IHARF
INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

# 2021 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 2021 IHARF Directors included:

- Cameron Gibson - President *(Kendal)*
- Thom Weir - Vice President *(Yorkton)*
- Janel Delage - Secretary / Treasurer *(Indian Head)*
- 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, they include:

- Bruce McArthur - Associate Director, RDT
- Bill May - Research Scientist
- Chris Omoth - Research Assistant

## IHARF Staff

The 2021 team of IHARF staff included:

- Danny Petty - Executive Manager
- Chris Holzapfel - Research Manager
- Christiane Catellier - Research Associate
- Michelle Ross - Agronomy Research Associate
- Doug Stewart - Farm Technician
- Dylan Sebastian - Research Technician
- Danny Walker - Seasonal Technician
- Maiah Tratch - Summer Research Assistant

## 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 2021 was Kathryn Aldridge. Kathryn was pursuing her Master's degree in plant sciences at the University of Saskatchewan looking at herbicide screening in wheat.

## Extension Events

### Indian Head Crop Management Field Day

On July 20, 2021, IHARF and AAFC hosted the annual Indian Head Crop Management Field Day. The tours were scaled back due to Covid-19 restrictions. 84 producers and agronomists attended for the tour. Presentations were provided by:

- Chris Holzapfel (IHARF)
- Christiane Catellier (IHARF)

### AgriARM Research Update

IHARF, along with Agriculture Applied Research Management (AgriARM) sites from across the province, jointly hosted the virtual AgriARM Research Update on January 13, 2022. The event highlighted components of each organizations applied research and demonstration programs.

## IHARF Soil and Crop Management Seminar

On February 2, 2022, IHARF hosted its annual winter seminar in online platform, highlighting results of the 2021 season and current industry issues. 179 registrations took in including 138 viewers plus 71 post webinar views. Presentations were delivered by:

- Bill May (AAFC Indian Head)
- Chris Holzapfel (IHARF)
- Christiane Catellier (IHARF)
- Clark Brenzil (Saskatchewan Ministry of Agriculture)
- Dr. Mario Tenuta (University of Manitoba)

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

## 2021 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
- Saskatchewan AgriARM Program
- Saskatchewan Strategic Field Program
- Saskatchewan Wheat Development Commission
- Western Grains Research Foundation

### Gold

- Alberta Agriculture Funding Consortium
- Alberta Wheat Commission
- Bayer Crop Science
- Corteva Agri Science
- Koch Agronomic Services
- Saskatchewan Pulse Growers
- Saskatchewan Barley Development Commission
- Saskatchewan Canola Development Commission
- Saskatchewan Pulse Growers
- Syngenta

## Silver

- Albaugh
- Anuvia Plant Nutrients
- Asle Technology Group
- Azotic North America
- Crop Intelligence by South Country
- Fertilizer Canada
- Ag Action Manitoba
- Manitoba Pulse & Soybean Growers
- Mosaic
- NorthStar Genetics
- Novozymes BioAg
- Timac Agro
- Saskatchewan Farm Stewardship Association

## Bronze

- Blumer Seed & Cleaning
- CanMar Farms Indian Head
- Delage Farms
- Ennis Seed Farm
- Erwin & Priscilla Hanley
- FMC Canada
- GrainShark.com
- Manitoba Crop Alliance
- Nutrien Ag Solutions
- Town of Indian Head
- Trowell Seed Farm
- Willner Seed
- Saskatchewan Flax Development Commission
- Saskatchewan Oat Development Commission

## 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

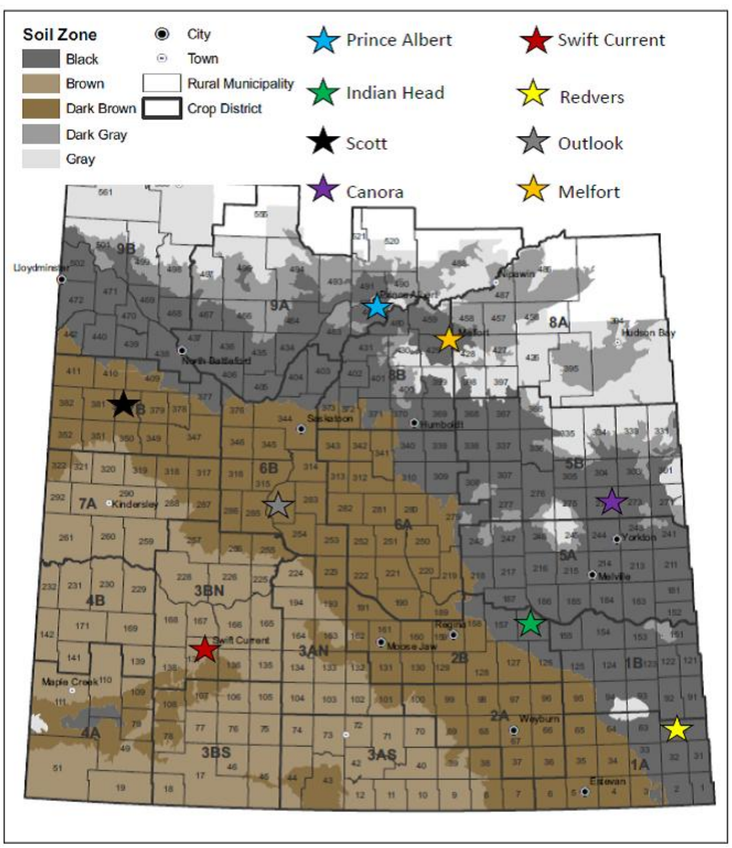


Figure 1. Locations of organizations comprising the Saskatchewan AgriARM Network.

## 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 September are presented with the long-term averages for each location in Tables 1 and 2, respectively. In 2021, all locations were much warmer than average and most of the locations were also dry. In terms of precipitation, Indian Head was the wettest location in 2021 with 121% of average precipitation; however, much of this rain came late in August. Melfort, Swift Current, and Scott were much drier relative to normal with 61-78% of their long-term average precipitation amounts. At all locations, a large percentage of the precipitation fell in August, which was too late to be of much benefit to the crops. With the combination of heat and low initial soil moisture reserves, yields were generally below average in 2021, even at locations that did receive more typical precipitation amounts.

Table 1. Mean monthly temperatures for the 2021 growing season and long-term normals (1981-2010).

| | | May | June | July | August | September | Average |
|---|---|---|---|---|---|---|---|
| | | | | *˚C* | | | |
| Indian Head | 2021 | 9.0 | 17.7 | 20.3 | 17.1 | 14.5 | 15.7 |
| | Normal | 10.8 | 15.8 | 18.2 | 17.4 | 11.3 | 14.7 |
| Melfort | 2021 | 9.6 | 18.2 | 20.1 | 16.9 | 14.0 | 15.8 |
| | Normal | 10.7 | 15.9 | 17.5 | 16.8 | 10.8 | 14.3 |
| Scott | 2021 | 8.9 | 17.3 | 19.6 | 17.2 | 12.5 | 15.1 |
| | Normal | 10.8 | 14.8 | 17.3 | 16.3 | 10.4 | 13.9 |
| Swift Current | 2021 | 9.5 | 18.3 | 21.6 | 17.9 | 14.7 | 16.4 |
| | Normal | 11.0 | 15.7 | 18.4 | 17.9 | 12.0 | 15.0 |

Table 2. Total monthly precipitation for the 2021 growing season and long-term normals (1981-2010).

| | | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| | | | | *mm* | | | |
| Indian Head | 2021 | 81.6 | 62.9 | 51.2 | 99.4 | 0.4 | 296 |
| | Normal | 51.7 | 77.4 | 63.8 | 51.2 | 35.3 | 279 |
| Melfort | 2021 | 31.4 | 37.6 | 0.2 | 69.3 | 7.5 | 146 |
| | Normal | 42.9 | 54.3 | 76.7 | 52.4 | 38.7 | 265 |
| Scott | 2021 | 43.9 | 43.8 | 10.4 | 51.3 | 6.1 | 156 |
| | Normal | 38.9 | 69.7 | 69.4 | 48.7 | 36.0 | 263 |
| Swift Current | 2021 | 30.0 | 26.8 | 36.6 | 53.5 | 0.5 | 147 |
| | Normal | 42.1 | 66.1 | 44.0 | 35.4 | 34.1 | 222 |

## 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.

# Winter Wheat Response to Contrasting Nitrogen Fertilizer Placement and Timing Options

Holzapfel, C. (IHARF)

*Description*

The objective of this project was to demonstrate winter wheat responses to nitrogen (N) rate when all the N was applied as untreated urea either in a sideband, early-spring broadcast, or a split-application with 50% of the N side-banded and the remainder as an early-spring broadcast application. A field trial with winter wheat was initiated in 2018-2019 at Indian Head and repeated the following two seasons (2019-2020 and 2020-2021). The treatments were a factorial combination of three N fertilizer placement/timing strategies and five N fertilizer rates, plus a control treatment where the only N fertilizer applied was 7 kg N/ha from seed-placed monoammonium phosphate (11-52-0). The N fertilizer rates were adjusted for residual soil $NO_3$-N and the treatments (Table 5) were arranged in a four replicate RCBD.

