 commercial soybean varieties at Indian Head in 2013.

Acknowledgements

Funding for this project was provided by NorthStar Genetics.

RR2 soybean yield, inoculant, and fertility trials

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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; and 3) to test the effects of different rates of P and K fertilizer on soybeans.

1) Variety Trial

A total of eight varieties were evaluated for relative growth and productivity characteristics (Table 29).

Table 29. Performance of 8 commercial soybean varieties at Indian Head in 2013.

Variety	**Plant Density** *plants m^{-2}*	**Plant Height** *cm*	**Pod Clearance** *cm*	**Relative Maturity** *days to 10% yellow*	**Seed Yield** *kg ha^{-1}*
TH 33003R2Y	55.0 a	71.8 a	7.98 a	103.8 c	1825 ab
TH 32004R2Y	55.4 a	61.7 bcd	7.18 ab	106.0 bc	2012 a
TH 33005R2Y	64.8 a	67.3 ab	7.68 a	112.0 a	2017 a
NSC Libau RR2Y	54.1 a	58.1 cd	4.73 bc	105.3 bc	1893 a
Dekalb 23-10RY	65.5 a	54.4 d	3.19 c	104.4 bc	1476 c
900Y61	55.8 a	54.4 d	5.08 bc	107.3 b	1654 bc
BY Pekko	48.4 a	63.6 bc	6.53 ab	110.5 a	1532 c
LS 002R21	57.2 a	60.8 bcd	6.22 abc	104.9 bc	1930 a

2) Inoculant Trial

Two different liquid inoculants were assessed; Optimize and Primo CL. Optimize liquid inoculant was also assessed in combination with various rates of the granular inoculant, Nodulator (Table 30).

Table 30. Soybean response to various types and rates of inoculant.

Treatment	**Relative Maturity** *days to 10% yellow*	**Seed Yield** *kg ha^{-1}*
Optimize (liquid)	107.5 d	1362.3 c
Primo CL (liquid)	108.3 bcd	1483.9 c
Optimize + 4.5 kg ha^{-1} granular	108.0 cd	1740.9 b
Optimize + 9.0 kg ha^{-1} granular	108.8 abc	1981.5 a
Optimize + 13.4 kg ha^{-1} granular	109.0 ab	1901.1 ab
Optimize + 17.9 kg ha^{-1} granular	109.3 a	1992.4 a

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 (Table 31).

Table 31. Soybean plant density, maturity, and yield response to different rates of P and K fertilizer.

P_2O_5 Rate *kg ha^{-1}*	**K_2O Rate** *kg ha^{-1}*	**Plant Density** *plants m^{-2}*	**Relative Maturity** *days to 10% yellow*	**Seed Yield** *kg ha^{-1}*
0	0	49.6 a	107.8 a	1808.1 bc
22	0	51.3 a	107.8 a	1835.8 abc
45	0	51.3 a	108.3 a	1971.7 ab
0	22	46.8 a	107.8 a	1872.5 abc
0	45	47.2 a	107.8 a	1762.2 c
22	22	59.9 a	107.8 a	2002.3 a
22	67	53.7 a	107.8 a	1908.7 abc
22	111	48.0 a	107.8 a	1939.6 ab

Acknowledgements
Funding for this project was provided by Quarry Seed.

Demonstrating canaryseed's weak response to nitrogen and strong response to fungicide

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Description

There are many questions regarding the effects of N fertilizer and fungicide applications on canaryseed. With the increased amounts of nitrogen being used in other crops, growers have difficulty believing that using more nitrogen in canaryseed will not be beneficial. The project included two fungicide treatments (no fungicide and fungicide), in combination with six nitrogen fertilizer rates (10, 20, 30, 50, 70, and 90 kg N ha^{-1}).

Results

In both 2012 and 2013, the application of a fungicide did not increase the yield response of canaryseed to N fertilizer. In 2012, the application of a fungicide increased grain yield at 2 out of 3 locations and in 2013 there were some numerical increases in grain yield from a fungicide, but they were not statistically significant. This may be due to the light levels of septoria leaf mottle observed in the plots.

