IHARF

INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2022 Annual Report

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Contents

Introduction

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

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

IHARF Mandate

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

IHARF Board of Directors

IHARF is led by a nine-member Board of Directors consisting of producers and industry stakeholders who volunteer their time and provide guidance to the organization. Residing all across southeastern Saskatchewan, IHARF Directors are dedicated to the betterment of the agricultural community as a whole. The 2022 IHARF Directors included:

- Cameron Gibson - President *(Kendal)*
- Thom Weir - Vice President *(Yorkton)*
- Jennifer Kreway - Secretary / Treasurer *(Regina)*
- Curtis Russell *(Indian Head)*
- Heather Haus *(Glenavon)*
- Justin Ritco *(Regina)*
- Dean Douhaniuk *(Killaly)*
- Bryce Thompson *(Regina)*
- Winston van Staveren *(Creelman)*

Ex-Officio

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

- Bruce McArthur - Associate Director, RDT
- Bill May - Research Scientist
- Chris Omoth - Research Assistant
- Sherri Roberts - Crops Extension Specialist

IHARF Staff

The 2022 team of IHARF staff included:

- Danny Petty - Executive Manager
- Chris Holzapfel - Research Manager
- Christiane Catellier - Research Associate
- Doug Stewart - Farm Technician
- Zak Woidyla - Research Technician
- Danny Walker - Seasonal Technician
- Courtney Nell - Summer Student
- Gillian Moses - Summer Student

Dr. Guy Lafond Memorial Award

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

The recipient of the Dr. Guy Lafond Memorial Award in 2022 was Subarna Sharma. Subarna was pursuing his PhD at the University of Saskatchewan, looking at wheat germplasm and reducing night-time water loss, improved water productivity and drought tolerance.

Extension Events

Indian Head Crop Management Field Day

On July 19, 2022, IHARF and AAFC hosted the annual Indian Head Crop Management Field Day. The field day was planned to take place in the field however, it was forced to held indoors due to heavy rain. 112 producers and agronomists attended for the field day. Presentations were provided by:

- Chris Holzapfel (IHARF)
- Christiane Catellier (IHARF)
- Bill May (AAFC)

AgriARM Research Update

IHARF, along with Agriculture Applied Research Management (AgriARM) sites from across the province, jointly hosted the virtual AgriARM Research Update on March 1, 2023. The event highlighted components of each organizations applied research and demonstration programs.

IHARF Soil and Crop Management Seminar

On February 1, 2023, IHARF hosted its annual winter seminar at Balcarres, SK. 87 producers and agronomists attended for the IHARF Soil & Crop Management Seminar. Presentations were delivered by:

- Bill May (AAFC Indian Head)
- Chris Holzapfel (IHARF)
- Christiane Catellier (IHARF)
- Mike Gretzinger (Farming Smarter)
- Dr. Phillip Harder (University of Saskatchewan)
- Shawn Senko (Canola Council of Canada)

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

2022 IHARF Partners

Every year, IHARF works with many organizations dedicated to advancing agriculture into the future. IHARF would like to thank all of our partners for their outstanding support of our efforts in 2021:

Platinum

- Agriculture & Agri-Food Canada - Indian Head Research Farm
- BASF
- Canada/Saskatchewan ADOPT Program
- Koch Agronomic Services
- Saskatchewan Pulse Growers
- Saskatchewan AgriARM Program
- Saskatchewan Strategic Field Program
- Saskatchewan Wheat Development Commission
- Western Grains Research Foundation

Gold

- Albaugh
- Alberta Agriculture Funding Consortium
- Alberta Wheat Commission
- Anglo American
- Azotic North America
- Corteva Agri Science
- Saskatchewan Barley Development Commission
- Saskatchewan Canola Development Commission
- Syngenta

Silver

- Ag Action Manitoba
- Bayer CropScience
- Fertilizer Canada
- Lallemand
- Manitoba Pulse & Soybean Growers
- Mosaic
- Novozymes BioAg
- Plant Response
- Saskatchewan ADF Program
- Saskatchewan Farm Stewardship Association

Bronze

- CanMar Farms Indian Head
- Delage Farms
- GrainShark.com
- Manitoba Crop Alliance
- Mazergroup
- NorthStar Genetics
- Nutrien Ag Solutions
- Town of Indian Head
- Canary Seed Development Commission of Saskatchewan
- Saskatchewan Flax Development Commission
- Saskatchewan Oat Development Commission
- University of Saskatchewan

AgriARM

The Saskatchewan AgriARM (Agriculture Applied Research Management) program connects eight regional, applied research and demonstration organizations into a province wide network. Each location 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. AgriARM provides a forum where government, producers, researchers and industry can partner on provincial and regional projects.

The eight AgriARM organizations found throughout Saskatchewan include:

- Conservation Learning Centre (CLC), Prince Albert
- East Central Research Foundation (ECRF), Yorkton
- 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

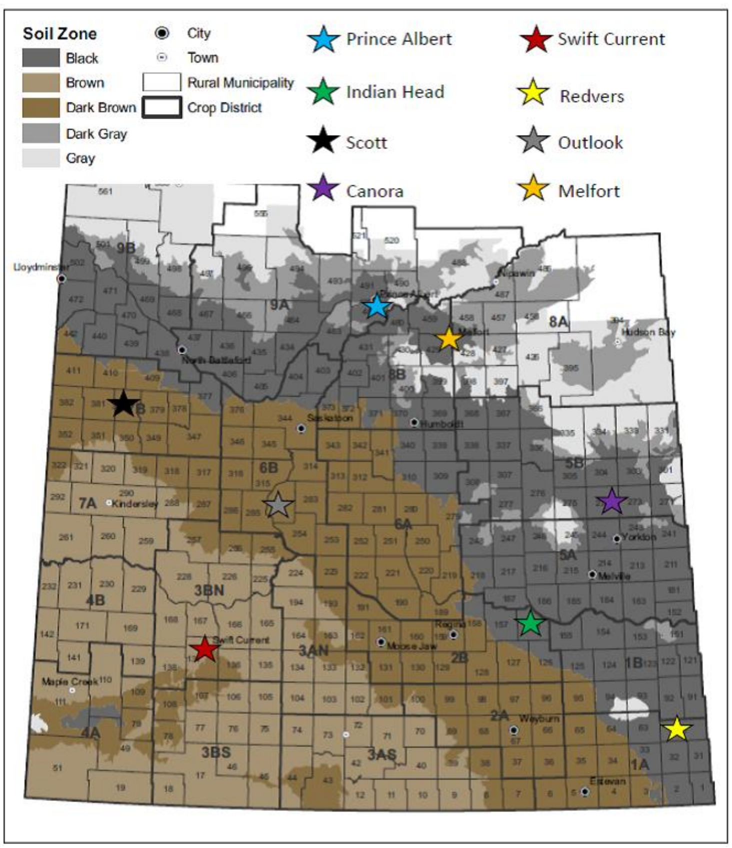

Figure 1. Locations of organizations comprising the Saskatchewan AgriARM Network.

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://climate.weather.gc.ca/historical_data/search_historic_data_e.html].

Mean temperatures and total precipitation amounts for May through August are presented with the long-term averages for each location in Tables 1 and 2, respectively. In 2022, the growing season at all sites was warmer than the long-term historical average. Precipitation varied greatly from historical norms between sites. Indian head had above average precipitation at 117% of the long-term average (285.6 mm). Melfort also had above average precipitation at 106% of the long-term average (240.3 mm). In contrast, Swift Current and Scott received less than average rainfall. Swift current was the site with the least amount of cumulative precipitation at 88% of the long-term average (187.0 mm).

Table 1. Mean monthly temperatures for the 2022 growing season and long-term normals (1981-2010).

		May	June	July	August	Average
				˚*C*		
Indian Head	2022	10.9	16.1	18.1	18.3	15.8
	Normal	10.8	15.8	18.2	17.4	15.6
Melfort	2022	9.9	15.2	18.2	18.7	15.5
	Normal	10.7	15.9	17.5	16.8	15.2
Scott	2022	10.0	15.0	18.3	18.9	15.6
	Normal	10.8	14.8	17.3	16.3	14.8
Swift Current	2022	10.9	15.9	19.8	20.9	16.9
	Normal	10.9	15.3	18.2	17.6	15.5

Table 2. Total monthly precipitation for the 2022 growing season and long-term normals (1981-2010).

		May	June	July	August	Total
				mm		
Indian Head	2022	97.7	27.5	114.5	45.9	285.6
	Normal	51.7	77.4	63.8	51.2	244.1
Melfort	2022	90.8	78.1	34.9	36.5	240.3
	Normal	42.9	54.3	76.7	52.4	226.3
Scott	2022	11.0	57.1	86.5	32.1	186.7
	Normal	38.9	69.7	69.4	48.7	226.7
Swift Current	2022	51.2	37.7	90.4	7.5	187.0
	Normal	44.1	74.5	51.9	43.2	213.7

Research

IHARF trials were situated at various locations in the Indian Head area, with the majority of projects located on NW28-18-12 W2 and NE27-18-12 W2. Each trial consisted of numerous plots, each representing a specific treatment being evaluated in that particular project (eg. rates, seed treatments, varieties, etc.). Apart from the specific treatments being evaluated, plots were generally cared for using best management practices and in a manner which was consistent with normal or typical practices in the Indian Head area. Deviations in agronomy and crop management have been specified where required as a result of the study objectives or treatments being evaluated and are indicated in the description of each trial. In general, plots were seeded as early as possible in mid-May to early June, with 8' x 35' plots and 12" row spacing using a SeedMaster air drill, or with 12' x 35' plots and 12" row spacing using a ConservaPak air drill. Cultivars and varieties were representative of those used by producers in the area, and recommended seeding practices (i.e. rate, depth) were typically used. Fertility and insect, weed and disease levels were normally kept non-limiting using commercial fertilizers and registered pesticide products so that yields would not be limited by anything other than the specific treatments being evaluated. Plots were desiccated or swathed when required, and harvested as closely as possible to the appropriate timing using a Wintersteiger plot combine, Kincaid-8 XP plot combine, or modified MF300 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 (

Table 3). In the example below, 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 demonstrating how statistical results are presented in the report.

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

Units

Some data are reported in metric terms (i.e. yield responses shown in kilograms per hectare), particularly in cases where it was not practical to convert the values to bushels per acre (bu/ac), as in certain figures. For reference, yield values ranging from 1000-6000 kg/ha are shown with the corresponding values in bu/ac for each crop in Table 4. Alternatively, multiplying the kg/ha by 0.8921 will provide the lbs/ac, making for an easy conversion to bu/ac.

Table 4. Conversion of kg/ha to bu/ac for various crops.

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

Disclaimer

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

Wheat Response to Shallow vs Deep Banded Nitrogen Fertilizer Formulations

Holzapfel, C. (IHARF)

Description

The objectives of this project were (1) to demonstrate the potential benefits, under field conditions, of banding urea at depths of at least 5 cm relative to the shallower banding depths commonly achieved when side-banding is combined with shallow seeding, along with other benchmark practices and (2) to demonstrate the potential benefits, under field conditions, of utilizing a commercially available volatilization/nitrification inhibitor to mitigate the risk of N losses under several contrasting fertilizer placement and timing options. A field demonstration with CWRS wheat was initiated at Indian Head, SK with the first N treatments applied in the fall of 2019 followed by subsequent treatment applications and seeding in spring 2020. The project was repeated in 2021 and 2022 growing seasons. The treatments were a combination of six N fertilizer rates/placement/timing strategies and two N fertilizer formulations, plus a control where no supplemental N was applied. The treatments were arranged in a four replicate RCBD and are described in greater detail in Table 5.

Table 5. Spring wheat nitrogen (N) management treatments evaluated over three growing seasons at Indian Head, Saskatchewan (2020, 2021, and 2022).

#	N Form	Treatment Name	Band Depth	Total N Rate [Z]
1	n/a	control	n/a	7 kg N/ha [Y] + residual
2	Untreated urea	high N side-band	≈3.5 cm (1.5”)	1.5x – 165 kg N/ha
3	Untreated urea	side-band	≈3.5 cm (1.5”)	1.0x – 110 kg N/ha
4	Untreated urea	fall surface broadcast	0 cm (0”)	1.0x – 110 kg N/ha
5	Untreated urea	spring surface broadcast	0 cm (0”)	1.0x – 110 kg N/ha
6	Untreated urea	fall deep-band	≈5.6 cm (2.3”)	1.0x – 110 kg N/ha
7	Untreated urea	fall shallow-band	≈2.5 cm (1”)	1.0x – 110 kg N/ha
8	SUPERU®	high N side-band	≈3.5 cm (1.5”)	1.5x – 165 kg N/ha
9	SUPERU®	side-band	≈3.5 cm (1.5”)	1.0x – 110 kg N/ha
10	SUPERU®	fall surface broadcast	0 cm (0”)	1.0x – 110 kg N/ha
11	SUPERU®	spring surface broadcast	0 cm (0”)	1.0x – 110 kg N/ha
12	SUPERU®	fall deep-band	≈5.6 cm (2.3”)	1.0x – 110 kg N/ha
13	SUPERU®	fall shallow-band	≈2.5 cm (1”)	1.0x – 110 kg N/ha

[Z] Includes residual NO_3-N (0-60 cm) estimated from fall composite soil samples

[Y] Provided by seed-placed 11-52-0 for all treatments

Results

The project demonstrated strong overall responses to N and showed that 110 kg total N/ha (the 1x rate) was not sufficiently high to maximize yield or protein and, as such, appropriate for detecting differences in environmental N losses and/or availability amongst the timing/placement options. The observed responses to the limited number of rates evaluated was reasonably consistent in all three years, despite the lower yield potential in 2021. In actuality, the optimum rate was likely closer to the 1.5x rate used in this project (165 kg N/ha, soil residual NO3-N plus fertilizer) than the 1x rate (110 kg N/ha, soil residual NO3-N plus fertilizer) (Figures 2 and 3); however, this could likely vary across geographic locations. As expected, side-banding proved to be the most effective N management strategy evaluated for both formulations, consistently resulting in amongst the highest grain yields and protein concentrations. Next to side-banding, the best options evaluated were fall in-soil bands; however, this practice generally still resulted in lower yields and, to lesser extent, protein, under the specific conditions encountered. With respect to formulations, the performance of untreated urea and SUPERU® was mostly similar; however, there were important exceptions. Most notably, there was a significant overall advantage to SUPERU® in 2021 which could largely be attributed to the fall broadcast applications. This was the treatment that was expected to be most likely to benefit from a product like SUPERU®, which offers protection against both volatilization and denitrification. In 2022, SUPERU® again appeared to be advantageous over untreated urea with the fall broadcast applications.

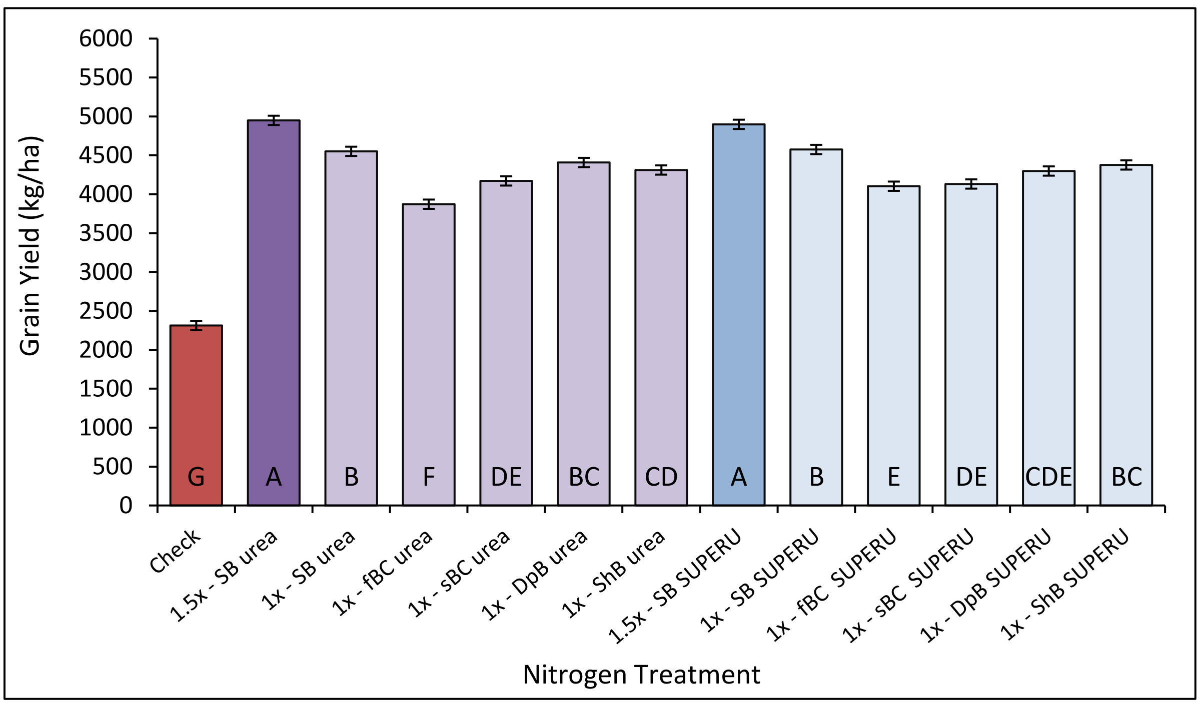

Figure 2. Individual nitrogen treatment means for spring wheat grain yield at Indian Head, averaged over a three-year period (2020, 2021, and 2022). Error bars are the standard error of the treatment means. The 1x rate is 110 kg N/ha (soil + fertilizer) and the 1.5x rate is 165 kg N/ha. SB is side-band, fBC is fall broadcast, sBC is spring broadcast, DpB is fall deep-band, ShB is fall shallow-band.