Table 5. Winter wheat nitrogen fertilizer management by rate treatments at Indian Head in 2019, 2020, and 2021.

| # | Timing / Placement | Total N Rate [Z] |
|---|---|---|
| 1 | N/A | 7 kg N/ha [Y] + residual |
| 2 | Side-Band | 60 kg N/ha |
| 3 | Side-Band | 90 kg N/ha |
| 4 | Side-Band | 120 kg N/ha |
| 5 | Side-Band | 150 kg N/ha |
| 6 | Side-Band | 180 kg N/ha |
| 7 | Spring Broadcast | 60 kg N/ha |
| 8 | Spring Broadcast | 90 kg N/ha |
| 9 | Spring Broadcast | 120 kg N/ha |
| 10 | Spring Broadcast | 150 kg N/ha |
| 11 | Spring Broadcast | 180 kg N/ha |
| 12 | Split-application (50/50) | 60 kg N/ha |
| 13 | Split-application | 90 kg N/ha |
| 14 | Split-application | 120 kg N/ha |
| 15 | Split-application | 150 kg N/ha |
| 16 | Split-application | 180 kg N/ha |

[Z] Includes Residual $NO_3$-N (0-60 cm) based on fall composite soil samples
[Y] Provided by seed-placed 11-52-0 for all treatments

*Results*

This project has demonstrated winter wheat response to fundamentally different N management strategies and a wide-range of rates. The response variables of interest were grain yield and grain protein. Winter wheat yields were optimized with 120-150 kg N/ha (soil plus fertilizer) with quadratic responses detected in all three years and the strongest overall response observed in 2019-2020, the latter which was also the season where the highest yields were achieved (Figure 2). Grain protein also responded to N rate but continued increasing at higher N rates compared to yield and, in some cases, the response was linear (Figure 3). Regarding timing/placement effects, environmental conditions were not particularly conducive to leaching or denitrification losses of fall-applied N and timely spring precipitation limited the potential volatile losses while increasing availability of the early-spring broadcast N. As such, all of the N timing/placement options performed reasonably well. In two of three seasons and when averaged over the three-year period, there were no significant differences between timing/placement methods for either yield or protein when averaged across rates. The exception was in 2019-2020 where yields were highest with side-banded N but protein was higher with spring broadcast N. Results with the split-applications were intermediate when differences occurred but generally were more similar to the fall side-band applications. This suggests that actual losses were not necessarily higher with the spring applied N; however, the availability shifted later into the growing season at the expense of yield but in favour of protein synthesis. While all three timing/placement strategies performed reasonably well under the conditions encountered, split-applications provide added flexibility and can buffer against both fall/early-spring N losses and early-spring N deficiencies.

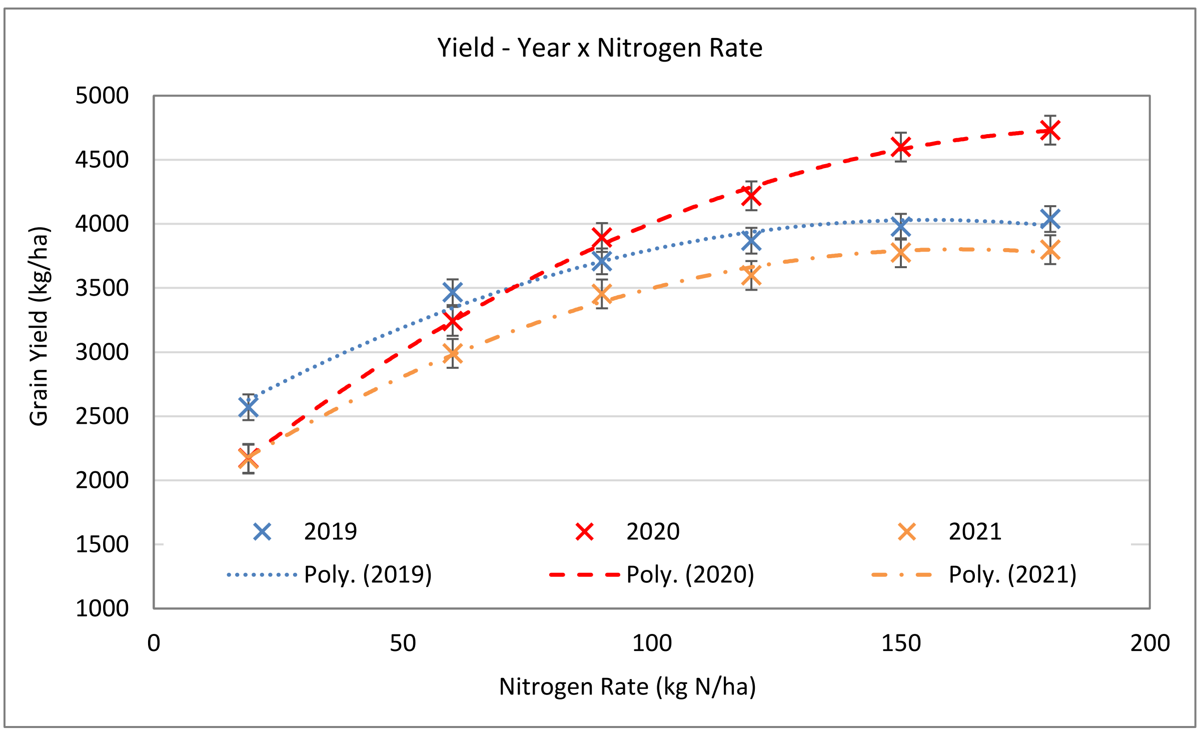


Figure 2. Winter wheat yield response to nitrogen (N) rate at Indian Head in 2019, 2020, and 2021. The N rates include fertilizer plus residual soil N which averaged 12 kg $NO_3$-N/ha over the three years. Error bars are the standard error of the treatment means.