The effect of N fertilizer on canaryseed yield was usually positive and larger than observed in past research (Figure 33). The yield declined as the N rate increased at two locations; Melfort 2012 and Redvers 2013. There was no response to applied N at Indian Head in 2012. At the other five site years, there was a significant increase in grain yield as the N rate increased, with yield optimized at 70 kg ha^{-1}, which is higher than the current recommended range of 40 to 60 kg ha^{-1}.

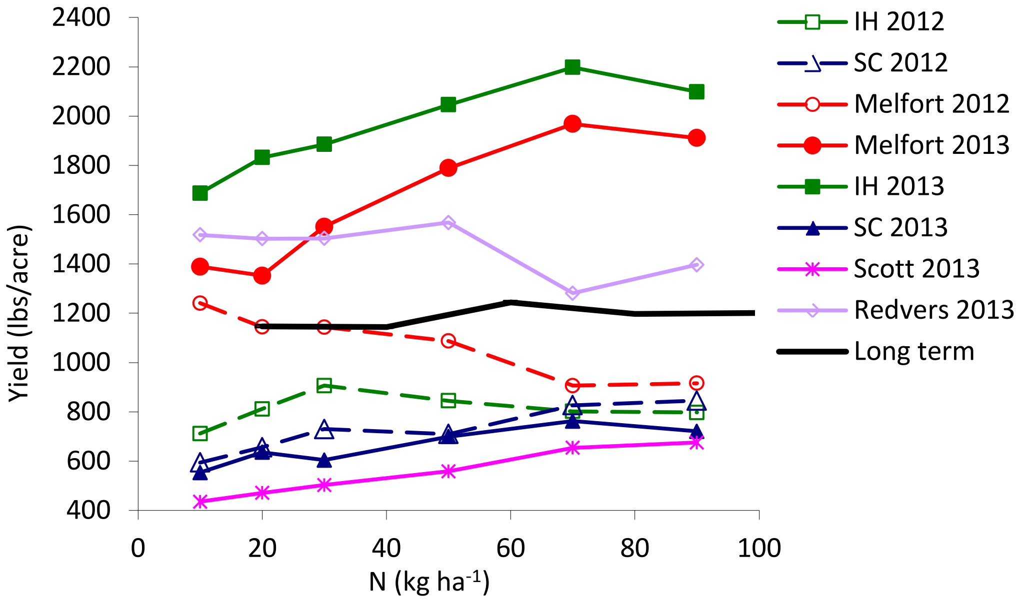

Figure 33. The effect of nitrogen on the grain yield of canaryseed.

Acknowledgements

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

Interactions of plot size and surrounding crop with the ability to statistically detect yield differences with fungicide application in canaryseed

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Description

The objective of this study was to determine whether plot size and surrounding crop affects our ability to statistically detect yield differences caused by the application of a fungicide to control Septoria leaf mottle in canaryseed. This was the first year of a multi-year project and results are still preliminary. The study was conducted in two fields one with canaryseed grown around the plots and the other without canaryseed grown around the plots. The plot sizes tested were: 1) 35’ x 13’, 2) 35’ x 26’, 3) 35’ x 39’, 4) 70’ x 13’, 5) 70’ x 26’, and 6) 70’ x 36’.

Results

In the field not surrounded by canaryseed, only when the plot length was extended to 70 feet were significant differences from the fungicide applications detected. In the field with canaryseed grown around the plots increasing the width or length of the canaryseed plots resulted in significant differences being detected (Table 32).

Table 32. The effect of plot size and surrounding field crop on the detection of statistically significant yield differences with fungicide application (‘ns’ indicates the contrast was not significant, ** indicates significant, and *** indicates the contrast was highly significant).

Plot Size	**Surrounding Field**	
	Non-canaryseed	*Canaryseed*
13’ x 35’	ns	ns
26’ x 35’	ns	***
39’ x 35’	ns	***
13’ x 70’	**	**
26’ x 70’	ns	***
39’ x 70’	**	**

Acknowledgements

This project was supported by the Agriculture Development Fund (ADF).