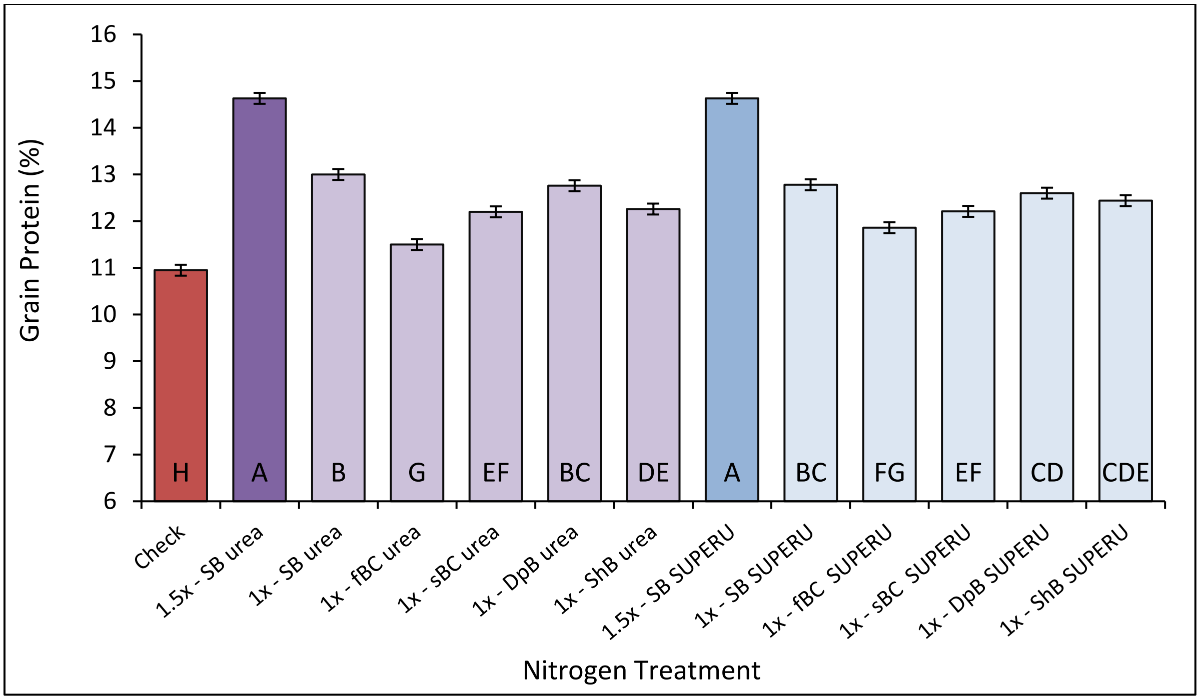

Figure 3. Individual nitrogen treatment means for spring wheat grain protein concentration at Indian Head, averaged over a three-year period (2020, 2021, and 2022). Error bars are the standard error of the treatment means. The 1x rate is 110 kg N/ha (soil + fertilizer) and the 1.5x rate is 165 kg N/ha. SB is side-band, fBC is fall broadcast, sBC is spring broadcast, DpB is fall deep-band, ShB is fall shallow-band.

Conclusions

The relative performance of the demonstrated N management strategies can vary widely with environment; therefore, farmers/agronomists are advised to understand environmental N loss mechanisms and consider options for mitigating those to which they are most vulnerable. This information, along with economic and logistic considerations, will help farmers adopt appropriate N fertilizer management strategies that are tailored to their operation and environmental conditions.

Acknowledgements

This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Fall Rye Cover Crop Effects on Canola Establishment and Response to Nitrogen

Holzapfel, C. (IHARF)

Description

The objectives of this project were to demonstrate the effects of a preceding cereal rye cover crop on 1) the overall establishment and yield of canola in addition to early season weed densities and 2) the nitrogen (N) fertilizer requirements of canola. A field trial was initiated near Indian Head, Saskatchewan in the fall of 2020 and repeated the following growing season. The treatments were a factorial combination of two cover crop scenarios (either no cover crop or a fall rye cover crop) and five N fertilizer rates (25, 60, 105, 140, and 175 kg N/ha). The N fertilizer rates were not adjusted for residual soil NO3-N because of the possibility that cover crops could have an impact on this parameter. The 10 treatments were arranged in a four replicate RCBD.

Results

Due to the extremely dry fall and early-spring, the 2020-21 growing season at Indian Head was not particularly favourable for establishment of a fall rye cover crop. The following 2021-22 growing season had sufficient fall soil moisture and an extremely wet spring, resulting in good cover crop establishment and substantial growth. While the 2021 growing season was warm dry overall, timely rains allowed for reasonably high yield potential. Moisture was generally non-limiting in 2022, and yields were slightly higher than the previous season (Table 6). Soil tests showed trends of slightly lower residual NO_3-N with the cover crop, but the effects were small and could not be confidently attributed to the treatments. The cover crop never reduced weed populations and increased them slightly in 2021, presumably due to late emerging rye seeds under the extremely dry conditions. In 2021, the cover crop negatively affected final plant populations and, to a lesser extent, yield. In 2022, canola emergence and final plant populations declined slightly with increasing rates of side-banded urea but were not consistently affected by cover crop and yields were similar for both cover crop treatments. The cover crop did not appear to affect canola yield response to N rate in either year.

Table 6. Main effect means for cover crop (CC) and nitrogen rate (NR) effects on canola seed yield, seed oil content, and seed protein content at Indian Head in 2021 and 2022. Main effect means followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

	------------------ 2021 ------------------			------------------ 2022 ------------------		
Main Effect	Yield	Oil	Protein	Yield	Oil	Protein
Cover Crop	-- kg/ha --	-------------- % --------------		-- kg/ha --	-------------- % --------------	
None	2218 A	43.7 A	19.0 B	2738 A	42.3 A	18.8 A
Fall Rye	2157 B	43.6 A	19.2 A	2654 A	42.2 A	18.9 A
S.E.M.	59.1	0.10	0.17	70.7	0.19	0.18
Nitrogen Rate						
25 kg N/ha	1050 E	44.6 A	17.5 D	1907 C	43.9 A	17.5 D
60 kg N/ha	1755 D	44.7 A	17.4 D	2490 B	43.3 B	17.7 D
105 kg N/ha	2476 C	43.9 B	18.8 C	2913 A	42.2 C	18.9 C
140 kg N/ha	2739 B	43.1 C	20.2 B	3051 A	41.4 D	19.6 B
175 kg N/ha	2917 A	41.8 D	21.5 A	3120 A	40.4 E	20.5 A
S.E.M.	62.0	0.12	0.19	81.0	0.21	0.20

Conclusions

In conclusion, producers who see merit in doing so are encouraged to be open to incorporating cover crops into their rotations where there is a reasonably high potential for success (i.e., early harvest, good fall soil moisture conditions). That said, if harvest is late and/or the fall is cool and dry, the likelihood of establishment and tangible benefits of the cover is relatively low. Furthermore, in addition to the potential for negative effects on productivity, there is a cost to this practice when seed, fuel, labour, and equipment is considered.

Acknowledgements
This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Spring Cereal Re-seeding Options for Poor Stands of Winter Wheat

Holzapfel, C. (IHARF)

Description

The objective of this project was to demonstrate the agronomic and economic performance of a wide range of winter wheat stands relative to a selection of agronomically suitable spring cereal re-seeding options. A field demonstration with winter wheat was established on canola stubble in the fall of 2021 at Indian Head, Saskatchewan. The treatments were arranged in a four replicate RCBD and were simply six different winter wheat seeding rates (50, 100, 200, 300, 400, and 500 seeds/m2). Three additional treatments were seeded to 100 seeds/m2 and destined to be terminated and re-seeded to spring cereal options. Winter wheat seeding was completed on September 15, and the variety was AAC Goldrush. The target seeding rates and varieties of the spring seeded crops were AAC Synergy barley at 300 seeds/m^2, CDC Arborg oat at 350 seeds/m^2, and Keet canary seed at 45 kg/ha. No additional fertilizer was applied with the spring seeded crops.

Results

The weather in the fall and early-spring was conducive to winter wheat establishment. Not unexpectedly, seedling mortality increased with seeding rate, with 92-97% of the viable seeds establishing into viable plants at the lowest seeding rates and 67-73% survival at the highest seeding rates (Table 7). The final winter wheat populations ranged from 46-333 plants/m^2. While overall establishment was better than expected, the results were reasonably consistent with past research and recommendations in that winter wheat stands of 100 plants/m^2, or even less, can yield remarkably well (Table 7). When populations fell below this level, yields declined substantially and agronomic issues such delayed maturity and weeds began to emerge. Re-seeding was completed on May 23 and, with abundant moisture, all of the options evaluated established and yielded remarkably well. Oats were the most profitable re-seeding option, followed by canary seed, and finally barley. Re-seeding to barley resulted in slightly lower economic returns than the most profitable winter wheat stands but was more profitable than winter wheat at less than 100 plants/m^2. Oats and canary seed were more profitable than all winter wheat treatments, even after the cost of re-seeding was accounted for.

Table 7. Treatment means for seeding rate effects on final plant populations and grain yield of winter wheat at Indian Head in 2022. Means followed by the same letter do not significantly differ (Fisher's protected LSD test, P ≤ 0.05).

Seeding Rate	Final Plant Density	Survival	Grain Yield
viable seeds/m²	-------- plants/m² --------	-------------- % --------------	----------- kg/ha -----------
50	46 f	92	4623 c
100	97 e	97	5641 a
200	168 d	84	5619 a
300	244 c	81	5392 ab
400	291 b	73	5487 ab
500	333 a	67	5267 b
S.E.M.	11.4	–	158.7
Pr > F (p-value)	<0.001	–	<0.001

Conclusions

Factors to consider when deciding how to manage a sub-optimal winter wheat crop include the overall uniformity and viability of the winter wheat, the calendar date when re-seeding can be completed and soil moisture conditions at that time, and the likelihood of the re-seeded crop maturing in time. This project is being repeated in 2022-23 in order to build upon these results for a wider range of environmental conditions.

Acknowledgements

This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Canola Seed Safety and Yield Response to Novel Phosphorus Sources in Saskatchewan Soils

Holzapfel, C. (IHARF), McInnes, B. (NARF), Singh, G. (ICDC), Shaw, L. (SERF), Enns, J. (WARC), Nybo, B. (WCA), and Hall, M. (ECRF)

Description

The objective of this project was to demonstrate canola response to increasing rates of seed-placed phosphorus (P) fertilizer for various formulations. The focus was on both stand establishment and yield. Field trials with canola were conducted over three growing seasons with the project locations varying from year-to-year. Collectively, the project was conducted at 14 sites which were comprised of Indian Head (2020, 2021, and 2022), Melfort (2021 and 2022), Outlook (2021), Redvers (2021), Scott (2020, 2021, and 2022), Swift Current (2020, 2021, and 2022), and Yorkton (2021), SK. The treatments were arranged in a four replicate RCBD and are described in greater detail in Table 8.

Table 8. Treatment descriptions for ADOPT Novel Phosphorus demonstrations completed at 14 sites from throughout Saskatchewan in 2020, 2021, and 2022.

#	Phosphorus Form	Nutrient Analyses	Phosphorus Rate
1	Control	Not applicable	0 kg P_2O_5/ha
2	Monoammonium phosphate	11-52-0	25 kg P_2O_5/ha
3	Monoammonium phosphate	11-52-0	45 kg P_2O_5/ha
4	Monoammonium phosphate	11-52-0	65 kg P_2O_5/ha
5	MicroEssentials® S15	13-33-0-15	25 kg P_2O_5/ha
6	MicroEssentials® S15	13-33-0-15	45 kg P_2O_5/ha
7	MicroEssentials® S15	13-33-0-15	65 kg P_2O_5/ha
8	CrystalGreen®[Z]	5-28-0 + 10% Mg	25 kg P_2O_5/ha
9	CrystalGreen®	5-28-0 + 10% Mg	45 kg P_2O_5/ha
10	CrystalGreen®	5-28-0 + 10% Mg	65 kg P_2O_5/ha
11	50:50 MAP:CrystalGreen®[Y]	8-40-0 + 5% Mg	25 kg P_2O_5/ha
12	50:50 MAP:CrystalGreen®	8-40-0 + 5% Mg	45 kg P_2O_5/ha
13	50:50 MAP:CrystalGreen®	8-40-0 + 5% Mg	65 kg P_2O_5/ha

[Z] CrystalGreen® will commonly be referred to as struvite throughout the report
[Y] Expressed as actual P_2O_5 the ratio is 65:35 MAP:CrystalGreen®

Results

All sites were reasonably low in residual soil P, with less than 15 ppm 93% of the time and less than or equal to 10 ppm 71% of the time. Treatment effects on establishment occurred at approximately 50% of the sites. While the lack of response could sometimes be reasonably explained by soil properties and/or moisture, this was not always the case and confirms the unpredictable nature of seedling injury with in-furrow P fertilizer placement. Where they did occur and when averaged across sites, stand reductions were usually most severe with S15 followed closely by MAP, were less severe with the MAP:CG blend, and were essentially non-existent with 100% CG (Table 9). Across forms and sites, yields increased up to the highest P rate and the responses were similar for all forms except CG applied on its own which performed slightly poorer (Table 9). For individual sites, yield responses to P were at least marginally significant 64% of the time. The non-responsive sites could usually, but not always, be explained a combination of low yields (due to drought) and at least moderately high residual soil P levels. When considering the poor uptake-efficiency in the year of application, P fertilization is also important from a long-term outlook. From an economic perspective, all forms performed reasonably well except 100% GC, due to its higher cost and weaker yield response. On average, the rates required to maintain P fertility over the long-term (i.e., approximately 45 kg P_2O_5/ha) were also profitable.

Table 9. Main effect means for seed-placed phosphorus (P) fertilizer formulation and rate effects on canola emergence, final plant densities, and seed yield when averaged across 14 location-years in Saskatchewan. Means followed by the same letter do not significantly differ (Tukey-Kramer, $P < 0.05$) and the 0 P control treatment was excluded from the factorial analyses.

Main Effect	Spring Plant Density	Final Plant Density	Seed Yield
	---------- plants/m^2 ----------	----------- stems/m^2 -----------	------------- kg/ha -------------
Control (0 P)	71.9	72.2	2200
P Form [Y]			
MAP	63.5 C	63.9 C	2397 A
S15	60.7 D	58.5 D	2429 A
CG	75.1 A	75.4 A	2324 B
MAP:CG	70.4 B	69.9 B	2400 A
kg P_2O_5/ha			
25	70.3 A	70.7 A	2315 C
45	68.0 B	66.9 B	2395 B
65	63.9 C	63.2 C	2452 A

[Z] MAP - monoammonium phosphate (11-52-0); S15 - MicroEssentials® S15 (13-33-0-15); CG - Crystal Green® (5-28-0 + 10% Mg); MAP:CG blend (8-40-0 + 5% Mg)

Conclusions

In conclusion, MAP generally performed as well or better than the options to which it was compared; however, other forms may be advantageous from a logistic/handling perspective (i.e., S15) or with regard to seed safety (i.e. MAP:CG blends) and, as such, will still commonly be a good fit for individual operations.

Acknowledgements

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Managing Drought Risk with Split Applications of Nitrogen in Spring Wheat

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Description

The objective of this study was to demonstrate the efficacy of various rates and timings of split applied N relative to applying all of the N at seeding. Trials at each site were setup in 2022 as a RCBD with four replicates. Sites included were Indian Head, Swift Current, Outlook, Scott, Yorkton, and Melfort, SK. An irrigation site (Outlook) was included in this study to guarantee one scenario where timely "precipitation" was received to move fertilizer into the soil. Table 10a below lists the treatments that were followed at Indian Head, Outlook, Scott and Swift Current. At Yorkton and Melfort the treatment list was modified to accommodate the very high residual levels of soil N which was 104 lb N/ac in the top 24 inches at both locations (Tables 10b and 10c).

Table 10a. Treatment list for Indian Head, Swift Current, Scott, and Outlook.

Trt#	Lb N/ac at seeding (soil+fert N)[a]	Post-emergent UAN[b] (30 lb N/ac)	Post-emergent UAN[b] (60 lb N/ac)	Post-emergent UAN[b] (90 lb N/ac)
1	Soil N	--	--	--
2	80	--	--	--
3	110	--	--	--
4	140	--	--	--
5	170	--	--	--
6	80	--	3-5 leaves (ideal)	--
7	80	--	Early Flag leaf	--
8	80	--	--	3-5 leaves (ideal)
9	80	--	--	Early Flag leaf
10	110	3-5 leaves (ideal)	--	--
11	110	Early Flag leaf	--	--
12	110	--	3-5 leaves (ideal)	--
13	110	--	Early Flag leaf	--

[a]Side banded urea + background soil N (0-24”).
[b]Agrotain added to reduce volatilization loss of N.

Table 10b. Treatment list for Yorkton.

Trt#	Lb N/ac at seeding (soil+fert N)[a]	Post-emergent UAN[b] (30 lb N/ac)	Post-emergent UAN[b] (60 lb N/ac)	Post-emergent UAN[b] (90 lb N/ac)
1	Soil N	--	--	--
2	110	--	--	--
3	140	--	--	--
4	170	--	--	--
5	200	--	--	--
6	110	--	3-5 leaves (ideal)	--
7	110	--	Early Flag leaf	--
8	110	--	--	3-5 leaves (ideal)
9	110	--	--	Early Flag leaf
10	140	3-5 leaves (ideal)	--	--
11	140	Early Flag leaf	--	--
12	140	--	3-5 leaves (ideal)	--
13	140	--	Early Flag leaf	--

[a]Side banded urea + background soil N (0-24”).
[b]Agrotain added to reduce volatilization loss of N.

Table 10c. Treatment list for Melfort.

Trt#	Lb N/ac at seeding (soil+fert N)[a]	Post-emergent UAN[b] (30 lb N/ac)	Post-emergent UAN[b] (60 lb N/ac)	Post-emergent UAN[b] (90 lb N/ac)
1	Soil N	--	--	--
2	Soil N	--	--	--
3	110	--	--	--
4	119	--	--	--
5	149	--	--	--
6	104	--	3-5 leaves (ideal)	--
7	104	--	Early Flag leaf	--
8	104	--	--	3-5 leaves (ideal)
9	104	--	--	Early Flag leaf
10	109	3-5 leaves (ideal)	--	--
11	109	Early Flag leaf	--	--
12	109	--	3-5 leaves (ideal)	--
13	109	--	Early Flag leaf	--

[a]Side banded urea + background soil N (0-24").
[b]Agrotain added to reduce volatilization loss of N.