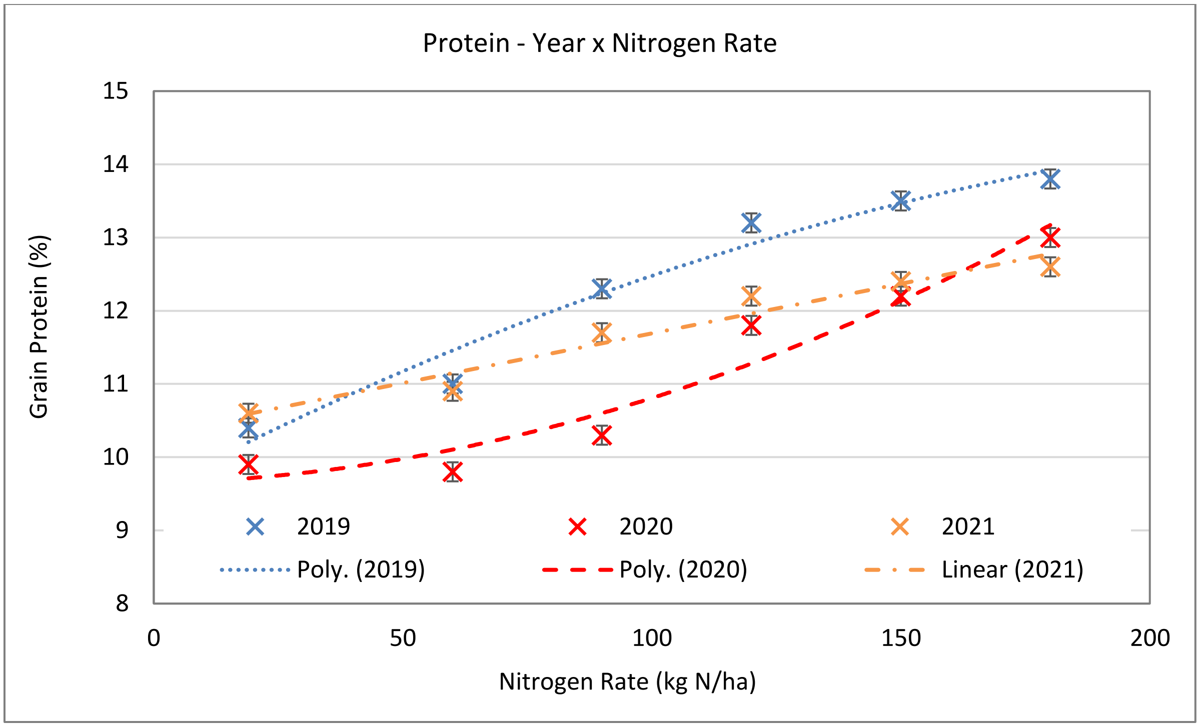


Figure 3. Winter wheat protein response to nitrogen (N) rate at Indian Head in 2019, 2020, and 2021. The N rates include fertilizer plus residual soil N which averaged 12 kg $NO_3$-N/ha over the three years. Error bars are the standard error of the treatment means.

*Conclusions*

Applying N sufficiently early in the spring can be a challenge in western Canada, particularly in wet springs, and there is also a risk of this N being stranded near the soil surface if timely precipitation after the application does not occur. Side-banded N is safest with later seeding (due to cooler soils and less fall crop growth) is combined with relatively dry/cool weather and well-drained fields. Deferring at least some of the crop's N requirements until spring is increasingly recommended if seeding occurs relatively early or in regions that are, in general, warmer and wetter. Although our results show that doing so can perform reasonably well, deferring all of a winter cereal crop's N fertilizer requirement until spring is generally not recommended unless, perhaps, residual soil N levels are unusually high or relatively large quantities of N are provided with phosphorus and/or sulfur fertilizer products. It would have been ideal to conduct this work under wetter conditions with higher yield potential and greater risk of environmental N losses; however, we speculate that such conditions would have favoured the split- or spring broadcast applications to a greater extent. Similarly, scaling this work up to whole fields, which are often more variable and may include poorly drained areas where standing water can occasionally occur, would likely favour split-applications over either banding all of the N during seeding or waiting until things dry up enough to broadcast it all in the early-spring.

*Acknowledgements*

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

# 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, and 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 for contrasting fertilizer placement and timing options. A field trial with CWRS wheat was initiated at Indian Head with the first N treatments applied in the fall of 2019 followed by subsequent treatment applications and seeding in the early spring of 2020. The project was repeated in 2020-2021. The treatments were a combination of six N fertilizer rate/placement/timing strategies and two formulations, plus a control where no supplemental N was applied. The treatments were arranged in a four replicate RCBD and are described in Table 6.

Table 6. Nitrogen management treatments evaluated for CWRS wheat at Indian Head in 2020 and 2021.

| # | 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*

With respect to rate, the project demonstrated strong overall responses to N and also 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. Regardless of the year, side-banding proved to be the most effective N management strategy evaluated for both formulations, simultaneously resulting in amongst the highest grain yields and protein concentrations (Tables 7 and 8). Next to side-banding, the best options evaluated were fall in-soil bands. Of the two-pass seeding/fertilization systems, fall in-soil banding was the best option but still never performed as well as side-banding when both yield and protein were considered. Deep-banding was preferable to shallow-banding; however, this advantage was more evident in protein than yield. Surface broadcast applications were the least efficient placement option, but the relative performance of fall versus spring broadcasting varied. In 2019-2020, fall broadcasting favoured yield (Table 7) while spring broadcasting favoured protein (Table 8). In 2020-2021, spring broadcasting was substantially better than fall-broadcasting by both measures. 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.

Table 7. Individual nitrogen (N) management treatment means for spring wheat yield in 2020, 2021 and averaged over the two-years. Values within a column followed by the same letter do not significantly differ (Tukey-Kramer; P ≤ 0.05). 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.

| # | N Treatment | 2020 | 2021 | 2-Yr Avg. |
|---|---|---|---|---|
| | | ------------------------------- Grain Yield (kg/ha) --------------------------------- | | |
| 1 | Control (0 N) | 2521 e | 1962 e | 2241 E |
| 2 | Urea – 1.5x SB | 5142 a | 3979 ab | 4560 A |
| 3 | Urea – 1x SB | 4766 b | 3753 bc | 4260 BC |
| 4 | Urea – 1x fBC | 3979 d | 3257 d | 3618 D |
| 5 | Urea – 1x sBC | 3908 d | 3687 bc | 3797 D |
| 6 | Urea – 1x DpB | 4685 bc | 3678 bc | 4182 BC |
| 7 | Urea – 1x ShB | 4493 bc | 3658 c | 4076 C |
| 8 | SUPERU – 1.5x SB | 5076 a | 4083 a | 4579 A |
| 9 | SUPERU – 1x SB | 4731 bc | 3915 ab | 4323 B |
| 10 | SUPERU – fBC | 4090 d | 3499 cd | 3795 D |
| 11 | SUPERU – sBC | 3856 d | 3732 bc | 3794 D |
| 12 | SUPERU –DpB | 4452 c | 3703 bc | 4077 C |
| 13 | SUPERU –ShB | 4522 bc | 3784 abc | 4153 BC |

Table 8. Individual nitrogen (N) management treatment means for spring wheat protein in 2020, 2021 and averaged over the two-years. Values within a column followed by the same letter do not significantly differ (Tukey-Kramer; P ≤ 0.05). 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.

| # | N Treatment | 2020 | 2021 | 2-Yr Avg. |
|---|---|---|---|---|
| | Source | ------------------------------- | Grain Protein (%) | --------------------------------- |
| 1 | Control (0 N) | 10.42 g | 10.69 f | 10.55 G |
| 2 | Urea – 1.5x SB | 14.70 a | 15.05 a | 14.88 A |
| 3 | Urea – 1x SB | 13.11 b | 13.51 b | 13.31 B |
| 4 | Urea – 1x fBC | 11.11 fg | 11.48 e | 11.29 F |
| 5 | Urea – 1x sBC | 11.83 def | 12.56 cd | 12.19 D |
| 6 | Urea – 1x DpB | 12.49 bcd | 13.49 b | 12.99 B |
| 7 | Urea – 1x ShB | 12.09 cde | 12.78 bcd | 12.43 D |
| 8 | SUPERU – 1.5x SB | 14.48 a | 15.01 a | 14.75 A |
| 9 | SUPERU – 1x SB | 12.72 bc | 13.21 bc | 12.96 B |
| 10 | SUPERU – fBC | 11.36 ef | 12.19 de | 11.78 F |
| 11 | SUPERU – sBC | 11.76 def | 12.76 bcd | 12.26 D |
| 12 | SUPERU –DpB | 12.49 bcd | 13.45 b | 12.97 B |
| 13 | SUPERU –ShB | 12.03 cde | 13.22 bc | 12.62 D |

*Conclusions*

The relative performance of these 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 management strategies that are tailored to their operation and the specific environment in which it exists. This demonstration is continuing in 2021-2022.

*Acknowledgements*

Funding for this project was provided by Fertilizer Canada and the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

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

Holzapfel, C. (IHARF)

*Description*

The broader objectives of this project were to gain experience and expertise with cover crops while providing a forum for discussion on how they might be successfully incorporated into annual cropping systems under Saskatchewan conditions. Specifically, we aimed 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. 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 $NO_3$-N because of the possible impacts of cover crops on this parameter. The 10 treatments were arranged in a four replicate RCBD.