Responsiveness of oats to fertilizer N and fungicides

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Description

The objective of this project was to validate recent research results showing that oats require substantially less N than other cereal crops in the region, as oat scavenges soil N more effectively than other cereals like wheat. A second objective was to validate other recent research results showing that oat does not require fungicide treatment because disease incidence and severity are too low to require treatment. Three fungicide treatments (no fungicide, Headline and Stratego) in combination with eight nitrogen fertilizer rates (5, 20, 40, 60, 80, 100, 120 and 140 kg/ha) were evaluated.

Results

The study was conducted at Indian Head and Melfort in 2012 and 2013, though only the results from Indian Head in 2013 are shown below (Table 33). There was no interaction between the fungicide and applied N fertilizer for any of the variables measured at either location in either year. The oat was more responsive to higher N rates than expected, with yield increasing as N rate increased to 140 kg N ha^{-1} at Melfort in 2012, 100 kg N ha^{-1} at Melfort in 2013 and Indian Head in 2012 and 2013. Test weight declined as the N rate increased at all four site years; however, the only decline to be large enough to result in a lower grade was at Indian Head in 2012.

Table 33. The effect of fertilizer N and fungicide application on the severity of leaf disease and oat yield and quality at Indian Head in 2013.

	Leaf Disease: Flag		**Leaf Disease: Flag 2**		**Yield**		**Test Weight**	
	%		*%*		*kg ha^{-1}*		*g 0.5L^{-1}*	
Fungicide								
No Fungicide	5.07	a	10.91	a	7405	a	249.69	a
Headline	4.02	a	7.64	a	7812	a	248.18	a
Stratego	3.53	a	6.95	a	7589.4	a	250.05	a
Nitrogen Rate								
5	4.23	a	6.19	a	6350.8	e	251.04	ab
20	4.06	a	5.94	a	6872.1	d	248.43	bcd
40	3.29	a	6.65	a	7275.8	c	251.3	a
60	4.58	a	9.8	a	7484.5	c	249.92	abc
80	5.84	a	11.43	a	7981.8	b	249.46	abcd
100	3.9	a	10.03	a	8305.3	a	249.58	abcd
120	3.76	a	9.23	a	8355.6	a	247.73	cd
140	4.01	a	8.73	a	8191.2	ab	247	d

This response requires further study to determine if it is stable over various environmental conditions. Triactor has enough disease resistance that a fungicide application did not increase yield in the absence of disease, or improve the responsiveness of oats to N rates.

Acknowledgements

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

Demonstration of seeding rates for sunflowers in Saskatchewan

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Description

Recommendations for the optimum seeding rate for sunflowers were developed in areas that have long growing seasons, and using row crop management practices. The current recommendation for early maturity hybrids is 24,000 plants acre^{-1} while for open pollinated cultivars it is 30,000 plants acre^{-1}. This project looked at seven seeding rates (15,000, 20,000, 25,000, 30,000, 40,000, and 45,000 plants ac^{-1}) for the hybrid 63A21 and the cultivar AC Sierra.

Results

Increasing the seeding rate increased the grain yield at three out of five locations (Table 34). The locations that responded tended to be higher yielding than the locations with no response. At Melfort, the seeding rate increased yield until a population of 28,306 plants acre^{-1} was reached using a seeding rate of 35,000 seeds acre^{-1}. At Indian Head, increasing the seeding rate increased yield until a population of 32,800 plants acre^{-1} was reached using a seeding rate of 35,000 seeds acre^{-1}. At Tribune, increasing the seeding rate increased yield until a population of 23,200 plants acre^{-1} was reached using a seeding rate of 30,000 seeds acre^{-1}. It is interesting to note that a corn planter was used at Tribune, the location that required the lowest plant density to maximize yield. A plant density of 23,000 plants acre^{-1} is close to the density recommended in many regions where a corn planter is used to seed sunflowers. At the Indian Head and Melfort locations, where a no-till drill was used, yield was maximized at a seeding rate of 35,000 seeds acre^{-1}.