Results

In the majority of comparisons, this study successfully demonstrated that early season applications of UAN at the 3-5 leaf stage produced more yield and provided greater economic returns compared to late season applications at early flag. While late season applications usually produced more grain protein, this did not provide enough value to compensate for the economic loss of yield that often occurred. Late season applications of UAN were anticipated to be more efficacious when applied to a higher base rate of N but this was not consistently observed. The efficacy of split N differed greatly between sites. Under drought conditions, the most economic approach was to maintain a relatively low level of soil fertility of 80 lb N/ac at Swift Current and 110 lb N/ac at Scott. Increasing N fertility at Swift Current to 140 lb/ac and 170 lb/ac reduced economic returns by $8/ac and $57/ac, respectively. At Scott, supplying the same levels of N fertility reduced economic returns by $11/ac and $58/ac, respectively. These economic losses represent the risk of over applying N at seeding during drought. Of course, the economic cost of split applying N under these conditions was even greater, but producers would not likely apply additional N during drought to incur these costs. In contrast, under applying N at seeding for Indian Head and Outlook, where soil moisture was adequate, came with substantial economic losses if split N could not be applied in season. At Indian Head, the most economic rate was 170 lb N/ac but 140 lb N/ac provided essentially the same return. If N was held back to base rate of 80 lb/ac, and additional N was not dribble banded, the economic loss was $191/ac. Likewise, an economic loss of $113/ac by holding back N to 80 lb/ac would have occurred at Outlook. When split applications at Outlook were applied successfully at the 3-5 leaf stage, economic returns were greatly improved compared to putting all the N down at seeding (between $43/ac and $137/ac depending on comparison). At Indian Head, split applications provided modest economic returns at the 170 lb N/ac level ($14/ac for 90 N on 80 N base; $6/ac for 60 N on 110 N base). However, modest economic losses were observed at the 140 lb N/ac level (-$15/ac for 90 N on 80 N base; -$41/ac for 60 N on 110 N base). If split applications were delayed to early flag, economic losses were greatly increased at Indian Head (-$39/ac to -$95/ac depending on comparison) and economic returns even turned negative for the 140 lb N/ac level at Outlook.

Conclusions

To conclude, split applying N may have potential to increase N use efficiency where dribble banded applications of UAN will be moved into the soil with irrigation. However, there is still a risk UAN would not be applied in a timely manner if excessive precipitation prevents equipment from accessing the field. The benefit of split applications on irrigated land requires further study to determine if the results can be replicated. For dry land farming, holding back on N at seeding will reduce economic loss from over fertilizing during drought. However, no more than 30 lb N/ac should be held back at seeding. The economic risk of holding back too much N and missing the opportunity to dribble band N in a timely manner, should conditions improve, is much greater than losses incurred from over fertilizing the crop by 30 lb N/ac at seeding.

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Sclerotinia Spray Decision Support Tools in Canola

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Description

The objectives of this project were 1) to demonstrate various tools for assessing Sclerotinia stem rot risk in canola and 2) to assess their value in supporting producers with the decision to spray fungicide for Sclerotinia management. The tools being demonstrated included the Spornado sampler from 20/20 Seed Labs, petal testing kit from Discovery Seed Labs, Q-Protect petal test kit from Quantum Genetix, an online Decision Support Tool (CanolaDST.ca), and the Sclerotinia Stem Rot (SSR) checklist from the Canola Council of Canada. These tools have the potential to help producers avoid unnecessary fungicide applications. The demonstration was conducted in commercial fields in Saskatchewan, in cooperation with local producers at each location (R.M. of Indian Head no. 156, R.M. of Trampling Lake no. 380, R.M. of Star City no. 428). Producers were asked to leave an unsprayed strip in their canola fields for the purpose of this demonstration. There were three fields at each of the three locations, a total of 9 fields across the province. Each of the tools were utilized to assess Sclerotinia stem rot risk in each field, at both optimal spray timing (20-30% flower) and late spray timing (50% flower).

Results

At both timings, all the tools generally predicted a low disease risk overall (Tables 11 and 12). A SSR checklist value over 35 indicates a more significant risk, and there were a few fields at this level. There was only one field assessed as moderate disease risk with the decision support tool. Petal test results from Quantum Genetix were all within the low-risk category at Indian Head. Percent infection values from Discovery seed lab's petal test were all in the lowest bracket in their calculator at both Indian Head and Melfort fields. Only one sample came back with trace levels for the Spornado samples at each Indian Head and Melfort locations. Results were very similar between the two timings.

Table 11. Sclerotinia risk assessment values for each field at optimum spray timing (20-30% flower) for each of the tools evaluated in the project in 2022.

Field	SSR checklist	CanolaDST	Quantum (% Positive)	Discovery (% Infected Petals)	Spornado
Indian Head 1	40	High	15	12.5	Detected
Indian Head 2	50	High	2.5	9.9	Not Detected
Indian Head 3	55	High	5	11.6	Trace levels
Melfort 1	50	High	32.5	4.8	Not Detected
Melfort 2	30	Low	10	2.4	Detected
Melfort 3	30	Moderate	2.5	1.6	Trace levels
Scott 1	35	High	22.5	29.3	Trace levels
Scott 2	30	High	82.5	72	Detected
Scott 3	30	High	80	56.7	Trace levels

Table 12. Sclerotinia risk assessment values for each field at late spray timing (50% flower) for each of the tools evaluated in the project in 2022.

Field	SSR checklist	CanolaDST	Quantum (% Positive)	Discovery (% Infected Petals)	Spornado
Indian Head 1	45	High	7.5	18	Trace levels
Indian Head 2	45	High	10	25	Trace levels
Indian Head 3	50	High	22.5	48.5	Trace levels
Melfort 1	35	High	5	11.6	Not Detected
Melfort 2	25	Low	2.5	2.4	Not Detected
Melfort 3	25	Moderate	10	16.2	Trace levels
Scott 1	35	High	10.3	7.3	Trace levels
Scott 2	30	High	57.5	44	Trace levels
Scott 3	30	High	65	38.8	Trace levels

The current project was also conducted as an ADOPT demonstration in 2021. There was little or no sclerotinia development in any of the fields monitored in 2021, and all risk assessment methods correctly identified the risk of sclerotinia development as low in all fields. This contrasts with the conditions experienced in 2022 and so a good opportunity to compare the benefits and effectiveness of the risk assessment methods under each situation. Based on the results of the past two years, we have seen that a higher level of spore detection using either the petal tests or spore sampler is a good

indicator that disease development in the crop is likely. However, a low level of spore detection has not been shown to be a good predictor of the probability of disease on its own, as higher levels of disease was found in fields with low levels of spores detected in all three tests. The SSR checklist indicated a high level of risk in many of the fields in both years, above 30-35 points which is the level at which it is recommended producers consider a fungicide application. A new, improved Sclerotinia Risk Calculator online tool is in development and was tested as part of this project.
In regard to the usefulness of the tests in helping producers with the decision to spray, the main observation from this project was the importance of timing. For planning and logistics reasons, especially with larger operations, the decision to spray must be made at least a few days or more before the date of fungicide application. Thus, if the crop is to be sprayed at the optimum timing of 20-30% flower, samples should be submitted, and results obtained prior to the crop reaching this stage. Courier time is significant; depending on location, there may be an additional day required for samples to be received at the labs, and couriers do not generally operate over the weekend. The appropriate amount of time ahead of a fungicide application required for effective spore detection is also being investigated in separate research.

Conclusions

The main conclusion of this project is that with the current use guidelines under field production conditions, the spore detection methods appear to be accurate under high levels of spore detection but less accurate under low levels of spore detection. The risk assessment tools are more helpful in assessing risk when combined with other tools and methods.

Acknowledgements

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Regional Adaptation and Response to Nitrogen of Hemp and Quinoa in Saskatchewan

Holzapfel, C. (IHARF)

Description

The objectives of this project were 1) to gain experience with and information on the overall productivity and adaptation of two specialty crops, hemp (*Cannabis sativa*) and quinoa (*Chenopodium quinoa*), across a range of soil climatic zones in Saskatchewan, 2) to demonstrate the overall yield response of hemp to increasing nitrogen (N) fertilizer rates, and 3) to demonstrate the overall yield response of quinoa to increasing N fertilizer rates. Field demonstrations with hemp and quinoa were established near Indian Head, Saskatchewan for the 2022 growing season. The treatments were simply five N fertility levels ranging from 60-220 kg N/ha, adjusted for fall residual soil NO_3-N. The specific rates were 60, 100, 140, 180, and 220 kg N/ha (soil plus fertilizer) and the N sources included monoammonium phosphate (11-52-0), ammonium sulphate (21-0-0-24), and urea (46-0-0).

Monoammonium phosphate, ammonium sulphate, and potash rates were held constant across all treatments to provide 28-40-20-20 kg N-P_2O_5-K_2O-S/ha, while the rate of urea was adjusted as required to achieve the target N rates. The rationale for setting the lowest N rate to 60 kg N/ha was to allow for modest soil residual N levels and the N that would be provided by P and S fertilizer sources. All fertilizer was side banded approximately 3.75 cm (1.5") beside and 1.4 cm (0.75") below the seed row. The N fertility treatments were arranged in a separate RCBD for each crop and replicated four times. The plots were seeded directly into oat stubble on June 1 for hemp and May 24 for quinoa. The varieties were X59 hemp and NQ Red quinoa seeded at 49 kg/ha and 11 kg/ha, respectively.

Results

Overall, the 2022 growing season at Indian Head was quite favourable, with relatively high yield potential for both crops. Focussing on hemp, N fertilizer rate had no impact on plant densities; however, stands were poorer than targeted due to wet conditions at seeding followed by an extended period of dry weather. Hemp height increased quadratically from 121 cm at 60 kg N/ha to 146 cm at 220 kg N/ha, but height increases began slowing down at 140 kg N/ha. The yield response to N was somewhat stronger than expected for hemp, increasing linearly right to the highest rate of 220 kg N/ha by a magnitude of 960 kg/ha or 108% over the 60 kg N/ha rate (Figure 4). The maximum yield was 1853 kg/ha, which was likely above the average that could be expected for this region. For quinoa, emergence was excellent with mean plant densities of 143-180 plant/m^2. Despite this range, no differences between treatments were significant and there were no trends in terms of an N rate effect. Quinoa height increased quadratically from 110 cm at 60 kg N/ha to 146-149 cm at 180-220 kg N/ha. The quinoa yields followed a similar trend as height, peaking at 180 kg N/ha but starting to level off at approximately 140 kg N/ha (Figure 5). The top yield was 2134 kg/ha compared to 1233 kg/ha at 60 kg N/ha, an increase of 788 kg/ha or 64%.

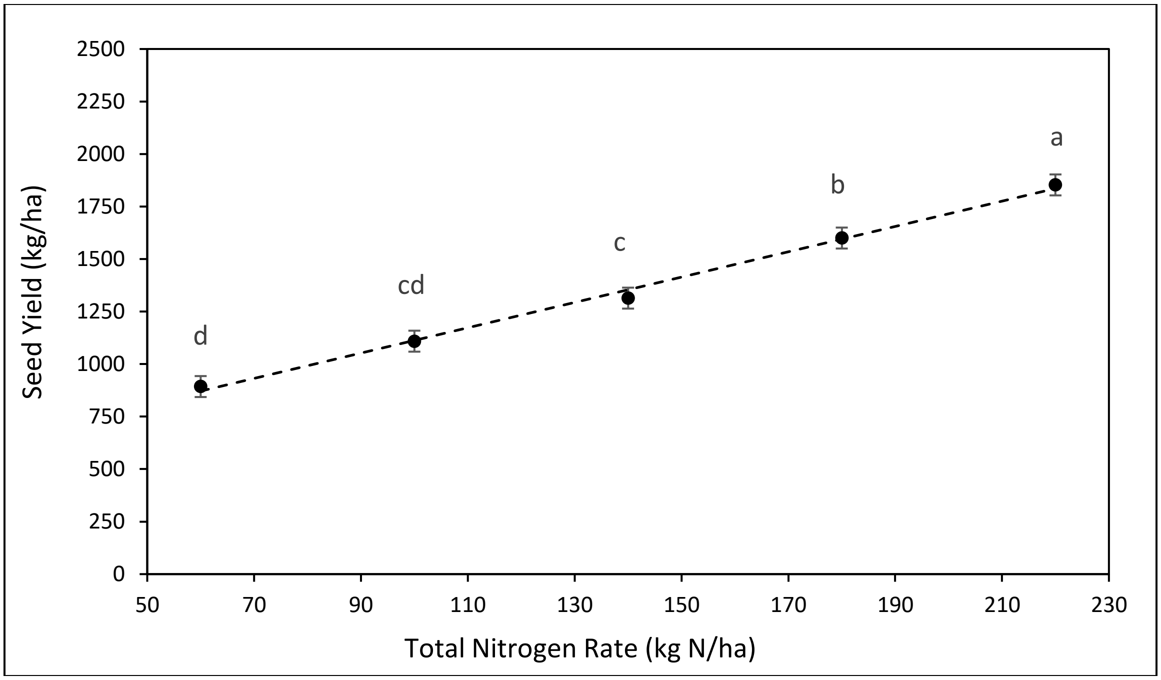

Figure 4. Side-banded nitrogen (N) rate effects on hemp seed yield at Indian Head in 2022.

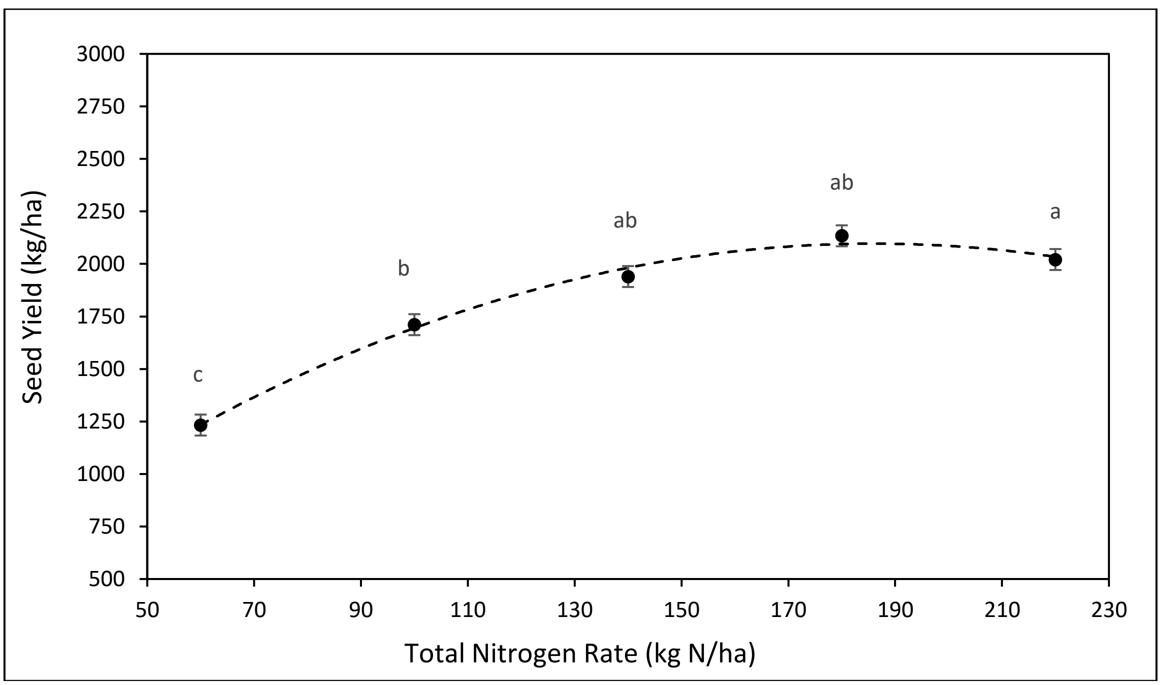

Figure 5. Side-banded nitrogen (N) rate effects on quinoa seed yield at Indian Head in 2022.

Conclusions

These results show promise for both crops in the thin-Black soil zone; however, producers should recognize that the yields reported are likely above average for the region and should research potential challenges with these crops prior to committing to growing them on a commercial scale.

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Oat Varietal Response to PGRs

McInnes, B. (NARF) and Holzapfel, C. (IHARF)

Description
The objective of this project was to demonstrate the response of different oat milling varieties to applications of the registered plant growth regulators Moddus® and Manipulator®. The demonstration was conducted at Melfort and Indian Head, SK in 2022. Both sites are located in the black soil zone. The small-plot demonstration was set-up as a factorial RCBD with four replicates. The factorial combination consisted of two factors, which were variety and plant growth regulator (PGR). The varieties were CS Camden, CDC Dancer, CDC Arborg, and Summit, while the PGRs used were either no PGR, Moddus®, or Manipulator®. The four varieties used differed in varietal characteristics for height and lodging. The two taller varieties were CDC Arborg and CDC Dancer, and the two shorter varieties were CS Camden and Summit. Of these varieties CDC Arborg and CS Camden have very good lodging resistance, while CDC Dancer and Summit only have good lodging resistance. The treatments are listed in the Table 13.

Table 13. Treatments used in oat varietal response to plant growth regulators at Melfort and Indian Head, SK in 2022.

Treatment #	Plant Growth Regulator[x]	Variety
1	No PGR	CS Camden
2		CDC Dancer
3		CDC Arborg
4		Summit
5	Moddus® [y]	CS Camden
6		CDC Dancer
7		CDC Arborg
8		Summit
9	Manipulator® [z]	CS Camden
10		CDC Dancer
11		CDC Arborg
12		Summit

[x] PGRs were applied in a single application at GS 31 (1st node detectable)
[y] Moddus was applied at 0.83L/ha
[z] Manipulator was applied at 2.3L/ha

Results

Data collection consisted of plant density, height, days to maturity (DTM), lodging, grain yield, test weights (TW) and thousand kernel weights (TKW). When variety was significant, varieties generally performed as expected based on their characteristics in the Saskatchewan Seed Guide with respect to height, lodging, yield, and test weight. When PGR was significant, PGR applications reduced height, lodging, TW, and TKW, while sometimes increasing DTM and grain yield. When there was a significant two-way interaction between variety and PGR, taller varieties had greater height reductions with Moddus® and shorter varieties had similar height reductions regardless of product at Melfort; however, at Indian Head the two varieties with lesser lodging resistance were the only varieties with significant height reduction when Manipulator® was applied. Lastly, the significant two-way interaction for lodging at Melfort was that varieties with lesser lodging resistance demonstrated greater reductions in lodging when a PGR was applied as compared to varieties with greater varietal resistance to lodging.

Conclusions

Overall, there were many significant differences amongst the data collected that suggest there was a difference in oat varietal response to PGRs for crop height and lodging, and that PGR applications may result in height, TW, TKW, and lodging reductions with the potential to increase DTM and grain yield.