*Results*

With the extremely dry fall, cover crop establishment was poor; however, limited emergence and growth occurred in the spring. Fall rye plant populations were below what was targeted and the plants that did establish only reached 1-3 leaves. As such, impacts on residual soil nutrients were likely negligible, but the soil test results were inconsistent. Nitrogen had no impact on canola emergence, but final plant populations were 15% lower with the cover crop. The cover crop also increased populations of grassy weed species, presumably a result of ungerminated rye seeds emerging after the cover crop was terminated and the canola was seeded. Canola yield, seed oil, and protein all responded strongly and as expected to N rate with the effects on yield and protein being positive and negative effects on oil content. The fall rye cover resulted in slightly but significantly lower canola yields and higher protein content but had no impact on oil content (Table 9).

Table 9. Main effect means for cover crop and nitrogen rate effects on canola yield, oil content, and protein content at Indian Head in 2021. Means followed by the same letter do not significantly differ at $P \le 0.05$.

| Main Effect | Seed Yield | Oil Content | Protein Content |
|---|---|---|---|
| <u>Cover Crop</u> | ---------- kg/ha ---------- | ------------------------------ % | ------------------------------ |
| None | 2218 A | 43.7 A | 19.0 B |
| Fall Rye | 2157 B | 43.6 A | 19.2 A |
| <u>Nitrogen Rate</u> | | | |
| 25 kg N/ha | 1050 e | 44.6 a | 17.5 d |
| 60 kg N/ha | 1755 d | 44.7 a | 17.4 d |
| 105 kg N/ha | 2476 c | 43.9 b | 18.8 c |
| 140 kg N/ha | 2739 b | 43.1 c | 20.2 b |
| 175 kg N/ha | 2917 a | 41.8 d | 21.5 a |

*Conclusions*

Cover crop effects on initial soil fertility and subsequent crop response to N fertility were somewhat inconclusive and considered to generally be negligible. Overall, the project illustrated some of the potential challenges with incorporating cover crops into annual cropping systems under the short, frequently dry, Saskatchewan growing seasons; however, our results may have been quite different with better fall rye establishment and a wet spring. This project is being repeated for the 2021-2022 growing season in order to build upon these results.

*Acknowledgements*

Funding for this project was provided by the Fertilizer Canada and Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

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

Holzapfel, C. (IHARF), McInnes, B. (NARF), Hnatowich, 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 with focus on stand establishment and yield. Field trials with canola were conducted near Swift Current, Scott, Indian Head, and Yorkton in 2020 and repeated at these same four locations in 2021 with additional trials at Melfort, Outlook, and Redvers. For simplicity, we did not necessarily attempt to balance total sulfur (S) rates across treatments but did require that S be not limiting; therefore, supplemental ammonium sulfate was applied in all cases. Phosphorus fertilizer products were always seed-placed while urea and ammonium sulfate were side-banded. Detailed treatment information is provided in Table 10. The treatments were arranged in a four replicate RCBD.

Table 10. Treatment descriptions for novel Phosphorus demonstrations completed in 2021.

| # | Phosphorus Form [Z] | 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®[Y] | 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®[Z] | 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 |

[Y] Struvite is marketed under the trade name CrystalGreen®

[Z] Expressed as actual $P_2O_5$ the ratio is 65:35 MAP:CrystalGreen®

*Results*

Response data included spring and fall plant densities, maturity, and yield; however, maturity effects were rarely significant and too small to be of agronomic importance. 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 conditions, it was more difficult to confirm 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 and were less severe with the MAP:CG blend and essentially non-existent with 100% CG (Table 11). On average, 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 11). For individual sites, yield responses to P were significant less than half the time; however, yields for many sites were below average and P fertilization is also important from a long-term perspective when considering the poor uptake-efficiency in the year of application. 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 at least maintain P fertility over the long-term were also profitable.

Table 11. 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 10[Z] site-years in Saskatchewan.

| Main Effect | Spring Plant Density | Final Plant Density | Seed Yield |
|---|---|---|---|
| | ---------- plants/m$^2$ ---------- | ---------- stems/m$^2$ ---------- | ------------ kg/ha ------------ |
| Control (0 P) | 75.8 | 72.5 | 2138 |
| P Form [Y] | | | |
| MAP | 65.1 c | 63.4 c | 2313 a |
| S15 | 61.0 d | 57.4 d | 2336 a |
| CG | 76.8 a | 73.6 a | 2242 b |
| MAP:CG | 71.5 b | 67.5 b | 2305 a |
| kg $P_2O_5$/ha | | | |
| 25 | 71.1 A | 68.6 A | 2230 C |
| 45 | 69.7 A | 65.5 B | 2303 B |
| 65 | 65.1 B | 62.3 C | 2364 A |

[Z] Yorkton-2020 was excluded from the combined analyses due to missing treatments
[Y] MAP - monoammonium phosphate (11-52-0); S15 - MicroEssentials® S15 (13-33-0-15); CG - Crystal Green® - 5-28 0 + 10% Mg; MAP:CG - 8-40-0 + 5% Mg (50:50 by mass of product)

*Conclusions*

Most western Canadian research has shown side-banding to be as effective as in-furrow placement, or even advantageous if utilizing rates that have potential to reduce stands. Dual banding P fertilizer with high rates of urea can reduce its availability early in the season; however, late-season availability can be enhanced with dual banding and documented yield advantages to seed-row versus side-band placement are rare. With respect to rates, our results show that the amounts of fertilizer that are generally required to, at minimum, replace the P removed by the crop are also profitable when averaged across a range of environments. While yield responses to P can be variable on a field-to-field basis, it must be appreciated that P fertilization is also a long-term investment that is necessary for maintaining or building the overall productivity of our land, regardless of the chosen formulation or responses in the year of application.

*Acknowledgements*

Funding for this project was provided by the Fertilizer Canada and Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

## Seeding Rates to Reduce Tillering and Flowering for FHB Management in Wheat

Holzapfel, C. (IHARF), Enns, J. (WARC), and Nybo, B. (WCA)

*Description*

The objectives of this project were (1) to demonstrate the potential for higher plant populations to reduce tillering, duration of flowering, fusarium head blight (FHB) infection, and quality loss in durum wheat, (2) to demonstrate the ability of foliar fungicide applications to increase grain yield and reduce FHB infection, and subsequent quality loss in durum wheat, and (3) to demonstrate the combined ability of higher plant populations and foliar fungicide to optimize both yield and quality of durum wheat. Field trials with durum wheat were conducted at Swift Current, Scott, and Indian Head in 2020 and repeated at the same three locations in 2021. The treatments were a factorial combination of four seed rates and two fungicide treatments. Each treatment was arranged in an RCBD and replicated four times. Treatment information is provided in Table 12.

Table 12. Individual treatment descriptions for ADOPT fusarium head blight management demonstrations completed at Swift Current, Scott, and Indian Head in 2020 and 2021.

| # | Foliar Fungicide [Z] | Seed Rate [Y] |
|---|---|---|
| 1 | No foliar fungicide applied | 125 seeds/$m^2$ |
| 2 | No foliar fungicide applied | 250 seeds/$m^2$ |
| 3 | No fungicide applied | 375 seeds/$m^2$ |
| 4 | No fungicide applied | 500 seeds/$m^2$ |
| 5 | 0.803 ml Prosaro XTR/ha | 125 seeds/$m^2$ |
| 6 | 0.803 ml Prosaro XTR/ha | 250 seeds/$m^2$ |
| 7 | 0.803 ml Prosaro XTR/ha | 375 seeds/$m^2$ |
| 8 | 0.803 ml Prosaro XTR/ha | 500 seeds/$m^2$ |

[Z] Applied at 50% anthesis in at least 187 l/ha solution; [Y] Adjusted for seed size and germination

*Results*

Despite the dry weather and low disease pressure encountered through much of Saskatchewan over the past two seasons, this project occasionally demonstrated subtle benefits to both higher seed rates and foliar fungicide applications to reduce FHB in durum. In contrast, the quality benefits were not always consistent and there were also occasions where, under severe drought, high seed rates negatively impacted grain yield and test weight. While the low fusarium pressure was not ideal for the purposes of this project, these results illustrate the importance of environment in determining the extent to which FHB can occur and what measures might be appropriate to manage it. Yield gains associated with fungicide applications were always small and never statistically significant (Table 13). Given the lack of disease, this was a reasonable response to expect at all locations in 2021 along with Swift Current and, to a lesser extent, Indian Head in 2020, but was more difficult to explain at Scott in 2020 where disease pressure was relatively high. The yield responses to seed rate varied, with intermediate rates being optimal both years at Indian Head, high seeding rates performing well at Scott and Swift Current in 2020, but negative responses to seed rates greater than 125-250 seeds/m$^2$ at Scott and Swift Current 2021 under severe drought conditions (Table 13). Seed rate effects on test weight were similar to those observed for yield. Fungicide application increased test weight at Indian Head in both years but not at any other sites. Where disease pressure was high enough to make meaningful observations, higher seed rates combined with a foliar fungicide application provided the most consistent benefits with respect to fusarium damaged kernels (FDK) and DON; however, these values were rarely high enough to be a concern, regardless of the treatment. At the two sites with the highest levels of disease (Indian Head and Scott 2020), higher seed rates appeared to have a greater impact on FDK and DON than fungicide; however, both were beneficial.