Table 34. Effect of cultivar/hybrid and seeding rate on grain yield at 5 locations in Saskatchewan in 2013.

	Swift Current		Melfort		Tribune		Indian Head		Redvers	
Cultivar/Hybrid	*Seed Yield (kg ha^{-1})*									
AC Sierra	904	b	1790	b	854	b	1291	b	431	a
63A21	1837	a	2712	a	1914	a	2089	a	932	a
Seeding Rate										
15,000	1165	a	1348	d	1094	d	1208	c	666	a
20,000	1471	a	1575	d	1253	c	1474	bc	700	a
25,000	1416	a	2093	c	1315	bc	1740	ab	535	a
30,000	1447	a	2436	bc	1529	a	1809	ab	593	a
35,000	1268	a	2799	a	1530	a	1933	a	662	a
40,000	1351	a	2820	a	1534	a	1755	ab	561	a
45,000	1475	a	2686	ab	1430	ab	1915	a	668	a

Acknowledgements

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

Testing of mid-oleic and high-oleic hybrid sunflowers across Saskatchewan

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Description

Sunflower is an oilseed crop used as whole seed for human consumption, as oil for human consumption and as a feed for caged birds. The oil profile of sunflowers demanded by the market place has changed to mid-oleic and high-oleic sunflowers. New hybrids bred in Europe and the United States have been released in Canada. The seed companies have not tested these new hybrids in Saskatchewan due to the small acreage of sunflowers grown (approximately 10,000 acres) spread across a wide geographic area of the province. Growers are unable to evaluate the wide range of hybrids that have been released, and need to see these hybrids grown locally to evaluate their relative maturity and rate of dry down after they have reached physiological maturity. This differs among hybrids but these differences are not known for Saskatchewan growing conditions. In 2013, the study was conducted at 6 locations: Redvers, Indian Head, Swift Current, Melfort, Tribune, and Saskatoon.

Results

Kernel moisture at harvest is very important for evaluating hybrids in Saskatchewan because some varieties are slow to dry down in our climate. In 2013, AC 60 consistently had the lowest kernel moisture at harvest across all locations (Table 35). AC Sierra, which is the earliest cultivar available for sale, had kernel moisture that was statistically similar to AC 60 at all locations except Tribune. Averaged over all locations, AC 60 had a kernel moisture of 9% while AC Sierra had a kernel moisture of 17%. The kernel moisture of AC 60 was lower than the kernel moisture of the earliest hybrid 63A21. The other hybrids tended to have even higher kernel moistures than 63A21 although the statistical differences were not consistent.

Table 35. Performance of hybrids and cultivars averaged across 5 locations in Saskatchewan in 2013.

	Plant Density	**Height**	**First Flower**	**Maturity**	**Kernel Moisture**	**Grain Yield**
	plants ac^{-1}	*cm*	*days*	*days*	*%*	*kg ha^{-1}*
63A21	38623.6	140.84	77.2	104.7	19.22	2711.0
AC Sierra	32609.4	132.62	67.2	99.9	17.34	1675.7
X4270 (TALON)	19476.5	152.34	82.4	108.4	34.25	2301.4
8N270 CLDM	23821.8	151.40	81.0	108.5	24.86	2413.7
63A21	22575.4	135.80	77.8	103.6	20.41	2471.5
AC 60	24168.2	146.46	75.8	99.7	8.98	2461.6
7111	22043.8	144.1	98.2	110.1	24.82	2158.0
Cobalt II	23308.0	149.14	83.2	107.9	26.27	2386.1

Often, delayed maturity resulted in higher grain yield, but this was not the case for sunflowers in 2013. AC 60 had similar yields to the other hybrids at all locations except Redvers. Differences in maturity followed the same trends observed with kernel moisture. AC 60 and AC Sierra had the earliest maturity and 63A21 was earlier maturing than 8N270, 7111, Cobalt II and Talon (X4270) at many locations.