Acknowledgements

This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Are Oats Responding to Higher Levels of Macronutrients

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Description

The objective of this project was to demonstrate the response of a modern oat variety to the historically recommended rate of 60 lb N/ac against the more recent recommendation of 90 lb N/ac and to determine the relative importance of combining phosphorus (P), potassium (K) and sulphur (S) with these different nitrogen (N) recommendations in eastern Saskatchewan. The influence of treatments on oat yield, lodging and test weight were determined. The demonstration was conducted at Indian Head, Melfort, Redvers, and Yorkton, SK in 2022. At each location, the trial was setup as a 4 x 3 factorial RCBD with four replications. The first factor evaluated different combinations of P, K, and S. The four PKS fertility regimes tested were:

1. PKS added (40 lb P_2O_5/ac + 15 lb K_2O + 10 lb S/ac)
2. Sulphur limited - PK added (40 lb P_2O_5/ac + 15 lb K_2O)
3. Potassium Limited - PS added (40 lb P_2O_5/ac + 10 lb S/ac)
4. Phosphorus Limited - KS added (15 lb K_2O + 10 lb S/ac)

The second factor evaluated N rates of 17, 60 and 90 lb/ac. Care was taken ensure N rates for each PKS fertility regime were balanced, by adjusting rates of urea to account for N contributions from P and S fertilizers. Factorial treatments along with a “no fertilizer check” are listed in Table 14.

Table 14. Treatment list of oat macronutrient trial conducted at Indian Head, Melfort, Redvers, and Yorkton in 2022.

Trt#	Seed-placed box 1	Side-band box 1	Side-band box 2	Total N
1	none	none	none	
Nitrogen response with full rates of PKS				
2	40 lb P_2O_5/ac	15 lb K_2O/ac + 10 lb S/ac	0 lb N/ac	17 lb/ac
3	40 lb P_2O_5/ac	15 lb K_2O/ac + 10 lb S/ac	43 lb N/ac	60 lb/ac
4	40 lb P_2O_5/ac	15 lb K_2O/ac + 10 lb S/ac	73 lb N/ac	90 lb/ac
Nitrogen response with Sulphur limitation				
5	40 lb P_2O_5/ac	15 lb K_2O/ac	8.5 lb N/ac	17 lb/ac
6	40 lb P_2O_5/ac	15 lb K_2O/ac	51.5 lb N/ac	60 lb/ac
7	40 lb P_2O_5/ac	15 lb K_2O/ac	81.5 lb N/ac	90 lb/ac
Nitrogen response with Potassium limitation				
8	40 lb P_2O_5/ac	10 lb S/ac	0 lb N/ac	17 lb/ac
9	40 lb P_2O_5/ac	10 lb S/ac	43 lb N/ac	60 lb/ac
10	40 lb P_2O_5/ac	10 lb S/ac	73 lb N/ac	90 lb/ac
Nitrogen response with Phosphorus limitation				
11	None	15 lb K_2O/ac + 10 lb S/ac	8.5 lb N/ac	17 lb/ac
12	None	15 lb K_2O/ac + 10 lb S/ac	51.5 lb N/ac	60 lb/ac
13	None	15 lb K_2O/ac + 10 lb S/ac	81.5 lb N/ac	90 lb/ac

Results

Applying 90 lb/ac of N was the most economical rate at Indian Head and Melfort. Increasing added N from 17 lb/ac to 90 lb/ac at Indian Head and Melfort increased yield by 34% and 14%, respectively (Table 15). Indian Head site was highly responsive as soil reserves of N were very low (18 lb N/ac). Despite very high residual N at Melfort (104 lb N/ac), this site was also reasonably responsive to added N due to its very high yield potential. At Redvers, 60 lb N/ac was the most economic rate of N which increased yield by 19% compared to the 17 lb N/ac rate. In contrast, the most economical rate of N at Yorkton was only 17 lb/ac. Despite a high yield potential, the Yorkton site was unresponsive to added N, which was likely the result of high reserves of soil N (104 lb N/ac) and hail damage reducing yield potential. While increasing rates of N to 90 lb/ac reduced test weights into the discount range at Yorkton and Indian Head, discounts were not applied to the economic analysis as low test weight may not have been a reality for producers who may blow more light seed out the back of the combine than what we do with plot work. No significant yield responses to added P, K or S occurred at any site even though yield potentials were high. However, there were some numeric yield losses when limiting various nutrients that lead to reductions in net returns. An economic response to 40 lb P_20_5/ac was observed at Melfort despite high levels of soil test P. At Yorkton and Redvers, economic responses to 15 lb K_20/ac were achieved despite very high soil test K at both locations. At Indian Head, the application of 10 lb

S/ac proved economical, but the application of P did not despite soils testing low for P. Added P, K or S did not have significant or consistent effects of test weight.

Table 15. Main effects of fertilizer on oat yield at multiple locations in 2022.

Main effect	Yield (kg/ha @ 13.5%)			
	Indian Head	Melfort	Redvers	Yorkton
No Fertilizer[y]	4178	6065	4394	5385
Levels of PKS (PKS)				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	5470	7189	6094	5367
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	5388	7220	6121	5372
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	5518	7164	6017	5242
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	5410	6945	6167	5530
LSD	NS	NS	NS	NS
P-values[z]	NS	NS	NS	NS
Total Nitrogen (N)				
17 lb/ac	4538 c	6600 c	5443 b	5379
60 lb/ac	5681 b	7238 b	6498 a	5268
90 lb/ac	6121 a	7551 a	6358 a	5487
LSD	143	285	198	NS
P-values[z]	<0.0001	<0.0001	<0.0001	NS
PKS by N P-values[z]	NS	NS	NS	NS

[Y]No fertilizer check is for reference and is not part of statistical analysis
[Z] p-values ≤ 0.05 indicate that a treatment effect was significant and not due to random variability

Conclusions

In conclusion, the application of 90 lb N/ac can be the most economical if soil reserves of N are low (<30 lb N/ac) or the yield potential of oats is very high. Lodging was not substantial problem in this study, but producers must still consider this risk based on their own field experience. Responses to P, K, S were variable and would not have always been predicted based on soil test results. The response of oats to added N was not influenced by the level of P, K and S.

Acknowledgements
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Canaryseed Varietal Response to Agronomic Inputs

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Description

The main objective of the demonstration was to demonstrate the response of hairy versus hairless canary seed varieties to different agronomic inputs. The demonstration was conducted at Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022. Swift Current was the only site in the brown soil zone, with the remaining sites located within the black soil zone. The demonstration was set-up as a factorial RCBD with four replicates. The factorial combination consisted of three factors, which were variety (Hairy vs. Hairless), seeding rate (400 seeds/m^2 vs. 620 seeds/m^2), and potash (KCl) (0 kg/ha vs. 45 kg/ha) (Table 16). The hairy variety used was Keet and the hairless variety used was CDC Lumio. All potash was side-banded at the time of seeding.

Table 16. Treatments used in Canary Seed varietal response to agronomic inputs at Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022.

Treatment #	Variety (End use)	Seeding Rate (seed/m^2)^x	Added KCl (kg/ha)
1	Hairless (Human)	400	0
2	CDC Lumio	400	45
3		620	0
4		620	45
5	Hairy (Birdseed)	400	0
6	Keet	400	45
7		620	0
8		620	45

^{x} 400 seeds/m^2 is approximately 35 kg/ha of seed while 620 seeds/m^2 is approximately 55 kg/ha.

Results

Data collection consisted of plant density, lodging, days to maturity, and seed yield. When variety was significant, results were often consistent across sites whereby the hairy variety had greater plant densities, decreased lodging, longer days to maturity, and increased seed yields as compared to the hairless variety. Increasing seeding rate only significantly increased plant density, and the addition of potash only significantly increased yield at one site. The only significant varietal interactions were that the hairy variety was more responsive to increases in seeding rate as plant densities and yield were increased at the higher seeding rate. The addition of potash also decreased lodging in the hairless variety, and yield declined at one site when potash was applied to the hairless variety. Canaryseed yield response to variety and agronomic inputs is shown in the Table 17. In this demonstration, differences in varietal responses to agronomic inputs were less frequent than anticipated, as significant differences were more often a result of variety alone rather than the interaction between variety and agronomic inputs.

Table 17. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

2-way interaction	Yorkton	Melfort	Swift Current	Indian Head
	Grain Yield (kg/ha)[z]			
Var × SR	*NS*	*NS*	*0.0463**	*NS*
Var × KCl	*NS*	*NS*	*NS*	*0.0113**
KCl × SR	*NS*	*NS*	*NS*	*0.0249**
Var × SR				
400 × Hairless	2710.1a	2788.5a	535.7b	2840.2b
400 × Hairy	2626.4ab	3038.4a	464.3b	3367.6a
620 × Hairless	2328.6c	2725.8a	798.8a	2822.3b
620 × Hairy	2434.2bc	3077.5a	906.6a	3254.9a
Var × KCl				
Hairless × no potash	2615.5a	2729.4a	503.3b	2890.5b
Hairless × potash	2721.0a	2784.9a	496.7b	2772.0c
Hairy × no potash	2274.9b	3059.5a	815.9a	3282.1a
Hairy × potash	2487.9ab	3056.4a	889.4a	3340.3a
SR × KCl				
400 × no potash	2497.8ab	2923.0a	643.4a	3157.4a
400 × potash	2540.9ab	2903.8a	691.0a	3050.4b
620 × no potash	2392.6b	2865.9a	675.7b	3015.2b
620 × potash	2668.0a	2937.5a	695.1b	3061.9b

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Conclusions

Overall, there were many significant differences amongst the data collected between the different market classes of canary seed; however, there were very rarely significant interactions that suggested these varieties respond differently to agronomic inputs consistently across different locations.

Acknowledgements

This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Flax Response to Non-Traditional Nitrogen Fertilizer Management Strategies

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Description

The objectives of this project were to 1) demonstrate flax yield response to a range of nitrogen fertilizer rates for a variety of Saskatchewan locations, 2) demonstrate the seed-safety and potential yield benefits of polymer coated urea (ESN) relative to urea when side-banded at high rates, and 3) demonstrate the potential merits of utilizing split-applications of nitrogen in flax to reduce the likelihood of seedling injury and lodging while potentially enhancing yield. In the spring of 2021, flax field trials were initiated with locations at Indian Head, Melfort, Redvers, Swift Current, Yorkton, and Scott, SK. The project was repeated at all locations except for Scott in 2022. The treatments were selected to explore flax response to a range of N fertilizer rates (17-130 kg N/ha), contrasting fertilizer forms (untreated urea versus polymer coated urea – ESN®) at the higher rates, and split-applications of N with the post-emergent treatments applied during either the vegetative (4-10 cm tall) or early reproductive (bud formation/early flower) stages, with and without a volatilization inhibitor (NBPT; Agrotain®). The treatments were arranged in a four replicate RCBD and are described in greater detail in Table 18.

Table 18. Treatments evaluated in ADOPT nitrogen management demonstration in flax (2021 and 2022).

Trt#	Name	kg N-P_2O_5-K_2O-S/ha	Comments
1	Check	17-40-0-11	- N from 77 kg/ha MAP and 42 kg/ha AS
2	Low N – urea	55-40-0-11	- all N side-banded as either untreated urea or a blend of 75% ESN:25% untreated urea
3	Medium N – urea	80-40-0-11	
4	High N – urea	105-40-0-11	
5	High N – 75% ESN	105-40-0-11	
6	Ultra N – urea	130-40-0-11	
7	Ultra N – 75% ESN	130-40-0-11	
8	Split – early in-crop urea	105-40-0-11	- 55 kg N/ha side-banded and 50 kg N/ha broadcast as untreated urea or Agrotain when the flax is 4-10 cm tall
9	Split – early in-crop Agrotain	105-40-0-11	
10	Split – late in-crop urea	105-40-0-11	- 55 kg N/ha side-banded and 50 kg N/ha broadcast as untreated urea or Agrotain when the flax is budding to starting to flower
11	Split – late in-crop Agrotain	105-40-0-11	

Results

Due to issues with drought, high residual N levels, salinity, and/or errors during treatment applications, data from Scott, Swift Current, and Yorkton in 2021 were removed from the analysis. This left a total of eight-site years including Indian Head (IH), Melfort (ME), and Redvers (RV) in both 2021 and 2022 and Swift Current (SW) and Yorkton (YK) in 2022 and are discussed in the current report. The 2021 growing season was considered dry at all locations. In contrast, Indian Head, Melfort, Redvers, and Yorkton in 2022 were wetter than normal, and Swift Current in 2022 being considered somewhat dry. High rates of side-banded urea negatively impacted emergence at 50% of the sites, the exceptions being Indian Head (both years), Redvers 2022, and Yorkton 2022. Where they occurred, the magnitude of these reductions ranged from 11-32%. As hypothesized, substituting side-banded urea with the ESN® blend frequently reduced the stand reductions associated with side-banded urea and utilizing split-applications also helped in this regard. Lodging only occurred at one site and increased with N rate but was not alleviated by either the ESN® blend or split applications. When averaged across treatments, yields ranged from 1171-3072 kg/ha and responses to N fertilization occurred, to varying degrees, at all locations (Table 19). Where responses occurred, maximum yields were achieved with 55-130 kg N/ha, but yields were generally levelling off at 55-105 kg N/ha.

Table 19. Overall tests of fixed effects and mean flax seed yields as affected by nitrogen (N) treatment at Indian Head (IH), Melfort (ME), Redvers (RV), Swift Current (SW), and Yorkton (YK), in 2021 and 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Source / Treatment		IH-2021	IH-2022	ME-2021	ME-2022	RV-2021	RV-2022	SW-2022	YK-2022
		---------- Pr > *F* (p-values) ----------							
#	Treatment	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.019	0.019
		---------- Seed Yield (kg/ha) ----------							
1	Check	793 b	1964 d	1438 b	2188 d	903 b	1689 b	1374 b	2714 b
2	Low N – urea	1075 a	2662 c	1654 a	3033 ab	1300 a	2548 a	1501 ab	3022 ab
3	Med N – urea	1130 a	2999 b	1780 a	3186 a	1208 ab	2948 a	1415 ab	3081 ab
4	High N – urea	1328 a	3231 a	1715 a	3223 a	1276 ab	2770 a	1477 ab	3103 ab
5	High N – polymer	1243 a	3061 ab	1731 a	3245 a	1278 a	2620 a	1447 ab	3174 a
6	Ultra N – urea	1239 a	3194 a	1831 a	3297 a	1148 ab	2810 a	1435 ab	3152 a
7	Ultra N – polymer	1233 a	3150 ab	1794 a	3310 a	1355 a	2726 a	1448 ab	3064 ab
8	Split – early urea	1209 a	3150 ab	1749 a	2648 c	1336 a	2775 a	1541 ab	3122 a
9	Split – early NBPT	1194 a	3119 ab	1705 a	2892 bc	1234 ab	2806 a	1518 ab	3084 ab
10	Split – late urea	1226 a	3165 ab	1712 a	2867 bc	1397 a	2520 a	1476 ab	3064 ab
11	Split – late NBPT	1213 a	3146 ab	1658 a	2822 bc	1338 a	2554 a	1580 a	3209 a

Conclusions

Despite the occasional improvements in establishment, yield benefits were never realized by substituting side-banded urea with the ESN® blend or with split applications of N. There was occasional, weak evidence that flax responded better to in-crop N applied during the vegetative versus the reproductive growth stages and to Agrotain treated urea versus untreated urea. However, in most cases, the form or timing of in-crop N did not matter and, in one case and on average, the split applications did not yield as well as when all the N was side-banded.

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Reduction of Cadmium Uptake in Flax Using Agronomic Strategies

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Description

The objective of this project was to demonstrate the efficacy of zinc (Zn) and calcium (Ca) fertilization for reducing cadmium (Cd) levels in flaxseed. Varying rates of zinc sulphate ($ZnSO_4$) and gypsum ($CaSO_4 \cdot 2H_2O$) were applied and evaluated for their effect on cadmium accumulation in harvested flaxseed. The project was carried out at Scott, Yorkton, Indian Head, and Redvers, SK in 2022. Prior to seeding, soil tests were conducted at each site to determine the level of cadmium in the soil. Additionally, since commercial phosphate fertilizers naturally contain cadmium and can be a major source of cadmium addition to the soil, a sample of the fertilizer MAP (Monoammonium phosphate) used at each site was sent to the lab for cadmium testing. The flax variety used was Prairie Thunder, a high cadmium-accumulating variety. The field trials were set up as a RCBD with four replicates and seven treatments. The treatments are listed in the Table 20.

Table 20. Treatments and rates used for the project.

Trt #	Trt Description	Rate of Trt	Rate of product applied*
1	Untreated control - no zinc, no gypsum	-	-
2	Zn - 1× rate	2.5 kg/ha Zn	7.04 kg/ha $ZnSO_4$ product
3	Zn - low rate (0.5× rate)	1.25 kg/ha Zn	3.52 kg/ha $ZnSO_4$ product
4	Zn - high rate (2× rate)	5 kg/ha Zn	14.08 kg/ha $ZnSO_4$ product
5	Gypsum - 1× rate	107 kg/ha gypsum	133.75 kg/ha gypsum product
6	Gypsum - low rate (0.5× rate)	53.5 kg/ha gypsum	66.88 kg/ha gypsum product
7	Gypsum - high rate (2× rate)	214 kg/ha gypsum	267.5 kg/ha gypsum product

*Amount of product was calculated based on information from the product suppliers that the zinc sulphate product contained 35.5% zinc and the gypsum product contained 80% gypsum. The gypsum product contained 20% calcium.

Results

Soil and MAP fertilizer tests revealed a huge variation in Cadmium levels between sites. Cadmium levels in soil ranged from negligible (<0.1 ppm) at Redvers to 0.5 ppm at Yorkton. Cadmium levels in the MAP fertilizer ranged from 26.2 ppm at Scott to 43.4 ppm at Yorkton. Depending on the rate of application of MAP at each site, the amount of cadmium applied ranged from 0.003 lb/ac at Scott and Yorkton to 0.006 lb/ac at Indian Head. In evaluation of plant traits, none of the treatments were found to have toxicity effects on flax as emergence, height, and yield did not vary significantly between treatments at any of the sites. In comparing the effects of treatments on Cd accumulation in harvested flaxseed, Redvers was the only site that had seed Cd levels for all treatments under the MRL of 0.5 ppm set by the European Union (Figure 6). Significant differences between treatments were only observed at Yorkton, where zinc applied at 2× rate resulted in a significantly reduced seed Cd content compared to zinc applied at 1× rate and gypsum applied at 2× rate. So far, the efficacy of these treatments was questionable and there is need to test in another field season.