Table 13. Treatment means results for fungicide and seed rate effects on durum grain yield at Indian Head (IH), Scott (SC), and Swift Current (SW). Main effect means within a column followed by the same letter do not significantly differ ($P \leq 0.05$).

| Main Effect | IH-20 | IH-21 | SC-20 | SC-21 | SW-20 | SW-21 |
|---|---|---|---|---|---|---|
| Fungicide [Z] | ----------------- | ----------------- | Grain Yield (kg/ha) | ----------------- | ----------------- | ----------------- |
| Untreated | 4679 a | 3585 a | 5041 a | 1262 a | 3167 a | 559 a |
| Treated | 4812 a | 3662 a | 4845 a | 1222 a | 3211 a | 612 a |
| Seed Rate | | | | | | |
| 125 seeds/m$^2$ | 4592 a | 3225 b | 4551 b | 1380 a | 3035 b | 1134 a |
| 250 seeds/m$^2$ | 4888 a | 3820 a | 4997 ab | 1484 a | 3162 ab | 600 b |
| 375 seeds/m$^2$ | 4745 a | 3753 a | 5068 ab | 1099 a | 3248 ab | 336 c |
| 500 seeds/m$^2$ | 4757 a | 3696 a | 5157 a | 1005 a | 3310 a | 272 c |

[Z] The fungicide Prosaro XTR was applied at 50% anthesis

*Conclusions*

Implementing these practices can be beneficial for managing FHB; however, high seed rates are risky under drought conditions. Producers should consider overall moisture conditions, expected seedling mortality, and actual disease when choosing seed rates and deciding whether to apply fungicide.

*Acknowledgements*

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

# Dry Bean Response to Nitrogen Fertilizer Rates in Dryland, Solid-Seeded Production

Holzapfel, C. (IHARF), McInnes, B. (NARF), Shaw, L. (SERF), and Hall, M. (ECRF)

*Description*

The objective of this project was to demonstrate the response of dryland, solid-seeded black beans to varying rates of nitrogen (N) fertilizer, across a range of environments in Saskatchewan. Field demonstrations with CDC Blackstrap dry bean were conducted at Indian Head in 2020 and 2021. Similar trials were also conducted at Melfort, Redvers, and Yorkton. In 2020, the treatments were six N rates which included an unfertilized control, 45, 75, 105, 135, and 165 kg N/ha (soil residual plus fertilizer) with side-banded urea as the primary N source. In 2021, at the request of the Saskatchewan Ministry of Agriculture, the highest rate was reduced to 155 kg/ha; however, the treatments were otherwise unchanged. For the control, the only N available to the crop was provided by the soil and the monoammonium phosphate (11-52-0) that was applied. Treatments were arranged in a four replicate RCBD.

*Results*

Plant heights were largely unaffected by N rate in 2020, but increased quadratically in 2021, levelling off at approximately 105 kg N/ha. Maturity was delayed at the highest N rates both years and at the lowest rate in 2021. In 2020 at Indian Head, yields peaked at 712 kg/ha at a modest 75 kg N/ha (Figure 4). In 2021, the highest yield was 1785 kg/ha at 155 kg N/ha. The yield response to N was quadratic both years, declining slightly at the highest N rates in 2020 but simply showing diminishing returns to increasing N at the highest rates in 2021. Seed weight increased with N rate both years. The increase was quadratic in 2020, levelling off at slightly higher N rates than yield. In 2021, with a much stronger yield response, seed weight increased linearly with N rate. Overall, the seeds were much larger in 2021 compared to 2020. A basic economic analysis showed that the N rates where yields were maximized were also the most profitable, regardless of the assumptions for bean price or cost of urea. Across all eight site-years, yields ranged widely and the response to N was linear 62.5% of the time, quadratic 25% of the time, and not significant 12.5% of the time.

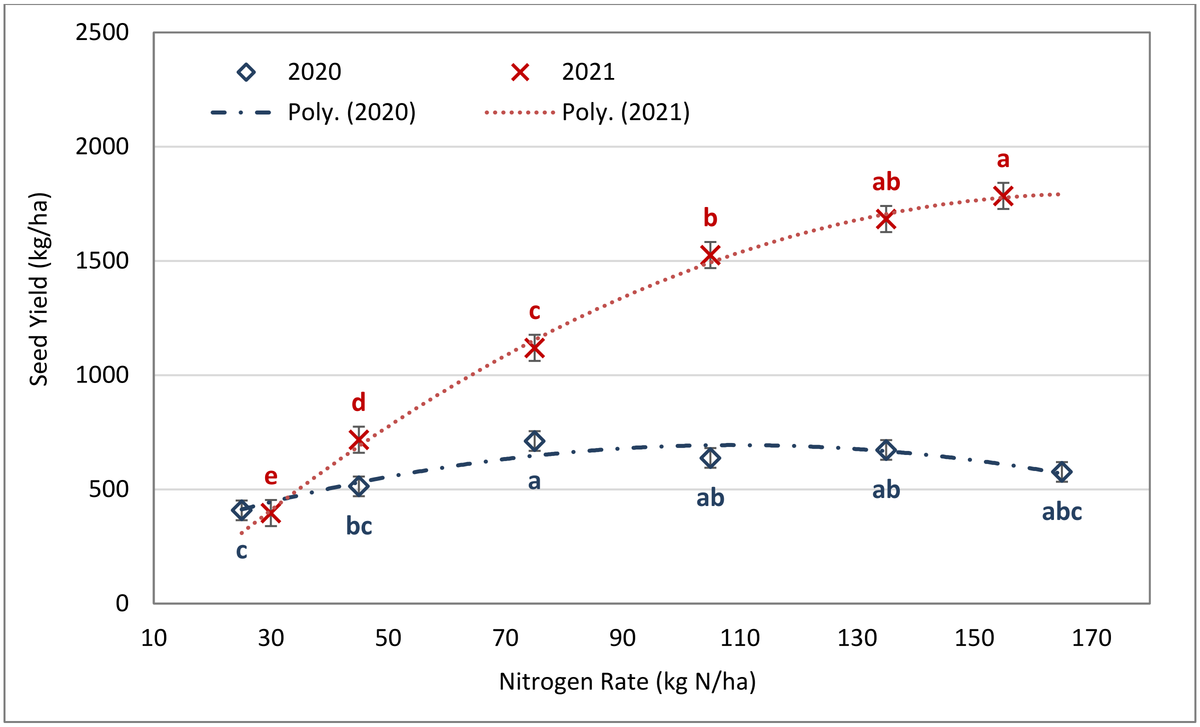


Figure 4. Total (soil plus fertilizer) nitrogen (N) rate effects on dry bean seed yields at Indian Head in 2020 and 2021. Error bars are the standard error of the treatment means and values within a year denoted by the same letter do not significantly differ (Tukey-Kramer; P ≤ 0.05).

*Conclusions*

Unless inoculant products become readily available and proven effective for western Canada, prospective dry bean growers in this region should plan on applying N fertilizer, potentially at quite high rates, to ensure optimum yields and more profitable production. That said, this is still a pulse crop with the ability to fix nitrogen, therefore utilizing check strips and regularly inspecting nodulation is still advisable, especially in cases where inoculant is applied, to ensure that this crop is being managed as efficiently as possible from both economic and environmental perspectives.