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Natural air grain drying: Testing an automatic controller for managing bin aeration fans

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Description

The main objective of this study was to investigate the common practice of natural air grain drying; running fans continuously until grain is dry, to determine whether it is the most efficient method, and if not, too attempt to develop a more efficient strategy. The utilization of a novel technique allowed us to determine the degree of drying of the grain within the bin on an hourly basis, by measuring the amount of water entering and leaving the bin, and calculating the net difference in water movement. Through extensive exploration of the hourly data, we discovered that with continuous running of the fans, the degree of drying was fluctuating on a daily basis, and that in particular, the highest degree of grain drying was occurring during the night. A more thorough analysis of the data led to the characterization of the diurnal drying cycle, which is illustrated in Figure 34. Positive values indicate water is leaving the bin, thus drying is occurring, while negative values indicate water is being added to the bin.

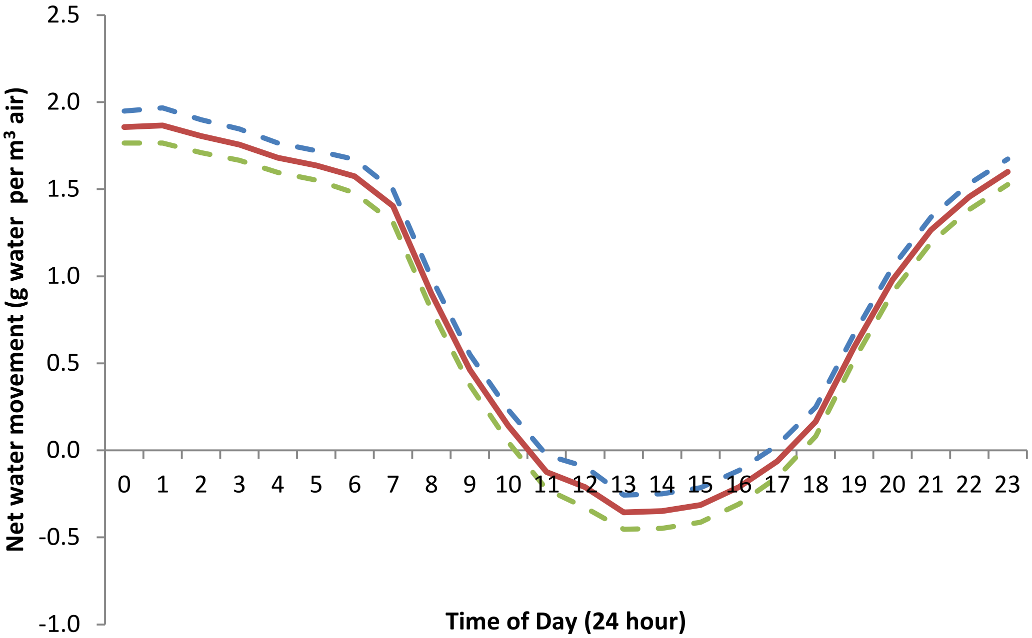

Figure 34. The diurnal cycle of natural air grain drying. Dashed lines indicate the 97% confidence interval based on simple hourly averages of all data from 2007-2013.

As the trend is likely a function of conditions that vary with time of day, in particular air temperature, we examined the correlation between the net water movement and grain temperature, and observed that drying occurred when the temperature of the grain was decreasing. This led to the logical conclusion that cooling the grain concurrently dries the grain, and thus, with natural air, drying will take place if the air temperature is less than the grain temperature. This control theory was implemented and tested in 2013, and results thus far indicate that the technique was successful in reducing the moisture content of grain, and providing safe grain storage with less fan running time.

It is widely accepted that safely stored grain is dry and cold; however the focus has often been on drying grain. This project has re-introduced the importance of cold storage. It is important that we continue to collect data to include the wide range of environmental conditions that are encountered from year to year, to reinforce our findings as it relates to the diurnal cycle and also to test potential control strategies.

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