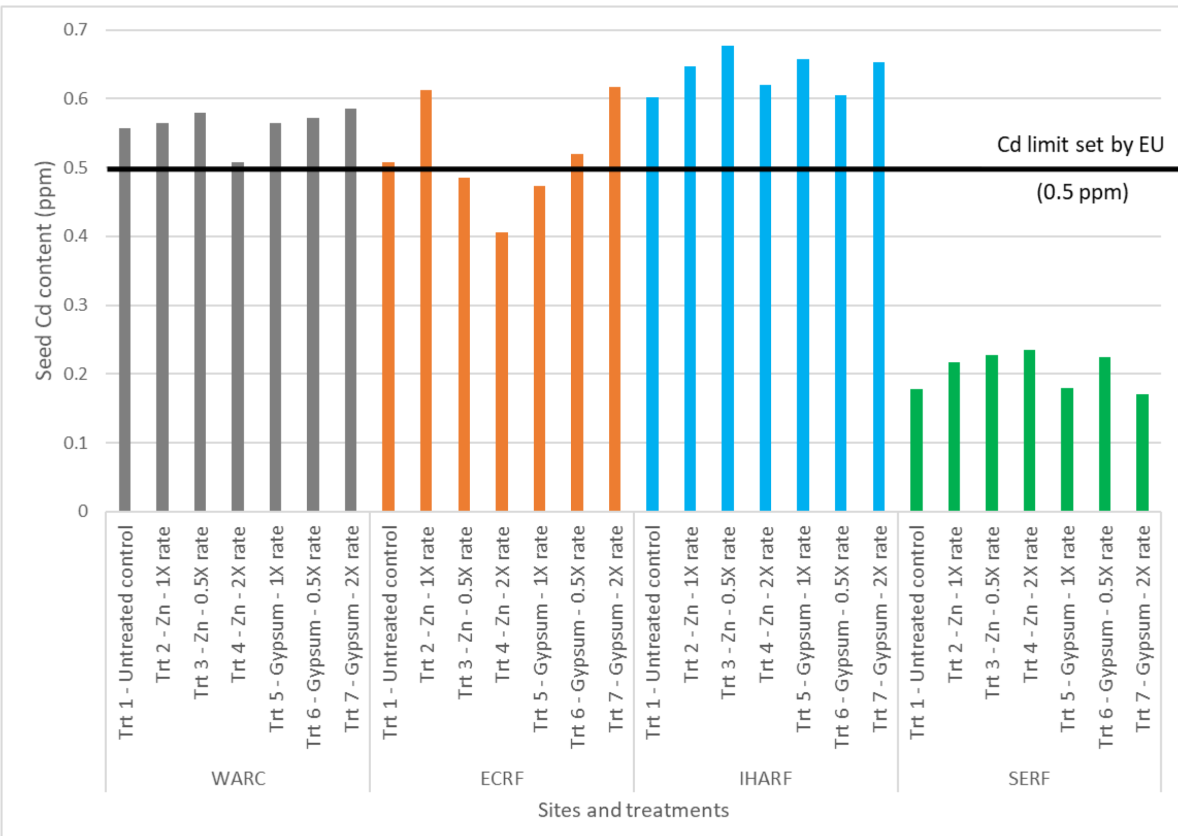

Figure 6. Cadmium accumulation in harvested flaxseed for various treatments at four different sites in the trial. Thick black line indicates maximum limit for cadmium in linseed set by the European Union (0.5 ppm).

Conclusions

Soil and MAP fertilizer samples analysed for Cd content confirmed that Cd levels vary drastically across Saskatchewan soils and in different samples of MAP. These differences in Cd levels in soil and MAP

fertilizer were reflected in how Cd accumulated in harvested flaxseed at different sites, several of which had flax Cd levels higher than the MRL of 0.5 ppm set by the EU.
Treatment of flax with varying rates of zinc and gypsum showed no statistically significant differences on plant establishment and plant height between treatments at any site. Treatment effect on yield was also not statistically significant. Furthermore, none of the treatments at any site were effective at significantly reducing seed Cd content compared to untreated control, thus making the treatments less economically worthwhile.

Acknowledgements
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Enhanced Barley Variety Trials: Fungicide Screening

Hall, M. (ECRF), Sorestad, H. (ECRF), Holzapfel, C. (IHARF), Catellier, C. (IHARF), Hnatowich, G. (ICDC), Singh, G. (ICDC), McInnes, B. (NARF), Nybo, B. (WCA), Wall, A. (WCA), Lokken, R. (CLC), and Enns, J. (WARC)

Description
The objective of this demonstration is to compare the responsiveness of three malt and three feed barley varieties to fungicide applied at heading (FHB timing). The trials were established at Swift Current, Scott, Indian Head, Prince Albert, Yorkton, Melfort, and Outlook, SK in 2022 as a split-plot design with four replicates. The main plot factor compared no fungicide against an application of fungicide at early heading for the control of leaf disease and fusarium head blight (FHB). The subplot factor was variety. All individual treatments are listed in Table 21. N rates at each site were soil N (0-24") + added N equalled 100 lb N/ac at Swift Current (low yielding group), 120 lb N/ac at Scott, Indian Head, Prince Albert (mid-range group), and 130 lb N/ac at Yorkton, Melfort, and Outlook (high yielding group).

Table 21. Treatment list for fungicide by barley variety trial in 2022.

Trt#	Variety	Type	Fungicide[1]
1	AAC Synergy	Malt	None
2	AAC Connect	Malt	None
3	CDC Fraser	Malt	None
4	CDC Austenson	Feed	None
5	Claymore	Feed	None
6	Oreana	Feed	None
7	AAC Synergy	Malt	Yes
8	AAC Connect	Malt	Yes
9	CDC Fraser	Malt	Yes
10	CDC Austenson	Feed	Yes
11	Claymore	Feed	Yes
12	Oreana	Feed	Yes

[1]Fungicide applied was to either be Prosaro or Caramba, applied at early heading (FHB timing).

Results

While levels of leaf disease were relatively low, application of fungicide tended to reduce the incidence of leaf disease at all locations. Leaf disease was reduced the most by fungicide for Oreana at Indian Head (Figure 7). Despite reducing leaf disease, the application of fungicide rarely increased yield. However, fungicide did numerically increase yield for Claymore, Oreana and CDC Fraser at Indian Head and yield of Oreana was significantly increased at Outlook. Grain protein was not affected by fungicide since yield was rarely affected. If yield is not increased, then an effect on protein would not be anticipated. Overall, fungicide did not affect lodging in this study, but lodging levels were low. However, fungicide reduced lodging for Oreana and Claymore at Indian Head. Claymore and particularly Oreana were frequently associated with higher levels of leaf disease. This would be anticipated as these varieties have a poor leaf disease package compared to the other varieties. The use of fungicide was more often beneficial for Claymore and Oreana in terms of leaf disease control, yield and lodging. This may be related to their greater susceptibility to leaf disease. However, if FHB was present, fungicide reduced DON for varieties with an Intermediate or lower level of resistance to FHB. At Indian Head, the application of fungicide was able to bring the DON levels for CDC Fraser and CDC Austenson, with Intermediate resistance to FHB, down from 1.05 ppm to less than 0.3 ppm making them acceptable for malt.

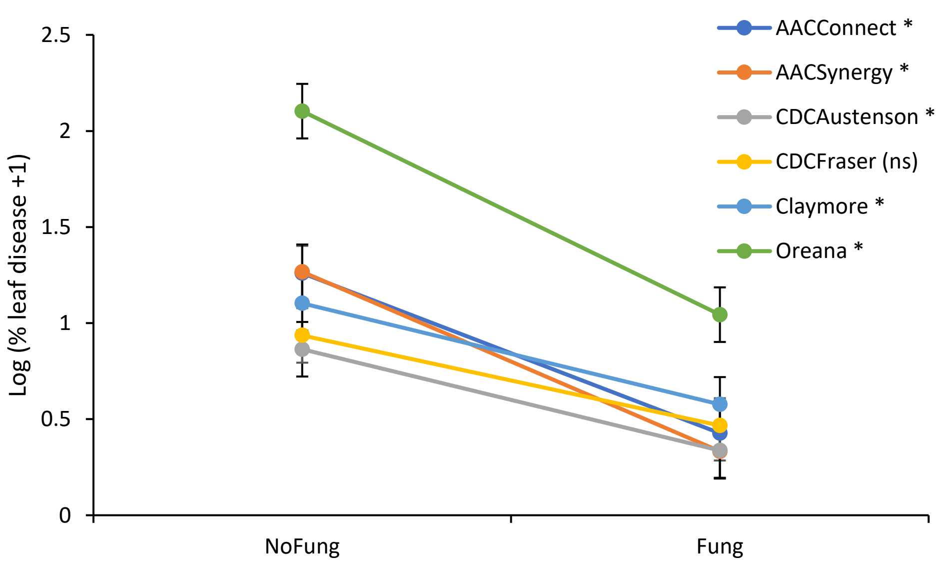

Figure 7. The interactive effect of variety and fungicide application on leaf disease at Indian Head. An asterisk shown beside the variety name indicates that the leaf disease was significantly different with and without fungicide application. NS indicates that leaf disease did not differ with fungicide application. Error bars indicate the standard error.

Conclusions

The poorer the leaf disease package and level of resistance to FHB, the more likely the variety would benefit from fungicide. Oreana was a variety that frequently benefited from the use of fungicide, whereas AAC Connect was not.

Acknowledgements
This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Enhanced Barley Variety Trials: PGR Response

Japp, M. (Sask Barley), McInnes, B. (NARF), Singh, G. (ICDC), Lokken, R. (CLC), Enns, J. (WARC), Catellier, C. (IHARF), and Holzapfel, C. (IHARF)

Description
The objective of this demonstration was to compare the responsiveness of three malt and three feed barley varieties to a plant growth regulator (PGR) applied at early stem elongation (Zadoks 30-32). The demonstration was conducted at five locations including Melfort, Indian Head, Prince Albert, Outlook, and Scott, SK in 2022. Scott and Outlook are in the dark brown soil zone, with the remaining sites located in the black soil zone. The demonstration was set-up as a split-plot with twelve treatments and four replications at all locations (Table 22). The main plot of the split-plot was the application of a plant growth regulator, and the sub-plot was barley variety. Nitrogen was applied based on yield potential of the site where Melfort and Outlook were considered high yield potential and applied 146 kg of N/ha (soil + applied) and Prince Albert, Indian Head, and Scott were considered mid-range yield potential and applied 135 kg N/ha (soil + applied).

Table 22. Treatments used in enhanced barley variety trials-plant growth regulators at multiple locations in 2022.

Trt #	Variety	Type	PGR[1]
1	AAC Synergy	Malt	None
2	AAC Connect	Malt	None
3	CDC Fraser	Malt	None
4	CDC Austenson	Feed	None
5	Claymore	Feed	None
6	Oreana	Feed	None
7	AAC Synergy	Malt	Yes
8	AAC Connect	Malt	Yes
9	CDC Fraser	Malt	Yes
10	CDC Austenson	Feed	Yes
11	Claymore	Feed	Yes
12	Oreana	Feed	Yes

[1]PGR applied was Moddus (Trinexapac-ethyl) at GS 30-32 (stem elongation)

Results
Data collection in the demonstration consisted of plant density, height, lodging, grain yield, protein, test weight, seed weight, and percent plumps. Plant density was significantly affected by variety at two sites, whereas AAC Synergy and Claymore had higher plant densities as compared to AAC Connect at both sites and CDC Fraser at one site. Height was significantly reduced for all varieties across all sites with the

application of a PGR, except for the variety Oreana. This may have been due to the fact that Oreana was significantly shorter than all other varieties without a PGR application. Lodging only occurred at Outlook and Indian Head, where lodging was significantly reduced with a PGR application across varieties when sites were analyzed individually. Grain yield was significantly different between varieties at Melfort, Indian Head, and Prince Albert, but was significantly increased for CDC Austenson when a PGR was applied at Outlook and when sites were combined (Table 23). For grain quality, PGR had no effect on protein, but often affected test weights, seed weight and percent plump kernels.

Table 21. F-test results and estimated marginal means for the main effects of variety and PGR, and their interaction on yield at individual sites. Means separation is indicated by letters where F-test results were significant at P<0.05.

	Indian Head	Melfort	Outlook	Prince Albert	Scott
	------------------ *Yield (kg ha^{-1})* ------------------				
Variety	*<0.001*	*0.024*	*0.290*	*<0.001*	*0.201*
PGR	*0.092*	*0.716*	*0.469*	*0.087*	*0.749*
Var × PGR	*0.461*	*0.957*	*0.024*	*0.550*	*0.356*
Variety					
AAC Synergy	7289 c	4415 ab	5202	6661 a	3071
AAC Connect	7222 cd	4451 ab	5528	6969 a	2855
CDC Fraser	7050 d	4253 ab	5523	7037 a	2996
CDC Austenson	7562 ab	4565 a	4495	6938 a	2848
Claymore	7721 a	4057 b	5531	6900 a	3050
Oreana	7373 bc	4656 a	5778	5456 b	2994
PGR					
None	7310	4447	5224	6488	2945
Yes	7429	4352	5462	6832	2993
Var × PGR					
AAC Synergy – None	7150	4516	5742 a	6792	2976
AAC Connect – None	7150	4553	5409 ab	6612	2921
CDC Fraser – None	6998	4256	5438 ab	6842	2869
CDC Austenson – None	7582	4545	3058 b	6668	2903
Claymore – None	7657	4152	5689 ab	6772	2984
Oreana – None	7322	4660	6006 a	5244	3017
AAC Synergy – PGR	7427	4315	4663 ab	6531	3166
AAC Connect – PGR	7293	4349	5647 ab	7326	2789
CDC Fraser – PGR	7103	4249	5608 ab	7231	3122
CDC Austenson – PGR	7542	4584	5932 a	7209	2794
Claymore – PGR	7784	3962	5373 ab	7028	3116
Oreana – PGR	7424	4651	5550 ab	5667	2971

Conclusions

The results across sites were often not consistent and were very dependent on location; however at most sites, a PGR application decreased average seed weights (3/5 sites), decreased average test weights (3/ 5 sites), and decreased percent plump seeds.

Acknowledgements

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Enhanced Barley Variety Trials: Fertility Screening

Japp, M. (Sask Barley), Hall, M. (ECRF), Sorestad, H. (ECRF), Holzapfel, C. (IHARF), Catellier, C. (IHARF), Singh, G. (ICDC), McInnes, B. (NARF), Nybo, B. (WCA), Wall, A. (WCA), Lokken, R. (CLC), and Enns, J. (WARC)

Description

The objective of this demonstration is to compare the nitrogen fertility responsiveness of three malt and three feed barley varieties. The trials were established at Melfort, Indian Head, Prince Albert, Outlook, Swift Current, Yorkton, and Scott, SK in 2022, as a two-factor factorial RCBD with four replicates. The first factor compared a “Standard” vs “Enhanced” rate of soil available N (0-24”) + fertilizer N. The second factor was variety. Standard and Enhanced rates of N varied by location group based on historic yield potential. All sites were fertilized with P and K levels to be not limiting, even for the high N rate based on soil test recommendations. The treatments are described in detail in Table 24.

Table 24. Treatment list for nitrogen fertility by barley variety trial in 2022.

Trt #	Variety	Type	Nitrogen Fertility[1]
1	AAC Synergy	Malt	Standard
2	AAC Synergy	Malt	Enhanced
3	AAC Connect	Malt	Standard
4	AAC Connect	Malt	Enhanced
5	CDC Fraser	Malt	Standard
6	CDC Fraser	Malt	Enhanced
7	CDC Austenson	Feed	Standard
8	CDC Austenson	Feed	Enhanced
9	Claymore	Feed	Standard
10	Claymore	Feed	Enhanced
11	Oreana	Feed	Standard
12	Oreana	Feed	Enhanced

[1]Standard and Enhanced rates of N Fertility [soil (0-24”) + added N] will vary between locations based on historic yield potentials obtained from SCIC data. Sites will fall into the following groupings:

- Group 1 = low yield potential: Swift Current: Intended comparison 100 vs 125 lb N/ac of soil + added N; actual comparison 159 vs 184 lb N/ac
- Group 2 = mid range yield potential: Prince Albert, Indian Head, Scott: Intended comparison 120 vs 150 lb N/ac of soil + added N; actual comparison for Prince Albert 139 vs 169 lb N/ac
- Group 3 = high yield potential: Yorkton, Melfort, Outlook: Intended comparison 130 vs 162 lb N/ac of soil + added N; actual comparison for Melfort 142 vs 174 lb N/ac

Results

Levels of lodging were very low in this study, however, there were a few instances where lodging was increased with the enhanced rate of N. CDC Fraser was the lowest yielding variety at Indian, Scott, and Swift Current (Table 25). However, the ranking of varieties did vary between sites. Yield did not respond to the enhanced rate of N at Swift Current, Scott, and Prince Albert. This was due to drought at Swift Current and Scott and likely higher than desired N rate comparisons at Swift Current and Prince Albert. At Outlook, yield was reduced when the N rate was increased due to seed safety issues that substantially reduced crop emergence. Since there was not a positive yield response to increased N or interactions between variety and N rate, no conclusions regarding the relative yield response between varieties could be made. At Indian Head, Melfort, and Yorkton, yield significantly responded to the enhanced rate of N (Table 25). The enhanced rate of N proved to be economical at all locations based on economic assumptions from the 2021 Saskatchewan Crop Planning Guide. However, the enhanced rate of N did not prove economical at Yorkton under the poorer economic assumptions provided in the 2023 Guide.

Table 25. Estimated marginal means for the main effects and interaction of variety and fertility on yield at individual sites. Means separation is indicated by letters where F-test results were significant at P<0.05.