*Acknowledgements*

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

# Influence of Potassium Fertilizer on Yield and Seed Quality of Malt Barley and Spring Wheat

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*Description*

The objectives of this project were (1) to evaluate the effects of potassium (K) fertilizer rate and placement on yield of malt barley and spring wheat, (2) to evaluate the influence of K fertilization on seed quality characteristics, and (3) to assess the impact of K fertilization on crop lodging. Small plot trials were established at Indian Head, Yorkton, Redvers, Prince Albert, Swift Current, and Outlook in 2021. Seven potassium fertilizer treatments were established in a RCBD with four replications (Table 14). Both spring wheat and malt barley were evaluated as separate and individual trials. Wheat variety selection was on a site-by-site preference to a regionally suitable variety. However, AAC Synergy or CDC Churchill were specified as preferred, high yielding malt barley varieties.

Table 14. Treatments for potassium fertility trial of malt barley and spring wheat in 2021.

| # | K Placement & Rate (kg/ha) | Seed Placed KCl | Side-Banded KCl |
|---|---|---|---|
| 1 | Control | Nil | Nil |
| 2 | 10 $K_2O$ – SP | 16.7 kg/ha | Nil |
| 3 | 20 $K_2O$ – SP | 33.3 kg/ha | Nil |
| 4 | 30 $K_2O$ – SP | 50.0 kg/ha | Nil |
| 5 | 10 $K_2O$ – SB | Nil | 16.7 kg/ha |
| 6 | 20 $K_2O$ – SB | Nil | 33.3 kg/ha |
| 7 | 30 $K_2O$ – SB | Nil | 50.0 kg/ha |
| 8 | 60 $K_2O$ – dual (20 $K_2O$ – SP + 40 $K_2O$ – SB) | 33.3 kg/ha | 66.7 kg/ha |

KCl – 0-0-60; SP – seed placed, SB – side-band

*Results*

Of the six trial sites, Indian Head, Yorkton, Redvers, Prince Albert, Swift Current trials were established under natural rain fed conditions (dryland) while Outlook trial was irrigated. Dryland trials did not respond to K fertilization with respect to any measured agronomic parameter. The 2021 growing season was characterized by a historic drought. The reason for the lack of K fertilizer responses cannot be positively determined. It may be that barley and wheat do not require additional K nutrition on most Saskatchewan soils; however, the lack of response could also have been due to the adverse environmental conditions experienced at most trial locations. Under irrigated production, wheat failed to respond to fertilizer K applications; however, irrigated barley did respond to K fertilizer applications. All K treatments under irrigation resulted in numerically higher barley yields compared to the unfertilized control, and most differences between treatments were statistically significant (Table 15). Yields were higher when the K fertilizer was moved away from the seed row, indicating that fertilizer salt damage might have been occurring when seed placed. Optimal rate of K fertilizer for irrigated barley was 10 kg $K_2O$/ha.

Table 15. Barley grain yield response to fertilizer K applications Outlook, Yorkton, Redvers, Indian Head, Swift Current, and Prince Albert in 2021. Means followed by the same letter do not significantly differ ($P \leq 0.05$).

| K Placement & Rate (kg/ha) | Yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|
| | Outlook | Yorkton | Redvers | Indian Head | Swift Current | Prince Albert |
| Control | 4706 b | 2737 a | 4000 a | 4162 a | 1554 a | 3581 a |
| 10 $K_2O$ – SP | 5425 a | 2116 a | 3890 a | 4258 a | 1448 a | 4392 a |
| 20 $K_2O$ – SP | 5360 ab | 2988 a | 3786 a | 4226 a | 1675 a | 4178 a |
| 30 $K_2O$ – SP | 5266 ab | 2305 a | 3959 a | 4199 a | 1471 a | 4221 a |
| 10 $K_2O$ – SB | 5555 a | 2417 a | 4058 a | 4270 a | 1555 a | 3785 a |
| 20 $K_2O$ – SB | 5446 a | 2984 a | 4221 a | 4185 a | 1706 a | 4118 a |
| 30 $K_2O$ – SB | 5821 a | 2589 a | 4089 a | 4264 a | 1483 a | 3902 a |
| 60 $K_2O$ – dual | 5760 a | 2280 a | 4048 a | 4241 a | 1651 a | 3532 a |

*Conclusions*

Ideally this trial should be repeated in a more “normal” growing season for proper evaluation. Barley may be more responsive than wheat to K fertilization in higher yielding environments.

*Acknowledgements*

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

## Pre-Harvest Weed Control and Desiccation Options for Flax

Holzapfel, C. (IHARF), Thompson, W. (Sask Flax), Hall, M. (ECRF), and Nybo, B. (WCA)

*Description*

The objectives of this project were (1) to demonstrate the effects of pre-harvest herbicide and desiccant options for flax on seed and straw dry-down and (2) to provide a forum for discussion on the potential advantages and disadvantages of the pre-harvest options evaluated with respect to both weed control and efficacy as a harvest aid. Flax field trials were initiated at Indian Head, Swift Current, and Yorkton in the spring of 2021. The treatments were a factorial combination of three varieties and three pre-harvest herbicide/desiccation options for a total of nine treatments. Treatments were arranged in a four replicate RCBD and are listed in Table 16.

Table 16. Variety by pre-harvest herbicide/desiccant options evaluated for flax at Indian Head, Swift Current, and Yorkton in 2021.

| # | Variety | Pre-harvest Application [Z] |
|---|---|---|
| 1 | CDC Bethune | Untreated |
| 2 | CDC Bethune | 894 g glyphosate/ha |
| 3 | CDC Bethune | 400 g diquat/ha |
| 4 | CDC Glas | Untreated |
| 5 | CDC Glas | 894 g glyphosate/ha |
| 6 | CDC Glas | 400 g diquat/ha |
| 7 | CDC Sorrel | Untreated |
| 8 | CDC Sorrel | 894 g glyphosate/ha |
| 9 | CDC Sorrel | 400 g diquat/ha |

[Z] Applied in a minimum solution volume of 185 l/ha when 75% of bolls had turned brown

*Results*

Treatments were applied when 75% of the bolls had turned brown and the variables of greatest importance were visible stem dry-down along with actual seed and stem moisture at harvest. At Swift Current, the season was dry, and the site was variable with salinity exacerbating the drought effects. While variability made detecting treatment effects difficult, these conditions and that the flax reached maturity in July meant there was little need for pre-harvest applications to accelerate crop dry-down. It was also extremely hot and dry at Yorkton. Despite the drought, benefits to both diquat and glyphosate were observed; however, the diquat did not work as well as glyphosate nor as well as it did at Indian Head. We attributed this to application timing and the weather following the treatment applications. At Indian Head, it was also hot and dry, but to a lesser extent than the other locations and late-season soil moisture was quite abundant. Under these conditions, the untreated plots stayed green and both glyphosate and diquat worked well. Based on the visible dry-down ratings across all three varieties, diquat took effect in the least amount of time with striking differences already observed four days after application (Figure 5). The plots were combined 21 days after the pre-harvest treatment applications and dramatic, but similar, reductions in seed and straw moisture occurred with both of the products evaluated.