	Indian Head	Melfort	Outlook	Prince Albert	Scott	Swift Current	Yorkton
				------------------------------- *Yield kg ha^{-1}* -------------------------------			
Variety	*<0.001*	*0.437*	*0.338*	*0.001*	*<0.001*	*<0.001*	*<0.001*
Fertility	*<0.001*	*<0.001*	*0.005*	*0.367*	*0.358*	*0.342*	*0.026*
V × F	*0.412*	*0.269*	*0.836*	*0.305*	*<0.001*	*0.879*	*0.121*
Variety							
AAC Synergy	7337 bc	5935	5082	6476 ab	3493 a	3037 bc	6853 ab
AAC Connect	7185 c	6123	5299	6975 a	3668 a	3196 ab	7191 a
CDC Fraser	6943 d	5977	4772	7183 a	2930 b	2708 c	6726 abc
CDC Austenson	7553 b	6195	5371	7112 a	3440 ab	3354 ab	6875 ab
Claymore	7909 a	5562	5356	6797 a	3729 a	3353 ab	6194 c
Oreana	7390 bc	5789	6213	5844 b	3892 a	3606 a	6257 bc
Fertility							
Standard	7092 b	5588 b	5895 a	6813	3571	3252	6542 b
Enhanced	7681 a	6273 a	4803 b	6649	3479	3166	6824 a
V × F							
AAC Synergy – Standard	6962	5699	5704	6606	4157 a	3101	6724
AAC Connect – Standard	6918	5771	5466	7092	3770 abc	3161	6954
CDC Fraser – Standard	6634	5975	5247	7618	2961 cde	2691	6394
CDC Austenson – Standard	7324	5785	5912	6803	3191 bcde	3414	6547
Claymore – Standard	7655	4752	6388	6753	3471 abcde	3500	6388
Oreana – Standard	7056	5545	6653	6006	3878 ab	3648	6242
AAC Synergy – Enhanced	7711	6171	4460	6346	2829 e	2974	6982
AAC Connect – Enhanced	7452	6475	5132	6859	3565 abcde	3231	7428
CDC Fraser – Enhanced	7252	5980	4298	6747	2898 de	2724	7058
CDC Austenson – Enhanced	7781	6604	4830	7421	3688 abcd	3294	7202
Claymore – Enhanced	8164	6372	4324	6840	3987 ab	3205	6000
Oreana – Enhanced	7724	6034	5773	5683	3907 ab	3564	6272

Conclusions

There were no N by variety interactions detected so there was no evidence to suggest most economic rate of N would differ within feed varieties or within malt varieties. However, the most economic rate of N would be higher for the malt varieties compared to feed varieties due to the greater value of malt.

Acknowledgements

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Lentil Response to Fertilizer Applications and Rhizobial Inoculation

Holzapfel, C. (IHARF), Fletcher, A. (Sask Pulse), Enns, J. (WARC), Slind, K. (WARC), Nybo, B. (WCA) and Wall, A. (WCA)

Description

The objective of this project was to demonstrate the response of lentil to a wide range of fertility management treatments that focus on phosphorus rate, rhizobial inoculation, and nitrogen fertilization strategies. Field trials with small red lentils were initiated near Indian Head, Scott, and Swift Current, SK in 2021. Due to environmental challenges, particularly at Scott and Swift Current, along with the recognized value of additional sites for which data would be available, the demonstration was repeated at all three locations in 2022. The treatments were combinations of P fertilizer rates, granular rhizobial inoculant, and supplementary N fertilizer applied either at the time of seeding (side-banded) or as an in-season broadcast application targeted for the bud formation stage prior to flowering. The phosphorus source was monoammonium phosphate (MAP; 11-52-0), supplemental N was provided as urea (46-0-0), and the granular inoculant product was Nodulator Duo SCG (BASF; minimum of 8 x 107 CFU/g of *Rhizobium leguminosarum* biovar *viceae* STRAIN 1435 and 2 x 108 CFU/g of *Bacillus subtilis* STRAIN BU1814) at the label recommended rate, adjusted for row spacing. The treatments were arranged in a four replicate RCBD (Table 26).

Table 26. Fertilizer and inoculant treatments evaluated in lentil fertility demonstrations conducted at Indian Head, Scott, and Swift Current in 2021 and 2022.

Trt#	P rate (side-banded MAP)	Granular Inoculant (label rate)	Extra N Fertilizer (adjusted for N from MAP but not residual NO_3-N)
1	0 kg P_2O_5/ha	No	None
2	0 kg P_2O_5/ha	Yes	None
3	22 kg P_2O_5/ha	No	None
4	22 kg P_2O_5/ha	Yes	None
5	45 kg P_2O_5/ha	No	None
6	45 kg P_2O_5/ha	Yes	None
7	45 kg P_2O_5/ha	No	55 kg N/ha sideband
8	45 kg P_2O_5/ha	No	55 kg N/ha in-season broadcast
9	45 kg P_2O_5/ha	Yes	55 kg N/ha sideband
10	45 kg P_2O_5/ha	Yes	55 kg N/ha in-season broadcast
11	67 kg P_2O_5/ha	Yes	None
12	67 kg P_2O_5/ha	Yes	55 kg N/ha sideband

- N balanced at 9.5 kg N/ha for treatments 1-4 to separate P from N responses
- Both in-crop and side-band urea rates are adjusted for N provided by MAP (i.e., the total quantity of N applied in each of treatments 7, 8, 9, 10, and 12 was 55 kg N/ha

Results

Data collection included residual soil nutrients, emergence, seed yield, test weight, seed weight, and seed protein. Emergence was not affected by the treatments in any cases; thus, indicating that side-banding provided adequate separation between the seed and fertilizer. Yields increased with P fertilizer at 3 of 4 sites, with the strongest responses observed at Indian Head, a modest response at Scott, and no response at Swift Current (Figure 8). Residual P was extremely low at Indian Head (both years), slightly higher but still deficient at Scott, and approaching sufficiency at Swift Current. No yield benefits to rhizobial inoculation were detected at any locations. Responses to extra N were inconsistent and small but detected at Swift Current and Indian Head in 2022. With low organic matter, coarse soil texture, and low residual N, Swift Current was the best candidate for supplemental N to be beneficial. These conditions were not met at Indian Head; however, yields were well above-average, and the N provided by biological fixation may not have been sufficient to achieve the maximum yield potential at this site.

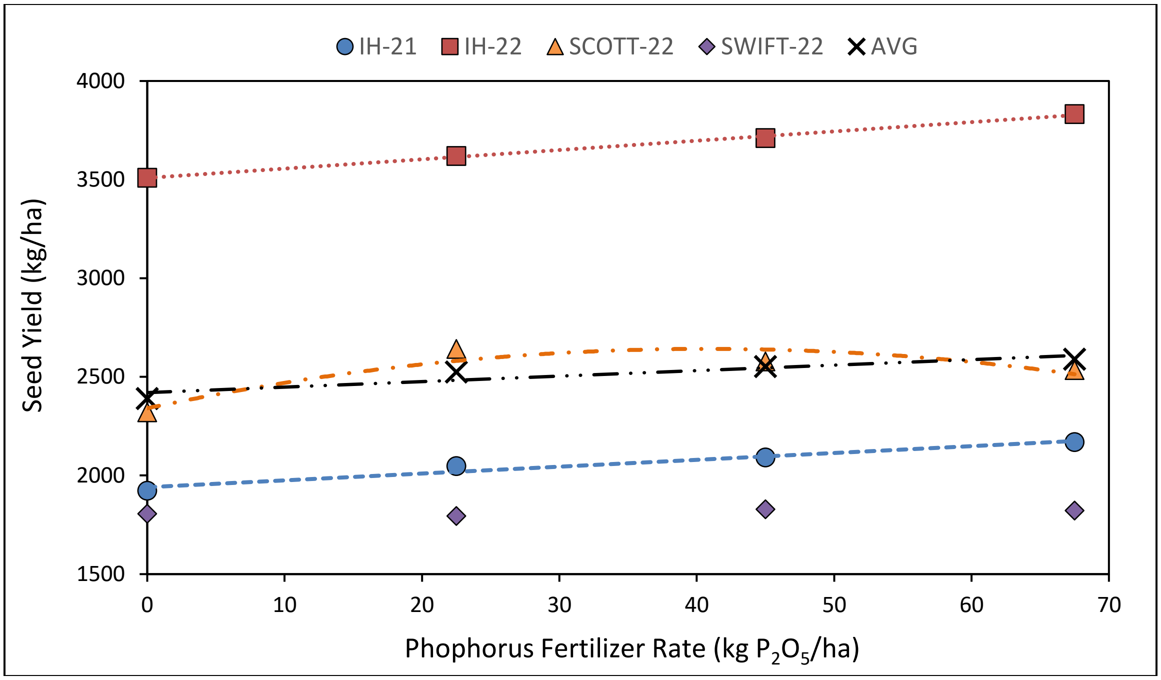

Figure 8. Lentil seed yield response to phosphorus (P) fertilizer rate at Indian Head (2021 and 2022), Scott (2022), and Swift Current (2022). Only the linear response at Indian Head was significant ($P < 0.001$).

Conclusions

In conclusion, we recommend P fertilizer rates that meet or exceed expected removal, depending on soil test levels and objectives, to achieve optimum yields without depleting soil fertility. An exception would be soils that are already high in P, in which case low rates of starter P are likely adequate. We hesitate to suggest that growers may not need to inoculate, as biological N fixation is critical for profitable lentil production and naturally occurring populations of *Rhizobium leguminosarum* may vary across the landscape and from year-to-year. We would not broadly recommend applying N fertilizer beyond what is supplied by modest rates of P and sulfur products; however, responses could occur in coarse textured soils low in both organic matter and residual N and, potentially, when yield potential is especially high; however, the latter can be difficult to predict.

Acknowledgements

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Expanding Rotational Options Using New and Novel Pulse Crops

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Description

The objective of this demonstration was to provide producers with economic and agronomic information on non-traditional pulse crops that may be adapted to various soil climatic zones in Saskatchewan. Field trials were established at Melfort, Indian Head, Prince Albert, Outlook, Swift Current, Yorkton, and Scott, SK in 2022 to provide provincial wide coverage consisting of multiple soil zones and growing conditions. Since some crops were likely to be better suited to certain regions, project managers and SPG selected the crops and varieties they considered best suited for their particular environments (minimum of 10 pulse crop varieties). Crops demonstrated included fenugreek, faba bean, mung bean, lupin, cow pea, a number of dry beans, field pea, maple pea, chickpeas, soybean, and lentils. Selected agronomic information is provide in Table 27.

Table 27. Select agronomic information of the new and novel pulse crops demonstrated in the trials conducted at Melfort, Indian Head, Prince Albert, Outlook, Swift Current, Yorkton, and Scott, SK in 2022.

Crop	Resistance to aphanomyces	Target (plants/m^2)	(lbs/ac)	End Use
Fenugreek	Non-host crop	135	30	Can sell back to Emerald Seeds, where we got the seed from - ingredient in spice blends and flavoring agent in foods, beverages and tobacco, extracts used in soaps and cosmetics
Faba bean	Partial	44	120	Human consumption (including fractionation) and livestock feed. Fractions include protein, starch and fibre for multiple markets
Mung bean	Unknown	30	20	Human consumption - dry beans, or bean sprouts. Can also be used as a green manure crop and as forage for livestock
Lupin	Resistant	45	45	4% human consumption - flour, mostly used for livestock feed, 10% higher protein than peas
Cowpea	Unknown	58	50	Human consumption - nutritious greens, snap beans, shell beans and dry beans (can be ground into flour for gluten free substitute). Useful as ground cover, weed suppression, green manure, and forage for livestock
Dry Bean	Varies	45	85	Mostly human consumption
Green peas	Susceptible	80	174	Human consumption and livestock feed
Yellow pea		80	168	
Maple Pea		80	168	Human consumption, pigeon feed
Red lentil	Susceptible	130	60	Human consumption, but can be used for livestock feed
Green lentil		130	60	
Black lentil		130	60	

Chickpea	Moderately resistant	44	150	Human consumption, but can be used for livestock feed
Soybean	Non-host crop	57	60	77% of global soybeans used for livestock feed. Used for biofuels, vegetable oils, 7% human consumption
Adzuki bean	Varies	45	85	Human consumption, but can be used for livestock feed, or soil improvement crop

Results

Data collection included residual soil nutrients, emergence, weed competition, seed yield, and basic economics. The data was not replicated and did not use to make any conclusions or recommendations, but all crops planted did emerge and made for a successful demonstration to commodity group representatives, crop extension specialists, producers, and industry partners from around the world. Generally, good weed control was correlated with higher yields. Faba beans, peas, and lentils were among the crops that had the best weed control. This project was of large interest during field tours and client visits and was deemed successful as it generated many questions and inquiries on field tours and events and created an avenue to discuss new pulses in a rotation.

Conclusions

While the project provided important insights into the adaption of the various pulse crops throughout the province, no concrete recommendations, or conclusions were made due to the lack of replication in the field trials and across years.

Acknowledgements

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture.

Faba Bean Agronomy to Enhance Yield, Hasten Maturity, and Reduce Disease

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Description

The objectives of the project were to demonstrate 1) the ability of early seeding to optimize yield and allow for earlier faba bean harvest, 2) the effects of higher seeding rates on disease development, maturity, and yield, and 3) the capacity for foliar fungicide applications to reduce disease, enhance yield, and potentially delay maturity. Over the 2021 and 2022 growing seasons, field trials with faba bean were established at 13 in Saskatchewan. These included two southern (Redvers and Indian Head), one central (Yorkton), and two more northern (Melfort and Prince Albert) locations. Redvers did not conduct field trials in 2022 and data from Outlook, Prince Albert, and Redvers in 2021 were excluded due to the data quality being compromised by unfavourable environmental conditions. The treatments were a factorial combination of two seeding dates (early vs. delayed), two seeding rates (45 vs. 65 viable seeds/m^2), and two fungicide treatments (untreated vs. treated). Early seeding was targeted for April 25 to May 7 while delayed seeding was targeted for May 20-30; however, the actual dates fell outside of this range in 2022 due to wet spring conditions. The fungicide was either Priaxor® or Dyax®, applied approximately 7-10 days after the initiation of flowering. These products contain the same active ingredients but in different proportions, providing 75-99 g/ha of fluxapyroxad and 99-148 g/ha pyraclostrobin. While the original intent was to use Priaxor® at all sites, this product was discontinued prior to the 2021 growing season and not all sites had access to it. The eight treatments were arranged in a split-plot design with seeding date as the main plots and seeding rates and fungicide treatments as the sub-plots. Each treatment was replicated four times.

Results

The seeding date responses varied and were not always as expected; however, overall, we can confirm that seeding faba beans as early as possible will be the best option for producers. Seeding date had no effect on establishment 70% of the time and, when it did have an impact, the responses were inconsistent and usually minor. For yield, however, early seeding was advantageous 50% of the time and had no effect for the remaining sites. With respect to seeding rates, impacts on maturity were sometimes observed and/or significant, favouring the higher seeding rate; however, they were always minor (1-2 days) and unlikely to have much impact on when the crop is ready to combine or how susceptible it would be to damage associated with fall frost. Yields were not affected by seeding rate 70% of the time but, when responses did occur, they favoured the higher seeding rate. Given the potentially high cost of seeds, logistic challenges associated with the large seed size, and relatively low probability and magnitude of benefits to higher seeding rates, seeding rates of 45 seeds/m^2 are likely to be sufficient in most cases. Fungicide effects on maturity were rare and, when observed, minor. Yield responses to fungicide were observed 40% of the time and were always positive when they did occur. Interestingly, 2/4 of the responsive sites had essentially no disease and were severely limited by drought (i.e., Swift Current-21 and Yorkton-21). Another responsive site (Yorkton-22) had minimal disease but was severely damaged by hail prior to the fungicide applications, which may have influenced the response. One of the responsive sites (Melfort-22) had relatively high yield potential and the presence of chocolate spot was confirmed by the crop protection lab; however, the observed level of disease was low according to the ratings. Notably, the fungicide response at this location was only observed with delayed seeding.

Conclusions

At this stage, we do not suggest any revisions to the current recommendations; however, the project will continue at six locations in 2023 which will improve the robustness of the results and hopefully add more sites with what might be considered average, or typical conditions, for the respective locations.

Acknowledgements

Financial support for the project was provided by the Saskatchewan Pulse Crop Development Board.

Agronomic and Economic Response of Lentil to Seeding Rate and Fungicides

Holzapfel, C. (IHARF), Enns, J. (WARC), Slind, K. (WARC), Nybo, B. (WCA), Sluth, D. (WCA), and Wall, A. (WCA)

Description

The objectives of this project were to 1) demonstrate the effects of lentil seeding rates and subsequent plant densities on competition with weeds, disease, yield, grain quality, and agronomic response to foliar fungicide applications and 2) demonstrate the most profitable combinations of seeding rates and foliar fungicide application strategies for lentils under a range of Saskatchewan growing conditions. Field trials with small red lentils were conducted at three locations (Swift Current – Brown Soil Zone; Scott – Dark Brown Soil Zone; Indian Head – thin Black Soil Zone) in SK for two growing seasons (2021 and 2022). The treatments were a factorial combination of three seeding rates (130, 190, and 250 seeds/m^2) and three fungicide management treatments (no fungicide applied, single application at early flowering, single application at early flowering and a second application approximately 14 days after the first) for a total of 9 individual treatments. The fungicide products and rates were 395 ml/ha Dyax (250 g/l fluxapyroxad and 250 g/l pyraclostrobin) for the first application and 420 g/ha Lance WDG (70% boscalid) for the second. The treatments were replicated four times in an RCBD and are listed in Table 28.

Table 28. Seeding rate and fungicide treatments in lentil input demonstration trials conducted Indian Head, Scott, and Swift Current in 2021 and 2022.

Seeding Rate	T1 Fungicide (early bloom)	T2 Fungicide (≈14 days after T1)
130 seeds/m^2	None applied	None applied
130 seeds/m^2	395 ml Dyax/ha	None applied
130 seeds/m^2	395 ml Dyax/ha	420 g Lance WDG/ha
190 seeds/m^2	None applied	None applied
190 seeds/m^2	395 ml Dyax/ha	None applied
190 seeds/m^2	395 ml Dyax/ha	420 g Lance WDG/ha
250 seeds/m^2	None applied	None applied
250 seeds/m^2	395 ml Dyax/ha	None applied
250 seeds/m^2	395 ml Dyax/ha	420 g Lance WDG/ha

T1 - 100 g fluxapyroxad/ha + 100 g pyraclostrobin/ha applied 3-7 days after 1st flowers observed

T2 – 294 g boscalid/ha applied approximately 14 days after the first fungicide application

Results

Establishment varied with environment in that the highest populations were achieved at Indian Head-22 and Scott-22 (174-18 plants/m^2 on average) and densities were lower at the remaining three sites (139-142 plants/m^2). Seedling mortality increased with seeding rate from 11% at 130 seeds/m^2 to 23% at 250 seeds/m^2. While the plots were conventionally managed with respect to herbicide applications, we saw occasional, minor benefits in the crop's ability to compete with weeds as seeding rate was increased.

However, the denser stands had potential to result in higher disease pressure. Yields were positively correlated with seeding at 1/5 sites (Indian Head-21), not affected at 2/5 sites (Swift Current-21 and Scott-22), and negatively affected at 2/5 sites (Indian Head-22 and Swift Current-22), and when averaged across sites (Figure 9). The contrasting results at Indian Head may have been due to poorer overall establishment in 2021 and much wetter conditions in 2022. The magnitude of the yield response was small at the affected sites; however, with higher input costs and similar or lower yields, increasing seeding rates from 130 seeds/m^2 to 190 seeds/m^2 reduced profits at 3/5 sites. Rates of 250 seeds/m^2 were less profitable than 130 seeds/m^2 at 4/5 sites. There was an overall benefit to applying a fungicide at early bloom, but not to following up with a second application, under the conditions encountered during this project. With generally low disease pressure, however, the yield responses were small, averaging only 3-4% at the most responsive sites and 2.5% across all five sites. The observed yield benefits to a single fungicide application were sufficient to cover the costs of the products and application at 2/5 sites but did not increase profits. At 3/5 sites and when averaged across sites, relative profits were lower with a single fungicide application than in the control. The dual fungicide application was always less profitable than the control. Fungicide effects on test weight were rare, inconsistent, and generally unimportant and seed weight was, on average, increased slightly with fungicide.

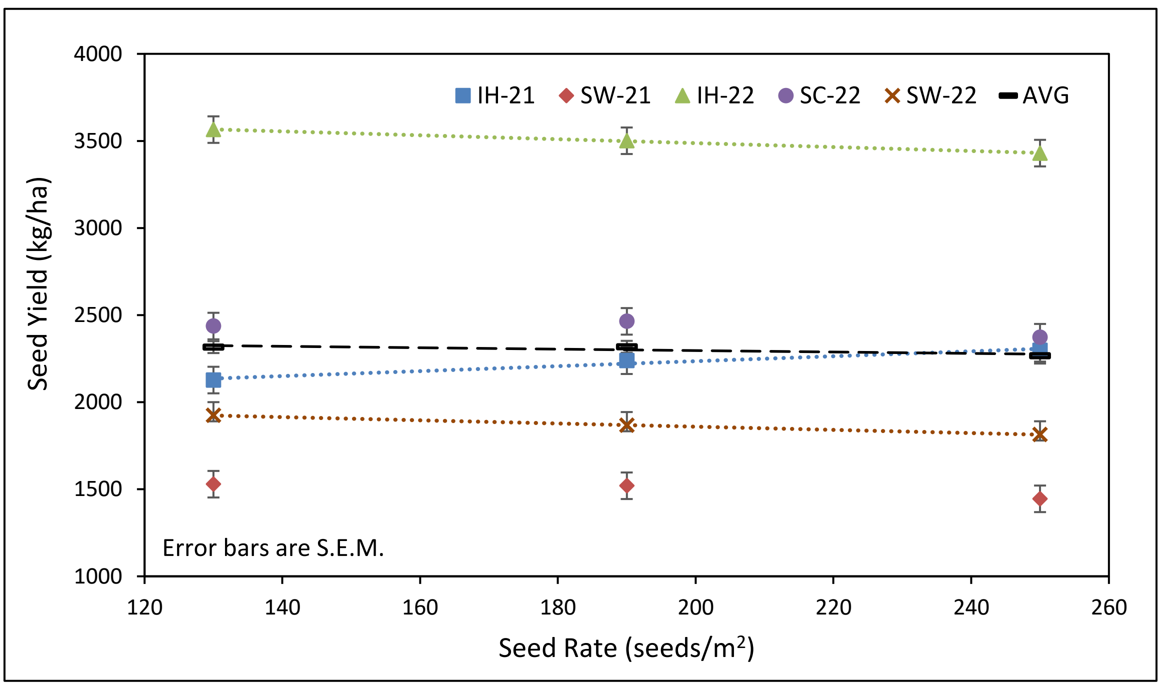

Figure 9. Seeding rate effects on lentil seed yield at Indian Head (2021 and 2022), Scott (2022), Swift Current (2021 and 2022), and averaged across all five sites. The overall F-test was highly significant at IH-21 ($P = 0.002$) and IH-22 ($P = 0.006$) and marginally significant at SW-22 ($P = 0.077$) and across sites ($P = 0.056$). The linear orthogonal contrasts were significant at IH-21, IH-22, SW-22, and across sites ($P < 0.001$-0.041) and marginally significant at SW-21 ($P = 0.083$).

Conclusions

In conclusion, seeding rates of 130-190 seeds/m^2 should generally be relatively low risk and considered optimal. If low mortality is expected and/or there is risk of either extreme drought or wet conditions, the lower of these rates may be preferable. If seeding conditions are poor (i.e., high mortality is expected), weed pressure is high, or general weather conditions are more 'average', moving to the higher end of the 130-190 seeds/m^2 range may be beneficial. With relatively weak responses to fungicide, our results support the recommendation to scout for disease and base management decisions on the actual disease pressure and weather conditions; however, we also recognize that results may be spatially variable in commercial fields with a higher general risk of disease relative to small plots.

Acknowledgements

Financial support for the project was provided by the Saskatchewan Pulse Crop Development Board.

Contrasting Fungicide Applications and Genetic Fusarium Head Blight Resistance for Enhanced Yield and Quality in Barley

Holzapfel, C. (IHARF), Turkington, K. (AAFC), Mohr, R. (AAFC), Hall, M. (ECRF), and McInnes, B. (NARF)

Description

The objective of this project was to investigate the potential merits of contrasting foliar fungicide strategies in barley production and the potential for foliar fungicide applications combined with genetic FHB resistance to enhance end-use quality of barley. The first field trials of the project were established at Indian Head, Yorkton, and Melfort, SK in the spring of 2020, with the Brandon, MB site postponed due to COVID-19 restrictions. For the 2021 and 2022 growing seasons, trials were conducted at all four locations for a total of 11 site-years. The treatments were a factorial combination of three varieties and four fungicide treatments, arranged in a four-replicate RCBD. The barley varieties were CDC Bow (moderately susceptible; MS), AAC Synergy (intermediate; I), and AAC Connect (moderately resistant, MR). The fungicide treatments were an untreated control, a flag-leaf application targeting leaf disease (Trivapro; T1), an application at 80-100% head emergence targeting FHB (Prosaro XTR; T2), and a dual application which received both the flag-leaf stage and heading fungicide applications (T1 + T2). The fungicides were applied as per protocol, using field sprayers and a minimum solution volume of 187 l/ha (20 U.S. gal/ac).

Results

At the time of the flag leaf fungicide applications (T1), leaf disease levels never differed between varieties (P = 0.069-0.933) and were 1% or lower (leaf area affected) at 10/11 sites, the sole exception being ME-20 where the trend was for the most disease in CDC Bow and the least in AAC Connect. In 2022, we introduced an additional measurement period prior to the second set of fungicide applications (T2); however, these collections were missed at ME-22. The percent leaf area affected by disease continued to be low at this time; however, variety differences were detected at BR-22 and YK-22 and, again, showed a trend for higher disease in CDC Bow relative to AAC Synergy and AAC Connect. Variety effects on final, total disease levels were significant at 8/11 sites, but the trends were not always consistent. Fungicide effects were significant at 6/11 sites and, where they occurred, were largely as expected with the highest disease levels observed in the untreated control. Grain yields were affected by variety at 7/11 sites and fungicide at 2/11 sites (Table 29), with significant VAR x FUNG interactions detected at 2/11 sites. In cases where the variety effect was significant, AAC Synergy was always amongst the top yielders. CDC Bow yielded lowest in 5/7 responsive sites while AAC Connect had the lowest yield at 1/7. For 1/7 responsive sites, Bow and Connect yielded similar to each other but lower than AAC Synergy. The sole two locations where fungicide effects on yield were significant on their own were BR-22 and IH-22, two of the wettest, highest yielding locations. Thousand kernel weight was affected by variety at 7/11 sites while fungicide effects were significant at 3/11 and the VAR x FUNG interaction was significant at 1 site. Percent plump kernels were affected by variety at 6/11 locations and by fungicide at 2/11 sites. Percent thin kernels were affected by variety at 7/11 sites and by fungicide at 4/11 sites, while VAR x FUNG interactions were detected at 2/11 sites. Deoxynivalenol (DON) accumulation was measured for all plots at all sites, and no DON was detected at any locations in 2021. Of the sites where data is available and DON was detectable; variety effects were significant at 1/7 site while fungicide effects were significant at 2/7 sites. Where the variety effects were significant (ME-22), the results were subtle, but as expected, with the highest levels observed with CDC Bow (0.56 ppm) and the lowest with AAC Connect (0.48 ppm) and intermediate values with AAC Synergy (0.53 ppm).

Table 29. Main effect means for variety and fungicide main effects on barley grain yield at 11 sites in 2020-22. Main effect means within a site followed by the same letter do not significantly differ (Tukey, P < 0.05).

Main Effect	BR-21	BR-22	IH-20	IH-21	IH-22	ME-20	ME-21	ME-22	YK-20	YK-21	YK-22
	------------------ Grain Yield (kg/ha) ------------------										
Variety											
Bow (MS)	3950 B	5863 C	4986 B	3156 B	6968 A	3394 A	2000 B	4166 A	2610 B	1948 A	5914 A
Synergy (I)	5653 A	6601 A	5609 A	3965 A	6917 A	3691 A	2728 A	4402 A	3074 A	1733 AB	6123 A
Connect (MR)	5288 A	6345 B	5429 A	3954 A	6751 A	3630 A	2484 A	4368 A	2624 B	1207 B	5795 A
S.E.M.	141.7	80.7 [Z]	123.9	120.6	84.1	138.0 [Z]	226.8 [Z]	239.8	124.7	252.3	150.9
Fungicide											
Untreated	4986 A	6139 B	5378 A	3635 A	6584 B	3487 A	2553 A	4094 A	2744 A	1636 A	5772 A
Flag	4895 A	6226 AB	5444 A	3720 A	6925 A	3691 A	2340 A	4728 A	2998 A	1575 A	6004 A
Head	4920 A	6307 AB	5258 A	3735 A	6997 A	3604 A	2382 A	4131 A	2647 A	1741 A	6036 A
Dual	5054 A	6406 A	5286 A	3677 A	7009 A	3505 A	2340 A	4294 A	2688 A	1564 A	5965 A
S.E.M.	158.8	86.3 [Z]	127.7	122.6	92.0	155.0 [Z]	239.1 [Z]	262.4	140.9	277.1	163.2

[Z] Overall average S.E.M. (values for individual treatments varied due to missing plots)

Conclusions

Despite a few minor issues, the field trials went well in 2020. The issues encountered were due to human error, minor misunderstandings of data collection requirements, or environment. In 2021, the field trials went reasonably well at all locations; however, drought, in some cases severe, resulted in negligible leaf disease levels at all sites and, in some (i.e., Yorkton and Melfort), low and/or extremely variable yields combined with relatively poor grain quality. In 2022, moisture conditions were much better at all sites, but there were still challenges. Yield data were extremely variable at Melfort, potentially due to variable fertility or compaction issues. Residual N was relatively high at Melfort 2022 and, as such, only 22 kg N/ha was applied as fertilizer. However, noticeable irregularities in crop condition were observed during the growing season and grain yields were extremely variable.

Acknowledgements
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Establishing Nitrogen Recommendations for Hybrid Brown Mustard Production in Saskatchewan

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Description
The objective of this project was to understand nitrogen requirements of a hybrid mustard compared to Centennial brown and define upper and lower limits of Nitrogen (N) rates for hybrid brown mustard. To evaluate this, small-plot research trials were established in three different soil zones in Saskatchewan. The locations were Swift Current, Indian Head, and Redvers in 2020 through to 2022. The treatments consisted of 7 nitrogen rates applied to both Centennial brown and AAC Brown 18 mustard seeded at 22 seeds/ft^2. The N rates were 0, 60, 80, 100, 120, 140 and 160 lbs/ac of total nitrogen (soil residual + nitrogen applied as urea). The first treatment (0N) ranged from 0-60 lbs of N, depending on the amount of residual nitrogen at the site. Treatments were arranged in a RCBD with four replicates.

Results
Centennial mustard had significantly greater establishment compared to AAC Brown 18. Plant density generally decreased with increasing N rate for both the hybrid and Centennial brown, but results were quite variable. The lowest establishment rates coincided with the driest growing season precipitation recorded at Swift Current indicating that the poor soil moisture and lack of precipitation negatively influenced emergence. Although AAC Brown 18 establishment rates were lower, average yields were statistically higher in 5/6 site years compared to Centennial brown yields. At Swift Current, AAC Brown 18 yield increased with nitrogen rates up to 100 lbs N/ac (1312 kg/ha, Table 30). Centennial brown mustard yield increased yield up to 100-140 lbs N/ac (1222 kg/ha). At Indian Head, both AAC Brown 18 and Centennial brown yields increased up to 160 lbs N/ac resulting in 2360 kg/ha and 1936 kg/ha, respectively. Yields increased linearly with increasing nitrogen likely as a result of having received adequate precipitation at this site. Redvers mustard yields also increased with nitrogen up to rates of 160 lbs N/ac with AAC Brown 18 yielding 1440 kg/ha and Centennial brown yielding 1332 kg/ha. The hybrid was more vigorous most site years and this vigor increased with nitrogen, despite the decrease in plant population. The hybrid does appear to have increased branching compared to the open pollinated variety throughout the season and most noticeably early on. There was no variety effect on lodging, but it did increase fairly linearly with increasing nitrogen levels at Indian Head and Redvers. Overall lodging ratings were low and did not have an impact on yield.

Table 30. Hybrid Brown and Centennial Brown mustard yield at increasing nitrogen rates in Swift Current, Indian Head and Redvers (kg/ha, 2020-2022). Means for each interaction and main effect within a column followed by the same letter do not significantly differ at $P \leq 0.05$.

Mustard Yield		Swift Current		Indian Head		Redvers	
		------------------------------------Yield (kg/ha)------------------------------------					
N Rate x AAC Brown 18							
	0 lbs/ac	933	c	922	g	952	f
	60 lbs/ac	1184	b	1347	f	1113	e
	80 lbs/ac	1234	b	1675	e	1232	d
	100 lbs/ac	1312	a	1873	d	1282	cd
	120 lbs/ac	1328	a	2080	c	1328	bc
	140 lbs/ac	1323	a	2269	b	1366	b
	160 lbs/ac	1329	a	2360	a	1440	a
N Rate x Centennial Brown							
	0 lbs/ac	878	d	813	g	901	f
	60 lbs/ac	1073	c	1176	f	978	e
	80 lbs/ac	1193	b	1492	e	1105	d
	100 lbs/ac	1222	ab	1679	d	1169	c
	120 lbs/ac	1231	ab	1766	c	1270	b
	140 lbs/ac	1277	a	1896	b	1310	ab
	160 lbs/ac	1195	b	1936	a	1332	a
N Rate							
	0 lbs/ac	905	d	867	g	926	f
	60 lbs/ac	1129	c	1262	f	1046	e
	80 lbs/ac	1214	b	1583	e	1167	d
	100 lbs/ac	1267	a	1776	d	1225	cd
	120 lbs/ac	1279	a	1923	c	1299	bc
	140 lbs/ac	1301	a	2082	b	1338	ab
	160 lbs/ac	1262	ab	2148	a	1386	a
Variety							
	AAC Brown 18	1235	a	1789	a	1245	a
	Centennial Brown	1153	b	1537	b	1152	b

Conclusions

AAC Brown 18 consistently yielded higher than Centennial brown when compared to the same nitrogen rate. Height, lodging and days to maturity varied by site, but did not have any impact on yield. The dry conditions that persisted over multiple growing seasons resulted in limited emergence and that ultimately had a negative impact on potential yield.

Acknowledgements

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Establishing Seeding Rate Recommendations for Hybrid Brown Mustard Production in Saskatchewan

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Description

The objective of this project was to maximize production by optimizing seeding rates based on seeds per square foot rather than lbs/ac, for both the hybrid and open pollinated brown mustard, due to the difference in seed size and establishment. To evaluate this, the plot trials were established at Swift Current, Indian Head, and Redvers in 2020 through to 2022. The treatments consisted of 5 seeding rates with balanced NPKS with both AAC Brown 18 and Centennial brown; seeded at increasing seed rates of 10, 14, 18, 22, and 26 seeds/ft^2. Treatments were arranged in a RCBD with four replicates.

Results

Centennial mustard establishment was significantly higher compared to AAC Brown 18 when combined across seeding rates. Plant density for the hybrid and Centennial brown varieties increased with seeding rate increases. However, percent survival decreased as seeding rate increased, meaning the lower seeding rates had a higher percentage of surviving plants. Overall, Indian Head had the highest percent emergence, followed by Redvers, and lastly Swift Current. Although AAC Brown 18 establishment rates were lower, average yields were statistically higher in 5/6 site years compared to Centennial brown. Despite poor establishment of the hybrid brown mustard, growing season rains likely promoted branching, flowering, and pod development. Overall, yields at Swift Current and Redvers were lower than at Indian Head due to limited precipitation. At Swift Current, AAC Brown 18 yield increased with seeding rates up to 18 seeds/ft^2 (1120 kg/ha) but was not significantly different than the yield at the lower seeding rates of 10 and 14 seeds/ft^2 (Table 31). Centennial brown mustard yield increased with seeding rates up to 26 seeds/ft^2 (1132 kg/ha). At Indian Head, hybrid brown yields increased up to a seeding rate of 18 seeds/ft^2 (2278 kg/ha) and Centennial brown yields increased up to a rate of 18 seeds/ft^2 (1941 kg/ha) but was not significantly different than at 14 seeds/ft^2 (1907 kg/ha). Results at Redvers resulted in little variation between seeding rate treatments due to poor environmental conditions in 2/3 years. Combined data at Redvers suggested there was no significant difference between seeding rates higher than 10 seeds/ft^2. However, when considering a more normal year rather than drought years, 2022 yields for AAC Brown 18 increased up to 22 seeds/ft^2 (1965 kg/ha) and Centennial brown mustard yields increased with seeding rates up to 18 seeds/ft^2 (1433 kg/ha). The hybrid was more vigorous most site years and its vigor also increased with increasing seeding rate, despite the decreased percentage of survival. The hybrid does appear to have increased branching throughout the season, most noticeably early on.