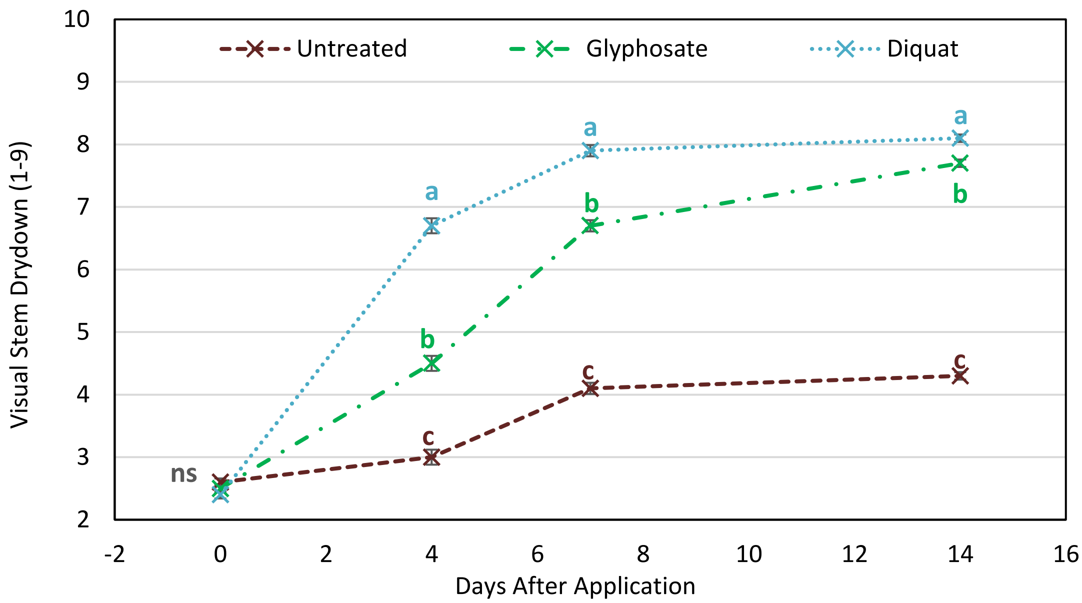


Figure 5. Visual stem dry-down ratings at 0, 4, 7, and 14 days after application (DAA) for various pre-harvest treatments at Indian Head, Saskatchewan (2021). Values within a date denoted by the same letter do not significantly differ and error bars are the standard error of the treatment means.

*Conclusions*

This project has shown that whether or not a pre-harvest herbicide or desiccant application is likely to be beneficial will depend on the specific crop and environmental conditions leading up to and following application. Under low yielding, drought conditions with more dry weather in the forecast, the potential for realizing a benefit with respect to crop dry-down or harvestability is low, especially if it is early in the fall with plenty of long days and time to complete harvest ahead. In contrast, if the weather is wet, stands are poor or uneven, and harvest will likely be delayed until late September or beyond, pre-harvest glyphosate or diquat can greatly accelerate crop dry-down leading to an earlier and easier harvest. In conclusion, both glyphosate and diquat can improve flax harvestability; however, which product is preferable and whether harvest aids are needed at all will vary with both environment and producer expectations.

*Acknowledgements*

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

## Flax Response to Non-Traditional Nitrogen Fertilizer Management Strategies

Holzapfel, C. (IHARF), Thompson, W. (Sask Flax), McInnes, B. (NARF), Shaw, L. (SERF), Nybo, B. (WCA), Hall, M. (ECRF), and Enns, J. (WARC)

*Description*

The objectives of this project were (1) to demonstrate flax yield response to a range of nitrogen fertilizer rates for a variety of Saskatchewan locations, (2) to demonstrate the seed-safety and potential yield benefits of polymer coated urea (ESN) relative to urea when side-banded at high rates, and (3) to 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. Flax field trials were initiated at Indian Head, Melfort, Redvers, Swift Current, Yorkton, and Scott in the spring of 2021. The treatments were selected to explore flax response to a range of N fertilizer rates (17-130 kg N/ha), contrasting fertilizer forms (urea vs 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/first 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 17.

Table 17. Treatments evaluated in nitrogen management demonstration for flax in 2021.

| # | 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 |

*Results*

The 2021 growing season was considered dry at all locations and, as such, yields were relatively low and variable. High rates of side-banded urea negatively impacted emergence at 67% of the locations, the exceptions being Indian Head and Yorkton. Where they occurred, the magnitude of these reductions ranged from 11-31%. As hypothesized, substituting side-banded urea with the ESN® blend greatly reduced or eliminated the stand reductions associated with side-banded urea and utilizing split-applications also helped in this regard. Lodging was not observed in any treatments, regardless of location. When averaged across treatments, yields ranged from 849-1706 kg/ha and responses to N fertilization occurred at Indian Head, Melfort, and Redvers, but not Swift Current, Scott or Yorkton (Table 18). Where responses occurred, maximum yields were achieved with 55-105 kg N/ha. In most cases, the observed yield responses could be reasonably explained by the combination of residual soil N levels and the actual yield potentials that could be achieved under the conditions encountered. Yield benefits were never realized by substituting side-banded urea with the ESN® blend or with split-applications where the in-crop source of N was untreated urea. No differences between the early or late in-crop applications were detected for yield. At Swift Current, there appeared to be a benefit to substituting untreated urea with Agrotain® treated urea; however, our confidence in this result was limited by the overall lack of N response.

Table 18. Mean flax seed yield as affected by nitrogen (N) treatment at Indian Head, Melfort, Redvers, Swift Current, Yorkton, and Scott in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

| Source / Nitrogen Treatment | Indian Head | Melfort | Redvers | Swift Current | Yorkton | Scott |
|---|---|---|---|---|---|---|
| | ------------------------------------ Seed Yield (kg/ha) ------------------------------------ | | | | | |
| Check | 793 b | 1438 b | 903 b | 807 a | 761 a | 1116 a |
| Low N – Urea | 1075 a | 1654 a | 1300 a | 840 a | 891 a | 1198 a |
| Med N – Urea | 1130 a | 1780 a | 1208 ab | 839 a | 864 a | 1145 a |
| High N – Urea | 1328 a | 1715 a | 1276 ab | 832 a | 653 a | 1213 a |
| High N – 75% ESN® | 1243 a | 1731 a | 1278 a | 883 a | 864 a | 1190 a |
| Ultra N – Urea | 1239 a | 1831 a | 1148 ab | 830 a | 761 a | 1150 a |
| Ultra N – 75% ESN® | 1233 a | 1794 a | 1355 a | 834 a | 845 a | 1071 a |
| Split – Early urea | 1209 a | 1749 a | 1336 a | 783 a | 894 a | 1062 a |
| Split – Early Agrotain® | 1194 a | 1705 a | 1234 ab | 939 a | 937 a | 1031 a |
| Split – Late urea | 1226 a | 1712 a | 1397 a | 802 a | 874 a | – |
| Split – Late Agrotain® | 1213 a | 1658 a | 1338 a | 945 a | 1062 a | – |

*Conclusions*

It would be beneficial to evaluate these treatments under more typical growing conditions where environmental conditions are more favourable for flax productions and, ideally, residual N levels are consistently lower.

*Acknowledgements*

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

## Lentil Response to Fertilizer Applications and Rhizobial Inoculation

Holzapfel, C. (IHARF), Fletcher, A. (Sask Pulse), Enns, J. (WARC), and Nybo, B. (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 lentil were initiated at Indian Head, Scott, and Swift Current in 2021. 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 treatments were arranged in a four replicate RCBD (Table 19). 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.

Table 19. Fertilizer and inoculant treatments evaluated in lentil fertility demonstrations conducted at Indian Head, Scott, and Swift Current in 2021.

| # | 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*

The most recent pea or lentil crop ranged from only two years prior at Scott to 13 years at Indian Head. Data collection included emergence, seed yield, test weight, seed weight, and seed protein. Emergence was not affected by the treatments in any cases, indicating that side-banding provided adequate separation between the fertilizer and seed-row. Yields were only increased with P fertilizer at Indian Head, the location with both the highest yields and the lowest residual P levels (Table 20). No yield benefits to rhizobial inoculation were detected at any locations. Whether supplied as side-banded urea or an in-season broadcast application, extra N did not affect yield. Neither rhizobial inoculant nor N fertilizer impacted seed protein concentrations; thus, providing compelling evidence that N was not limiting in any treatments at any locations.