Table 31. Hybrid Brown and Centennial Brown mustard yield at increasing seeding rates in Swift Current, Indian Head and Redvers (kg/ha, 2020-2022). Means for each interaction and main effect within a column followed by the same letter do not significantly differ at $P \leq 0.05$.

Mustard Yield	Swift Current		Indian Head		Redvers	
	-------------------------------------Yield (kg/ha)-------------------------------------					
Seed Rate x AAC Brown 18						
10 seeds/ft^2	1080	b	2150	c	1203	b
14 seeds/ft^2	1065	b	2227	b	1225	b
18 seeds/ft^2	1120	ab	2278	a	1297	ab
22 seeds/ft^2	1175	a	2145	c	1347	a
26 seeds/ft^2	1156	a	2160	c	1236	ab
Seed Rate x Centennial Brown						
10 seeds/ft^2	947	c	1885	b	930	b
14 seeds/ft^2	961	c	1907	ab	1011	a
18 seeds/ft^2	1031	b	1941	a	1003	a
22 seeds/ft^2	1036	b	1938	a	1050	a
26 seeds/ft^2	1132	a	1880	b	1013	a
Seed Rate						
10 seeds/ft^2	1014	c	2018	bc	1067	a
14 seeds/ft^2	1013	c	2067	a	1118	a
18 seeds/ft^2	1075	b	2110	c	1150	a
22 seeds/ft^2	1105	ab	2041	ab	1199	a
26 seeds/ft^2	1144	a	2020	bc	1125	a
Variety						
AAC Brown 18	1119	a	2192	a	1262	a
Centennial Brown	1021	b	1898	b	1002	b

Conclusions

AAC Brown 18 consistently yielded higher than Centennial brown when compared to the same seeding rate. AAC Brown displays strong nitrogen use efficiency as well as the ability to compensate with increased branching and ground cover when seeded at a lower target plant stand compared to the Centennial Brown. AAC Brown 18 has many desirable properties, but producers should keep in mind that the seed cost of the hybrid is higher than open-pollinated varieties. AAC Brown 18 also has half of the erucic acid content of the open-pollinated check which is desired in European markets.

Acknowledgements

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Hemp Seeding Date Demonstration for Grain Production

McInnes, B. (NARF), Singh, G. (ICDC), Holzapfel, C. (IHARF), and Kettenbach, K. (WARC)

Description

The main objective of this project was to determine the ideal seeding date of conventional hemp in Saskatchewan. Three hemp seed varieties, X59, Katani, and Picola, were seeded at three different seeding dates, late May, mid-June, and early July in 2021 and 2022. The four participating sites were Outlook, Scott, Melfort, and Indian Head. At all sites, plots were seeded to attain a plant population of 100-125 plants/m^2. Of the four trial sites, three were established under natural rainfed conditions (dryland), while one trial (Outlook) was irrigated. The treatments were arranged in a replicated RCBD.

Results

All sites experienced dry soil conditions early in the season, but Indian Head and Melfort received adequate rainfall toward the end of the season. Yield was affected at Scott due to limited precipitation. Seeding dates had a significant effect on hemp yield at two (Scott and Indian Head) of the four sites. Hemp yield was higher when seeded in late May at both Scott and Indian Head (Table 32). Seeding date effect on hemp yield was not significant at both Outlook and Melfort. Of the four test sites, Indian Head had the highest yield (grand mean = 1162 kg/ha). Yield did not vary with hemp varieties except at Indian Head, where Katani yielded higher than Picola and X59. The interaction between seeding timing and hemp variety was not significant at all four locations. Seeding date significantly affected hemp height at all sites. At Outlook, Melfort, and Indian Head early seeded (late May) hemp plants had a greater height, due to the longer growing season as compared to the other two seeding dates. At Scott, the hemp height increased as the seeding date was delayed as the late seeding coincided with the precipitation in July. Of the three hemp varieties, X59 was taller than Katani and Picola at Outlook, Scott and Indian Head. Seeding date and hemp varieties interaction were again non-significant for plant height.

Table 32. Seeding dates and varieties effect on mean yield (kg/ha) measured at four sites. Means for each main effect within a column followed by the same letter do not significantly differ at $P \leq 0.05$.

	Melfort	Outlook	Scott	Indian Head
	--Yield (kg/ha)--			
<u>Seeding dates</u>				
Late (early-July)	584 a	1240 a	637 c	1093 b
Mid (Mid-June)	497 a	640 a	890 b	1037 b
Early (Late-May)	715 a	714 a	1226 a	1356 a
<u>Varieties</u>				
Katani	585 a	1108 a	941 a	1207 a
Picola	595 a	539 a	911 a	1156 b
X59	616 a	947 a	900 a	1123 b

Conclusions

In year-two of this project, seeding date significantly affected yield, height, and days to maturity. Yield was higher when plots were seeded in late May and hemp variety Katani yielded higher than Picola and

X59. Hemp plants were also taller when seeded in late May, with X59 taller than the other varieties at all locations. Hemp variety X59 took longer to mature at all sites.

Acknowledgements
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Meta-Analysis of Small-Plot Trial data to Examine the Relationship Between Crop Development and Environmental Conditions in Canola

Catellier, C. (IHARF)

Description

The objective of this project was to utilize archived small-plot canola agronomic trial data and corresponding regional weather data to conduct a meta-analysis to examine the relationship between environmental conditions and canola emergence. Archived small-plot canola trial data was aggregated in collaboration with Agri-ARM organizations in Saskatchewan. Only publicly funded trial data was included in the data set. The trials were conducted in multiple locations in Saskatchewan and Manitoba in 2013-2022 and included data from 12 different projects/tests with a total of 47 site-years. Trials that contained the following obligatory plot-level data were included: 1) Seeding density (seeds per area), OR seeding rate (weight per area) and seed size (thousand seed weight); 2) Spring plant density assessment. Additional agronomic data was also collected and included: 1) Cultivar; 2) Previous crop; 3) Seeding date; 4) Row spacing; 5) Rates of seed-placed N, P, and S fertilizer; and 6) Treatments number and description, by trial. Also, maturity, fall stubble density, and yield data were included as additional response variables to explore if available. Daily weather data (mean temperature and precipitation) was obtained from the nearest Environment Canada weather station for each trial site and year. Single-variable and multiple regression with mixed effects modeling was used to examine the effect of individual management and environment variables and their interactions on the percent emergence of canola.

Results

The overall average canola emergence percent was 60.7%. Nearly all variables had a significant effect on canola emergence individually (Table 33). The effects of seeding density and seed-placed fertilizer on canola emergence were relatively mild and consistent with previous findings. Percent emergence varied from approximately 50% to 70% over the range of seeding densities, and approximately 47% to 62% over the range of seed-placed fertilizer rates observed in the data set. The effects of pre- and post-seed precipitation were also consistent with expectations, where percent emergence increased with greater levels of precipitation both before and after seeding. Pre-seed precipitation was more influential than post-seed precipitation, varying from approximately 53% to 72% emergence over the range of values. Canola emergence varied from 57% to 73% over the range of post-seed precipitation observed in the data set. Seeding date and temperature, meanwhile, had surprisingly large effects on canola emergence that were not exactly as expected. Canola emergence decreased from 80% at the earliest seeding date to 30% at the latest seeding date, and varied even more, from 90% to 20% emergence over the range of observed pre- and post-seeding average temperatures. Significant interactions between non-correlated independent variables indicated that seeding date and average air temperature before and after seeding were the most influential variables, but the effects appeared to be likely related to soil moisture, which was not examined in this project.

Table 33. Description of each independent variable and results of the tests of significance for the single variable models assessing the effect on canola percent emergence.

Independent variable	Range	Mean	Regression Intercept	Regression co-efficient	Pr(>|t|)
Seeding density (seeds m^{-2})	30 – 200	119	75.1	-0.124	<0.001
Seeding date (Julian)	124 – 161	137	251	-1.378	<0.001
Seed-placed N (kg ha^{-1})	0 – 30	4.46	62.6	-0.513	<0.001
Seed-placed P (kg ha^{-1})	0 – 100	15.9	62.5	-0.126	0.002
Seed-placed S (kg ha^{-1})	0 – 25.6	1.91	61.3	-0.450	0.003
Pre-seed temperature (°C)	3.73 – 16.1	9.14	110	-5.16	<0.001
Pre-seed precipitation (mm)	8.10 – 195	69.3	53.3	0.095	0.017
Post-seed temperature (°C)	9.98 – 17.1	13.5	141	-5.99	<0.001
Post-seed precipitation (mm)	0 – 111	24.6	57.3	0.139	0.152

Conclusions

To confirm absolute emergence values that could be applied directly to commercial fields, similar data could be obtained from commercial fields. It would also be beneficial to include soil moisture and soil temperature as independent variables in any future studies if possible. As was discussed, the effects of air temperature on canola emergence appear to be related to soil moisture. Further, air temperature was used as a proxy for soil temperature, yet the results suggest that air temperature and soil temperature could have contrasting effects on canola emergence.

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Alternate Analytical Methods for Evaluating Environment Specific Varietal Performance of Various Crops in Saskatchewan

Catellier, C. (IHARF)

Description

The objective of this study was to conduct a supplemental analysis of long-term regional variety trial data of various crops to differentiate varietal performance by environment in Saskatchewan and to provide producers with environment-specific varietal recommendations. Regional Variety Trials (RVT) data was obtained for barley, oats, durum wheat, spring wheat, chickpeas, faba beans, lentil, and field peas. Each data set was analyzed separately. A mixed model analysis was first conducted to obtain best linear unbiased predictors (BLUPs)-adjusted variety and trial mean yields, as an alternative approach to utilizing proportional yields relative to a check variety. A stress tolerance analysis and a yield stability analysis were then conducted for each crop using the adjusted yields. Based on the stress tolerance index (STI), crop varieties were grouped into Group A, Group B, Group C, and Group D. Group A varieties have higher yield potential and higher stress tolerance. Group B varieties have higher yield potential but lower stress tolerance. Group C varieties have lower yield potential but higher stress tolerance. Group D varieties have lower yield potential and lower stress tolerance.

Results

The analysis results showed that, more than half of current barley varieties were in Group A. A small selection was in Group B, and these would be desirable under low-stress (higher-yielding) conditions, especially where yield potential is higher than some Group A varieties. None of the current varieties were in Group C. Group D varieties are the least desirable but included some popular varieties such as 'AC Metcalfe' and 'CDC Copeland'. More than half of current durum varieties were in Group A, and three durum varieties are in Group B. The two durum varieties were in Group C, and they could be desirable in low yielding environments, especially if adapted to a specific environmental stressor. The durum check variety 'Strongfield' was in group D. Stress tolerance and yield potential were highly correlated in oats – half of the current varieties were in group A, and the other half were in group D. As with oats, most spring wheat varieties were in either group A or group D. Surprisingly, a large proportion of current oat varieties fell into group D, however the grouping is relative and a few varieties with very high yield potential are skewing the average. No current spring wheat varieties were in group B, and only two varieties were in group C. As for chickpea, all current varieties were in either group A or group D. Current faba bean varieties were equally represented among four groups, however it should be noted that there are fewer varieties of faba beans compared to other crops, and to keep in mind that the groupings are relative. Most of the current lentil varieties were in group A or group D. 'CDC Grimm' and 'CDC Jimini' were in Group B and 'CDC Greenstar' was in group C. A large proportion of current field pea varieties were in group A, a few field pea varieties were in Group B, and rest of the field pea varieties were in group D.

Conclusions

Overall, the supplemental analysis of RVT data provided results that would help producers in choosing varieties, especially if they are able to identify whether they are in a low- or high-yield potential environment. Knowing the relative stress tolerance or yield stability of varieties also provides a level of risk management for producers in variable environments.

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Targeted Tile Drainage for Agronomic and Environmental Efficiencies

Catellier, C. (IHARF)

Description

The objective of this project was to identify and quantify soil and crop production benefits of using targeted tile drainage to manage excess water associated with temporary or seasonal wetlands in a prairie pothole landscape. The study was conducted in the R.M. of Kellross No. 247, SK. Tile drainage was installed by the landowners on three separate fields in fall 2020, prior to the initiation of the study. The tile was installed using a targeted design, with the purpose of consolidating of several wetlands of varying sizes and permanence, mainly shallow and seasonal, within each field. The study was designed to monitor changes in the soil and crop productivity in the landscape in and around the managed wetlands, in the years following the tile installation. The edges of the managed wetlands, or areas that were previously uncropped, were delineated using geo-rectified aerial photography that was taken in the fall of 2020. Four separate zones were defined in the areas in and around the managed wetlands:

1) Zone 1 is the interior of the managed wetland, or the previously uncropped area.
2) Zone 2 comprises a 60-foot width around the outside edge of the managed wetland, or the first seeding pass using the cooperating operation’s 60-foot seeding implement and represents the marginal cropland.
3) Zone 3 is the second pass of the seeding implement around the wetland, so comprises the area between 60 and 120 ft from the edge of the wetland and represents the potential overlap and compaction zone.
4) Zone 4 is between 120 and 180 ft from the edge of the wetland and represents the control or where we would expect normal or average crop productivity.

The first two years of data collection have been completed, and a final year of data collection is planned for 2023.

Results

The effect of tile drainage on soil organic matter (OM) differed in each of the fields (Figure 10). In Field 1, OM did not differ between the zones in both 2021 and 2022. In Field 2, OM did not differ between zones in the first year but differed significantly between zones in 2022. OM was significantly higher in Zone 1 compared to Zone 4 and indicates that OM increased in Zones 1 and 2. In Field 3, OM was significantly higher in Zone 1 compared to Zones 2 and 3 in 2021, but did not differ between Zones in 2022, indicating that OM appeared to decrease in Zone 1 in this field. We hypothesized that soil P would potentially have been accumulating in the wetland, or Zone 1, due to overland flow of water, and would initially be high in this zone. However, there were no significant differences in residual P between zones in any field or year, but variability was high for this measurement. It was hypothesized that the relative level of residual nitrates could potentially decrease in Zones 2 and 3, if crop productivity and uptake of applied N improved in those Zones. Residual N in Zone 1 would not be expected to be high initially because there was no previous application of this nutrient in this zone. However, there was no significant change in the distribution of nitrate-N in the soil profile one year after the installation of tile drainage. In 2022, the fields differed in the accumulation of nitrate-N by zone. There was again no significant difference between the zones in Fields 2 and 3. In Field 1, there was a significantly higher nitrate-N accumulation in Zone 1 compared to Zones 3 and 4. As with nitrate-N, there was no significant change in the distribution of salts in the soil profile one year after the installation of tile drainage. In 2022, there was a significant change in the relative level of salinity among zones. In Field 2, the difference between zones was no longer significant, and this was because salinity decreased in both Zones 2 and 3. In Field 3, salinity in Zone 2 decreased and was no longer significantly higher than Zones 1 and 4. In Field 1, the difference in salinity between zones was still non-significant but appeared to decrease more in Zone 2 relative to the other zones. In the first year, crop yield did not differ significantly between zones in any of the fields. In 2022, there was again no significant yield differences between zones in Fields 1 and 2. In Field 3, yield increased significantly from Zone 1 to Zone 4.

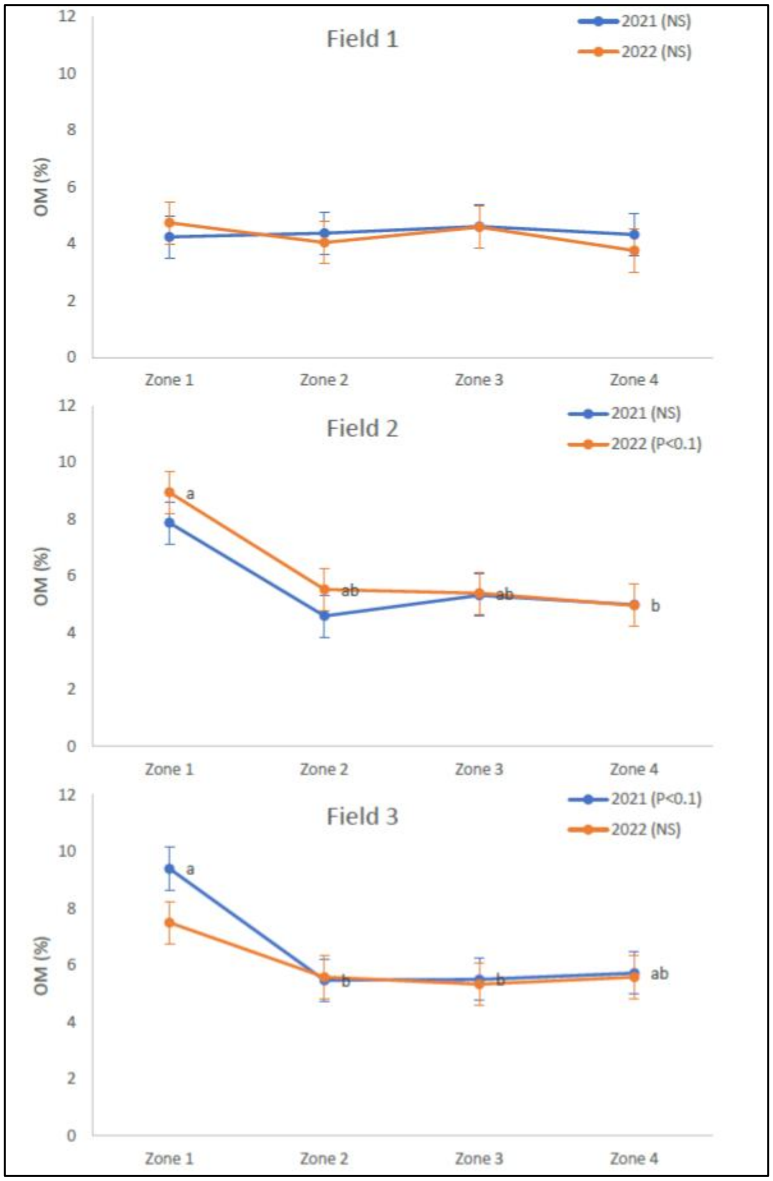

Figure 10. The change in soil organic matter (OM) in the zones surrounding the managed wetlands in each of the three fields. after one year of tile drainage.

Conclusions

In field scale research, high variability and limited replication reduce our ability to detect statistically significant differences. As such, results may come up as non-significant even though trends are apparent in the data. While interesting and potentially important trends should not be ignored only because they are not statistically significant, it is important to avoid speculating or drawing premature conclusions from non-significant results.

Acknowledgements

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