Table 20. Lentil fertility treatment effects on mean seed yield at Indian Head, Scott, and Swift Current in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, $P \leq 0.05$).

| # | $P_2O_5$ Rate - Inoculant - Extra N | Indian Head | Scott | Swift Current |
|---|---|---|---|---|
| | | --------------------------- | Seed Yield (kg/ha) | --------------------------- |
| 1 | 0P - No - None | 1937 c | 1668 a | 1393 a |
| 2 | 0P - Yes - None | 1923 c | 2067 a | 1478 a |
| 3 | 22P - No - None | 2003 abc | 1819 a | 1515 a |
| 4 | 22P - Yes - None | 2048 abc | 2086 a | 1558 a |
| 5 | 45P - No - None | 2065 abc | 1954 a | 1384 a |
| 6 | 45P - Yes - None | 2091 abc | 2018 a | 1468 a |
| 7 | 45P - No - 55N sideband | 2208 a | 1781 a | 1324 a |
| 8 | 45P - No - 55N in-crop | 2007 abc | 1990 a | 1531 a |
| 9 | 45P - Yes - 55N sideband | 2219 a | 1869 a | 1610 a |
| 10 | 45P - Yes - 55N in-crop | 2149 ab | 2367 a | 1387 a |
| 11 | 67P - Yes - None | 2169 a | 2132 a | 1341 a |
| 12 | 67P - Yes - 55N sideband | 2183 a | 1622 a | 1590 a |

*Conclusions*

In conclusion, we still recommend applying P fertilizer to prevent yield loss and maintain soil fertility with the sole exception potentially being fields where residual P is already high (i.e. manured fields). Similarly, we hesitate to suggest that growers may not need to apply inoculant as biological N fixation is critical for profitable lentil production. We do not recommend applying N fertilizer beyond what may be supplied by modest rates of P and sulfur products. Possible exceptions include rescue applications if nodulation failure is confirmed and, perhaps, coarse textured soils extremely low in both organic matter and residual N. Due to the unusually hot and dry weather in 2021, there may be value in repeating this project in 2022.

*Acknowledgements*

Funding for this project was provided by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement and Saskatchewan Pulse Growers.

# Are Oats Responding to Higher Levels of Macronutrients?

Holzapfel, C. (IHARF), Hall, M. (ECRF), McInnes, B. (NARF), and Shaw, L. (SERF)

*Description*

The objective of this project was to demonstrate the response of a modern oat variety to the historically recommended rate of 67 kg N/ha against the more recently suggested recommendation of 101 kg N/ha and to determine the relative importance of adding phosphorus (P), potassium (K) and sulfur (S) for these different nitrogen (N) recommendations in eastern Saskatchewan. The field trials were established at Indian Head, Melfort, Redvers, and Yorkton in 2021. The treatments were arranged in a four replicate RCBD and are described in greater detail in Table 21. Contributions of N from phosphorus and sulphur sources were balanced, so that total rates of N of 17, 60 and 90 lb/ac were evaluated for each PKS fertility regime.

Table 21. Treatment list of oats response to higher levels of micronutrients trial in 2021.

| 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*

Levels of P, K, S did not affect emergence at any location except Yorkton, where emergence was significantly higher when potassium was left out of the blend. Increasing N from 17 to 90 lb/ac significantly increased emergence at Redvers. However, increasing N had no significant effect on emergence at the other sites. Treatment effects on lodging and maturity were either insignificant or not of agronomic concern. Yield potentials varied greatly between sites. However, no interactions between the levels of P, K, S and nitrogen rate were detected, allowing us to focus on the main effects. Indian

Head, Melfort, and Redvers sites were responsive to added phosphorus and Yorkton was responsive to added potassium and sulfur. The only site to require the addition of 90 lb N/ac was Indian Head (Table 22). At this rate, the yield was maximized, and test weights were still acceptable (Table 23). The optimum rate at Yorkton was only 17 lb N/ac because of low yield potential due to drought and high residual levels of background nitrogen. Moreover, test weights at this location were well below the rejection level regardless of N rate. The Redvers site only required the application of 17 lb N/ac as well. While 60 lb N/ac provided the highest numeric oat yield at this location, it also pushed test weights below the acceptable range for milling. At Melfort, 60 lb N/ac was the optimum rate to significantly maximize yield and still maintained adequate test weight. Treatment effects on lodging and maturity were either insignificant or not of agronomic concern.

Table 22. Main effects of N rate on oat yield at Indian Head, Melfort, Redvers, and Yorkton in 2021. Means within a column followed by the same letter do not significantly differ at P ≤ 0.05.

| | Indian Head | Melfort | Redvers | Yorkton |
|---|---|---|---|---|
| Nitrogen Rate | ------------------------------ Seed Yield (kg/ha) ------------------------------ | | | |
| 17 lb N/ac | 3024.6 c | 3767.1 b | 2918.3 a | 2276.9 a |
| 60 lb N/ac | 3567.9 b | 3989.8 a | 3207.2 a | 2305.3 a |
| 90 lb N/ac | 3722.2 a | 3980.3 a | 3127.4 a | 2251.6 a |
| P - value | <0.00001 | 0.000077 | NS | NS |

Table 23. Main effects of N rate on oat grains test weight at Indian Head, Melfort, Redvers, and Yorkton in 2021. Means within a column followed by the same letter do not significantly differ at P ≤ 0.05.

| | Indian Head | Melfort | Redvers | Yorkton |
|---|---|---|---|---|
| Nitrogen Rate | ------------------------------ Test Weight (g/0.5L) ------------------------------ | | | |
| 17 lb N/ac | 243.9 a | 250.2 a | 237.9 a | 218.7 a |
| 60 lb N/ac | 241.7 b | 248.0 a | 229.8 b | 216.9 a |
| 90 lb N/ac | 241.5 b | 247.5 a | 227.5 b | 214.5 a |
| P - value | 0.002213 | NS | <0.00001 | 0.086 |

*Conclusions*

The effect of added P, K, or S on yield did not differ between rates of N. Focusing on N responses, Indian Head site was responsive to added N because residual levels of N were low, and the yield potential was relatively high. Furthermore, application of P, K, or S did not help to maintain any loss in test weight associated with increasing N.

*Acknowledgements*

Funding for this project was provided by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement and Saskatchewan Oat Development Commission.

# Which Oat Varieties "Hold It Together" When the Going Gets Tough?

Popescul, D. (Sask Oat), Mathieson, S. (Sask Oat), Hall, M. (ECRF), Holzapfel, C. (IHARF), McInnes, B. (NARF), and Shaw, L. (SERF)

*Description*

The objective of this project was to help producers select milling oat varieties that are more likely to maintain yield and grain quality when harvested late. Lodging, shatter loss, grain quality and yield between six commonly grown milling oats were compared between ideal and late harvest timings. Trials were established near Indian Head, Melfort, Redvers, and Yorkton in 2021. A complete treatment list is given in Table 24, and they were arranged in a four replicate RCBD.

Table 24. Treatment list for oat variety trial conducted at Indian Head, Melfort, Redvers, and Yorkton in 2021.

| Treatment # | Harvest Timing | Variety |
|---|---|---|
| 1. | Ideal[a] | CDC Arborg |
| 2. | Ideal | CS Camden |
| 3. | Ideal | CDC Minstrel |
| 4. | Ideal | CDC Ruffian |
| 5. | Ideal | AAC Summit |
| 6. | Ideal | ORE3542M |
| 7. | Late season[b] | CDC Arborg |
| 8. | Late season | CS Camden |
| 9. | Late season | CDC Minstrel |
| 10. | Late season | CDC Ruffian |
| 11. | Late season | AAC Summit |
| 12. | Late season | ORE3542M |

[a] Ideal harvest timing will be when grain is close to 12.5-13.5% moisture

[b] Late season harvest will occur around early to mid-October after the crop has matured

*Results*

Due to early maturity and rapid dry down caused by dry conditions, the ideal and late harvest timings were much earlier in the season than anticipated. The number of days separating ideal and late harvest timings were 19, 24, 26 and 29 for Yorkton, Indian Head, Redvers and Melfort, respectively. By the late harvest timing, the level of lodging had increased at all locations. However, the relative level of lodging between varieties did not vary between ideal and late harvest dates at Redvers, Indian Head, or Yorkton. At the Melfort site at late harvest date, lodging was more severe for AAC Summit and CDC Ruffian had a moderate level of lodging. Yield wise, harvesting late resulted in significantly lower yields at all locations except Yorkton where yields significantly increased. The higher yield at Yorkton might be related to improved seed filling of immature tillers when harvest was delayed. At Indian Head, an interaction between harvest timing and variety was significant at for the yield data. While all varieties yielded significantly less when harvested late, the relative loss varied between varieties (Figure 6). In terms of test weight, varietal responses to late harvest varied at all locations. Across locations, test weights were consistently low for CS Camden and high for AAC Summit.

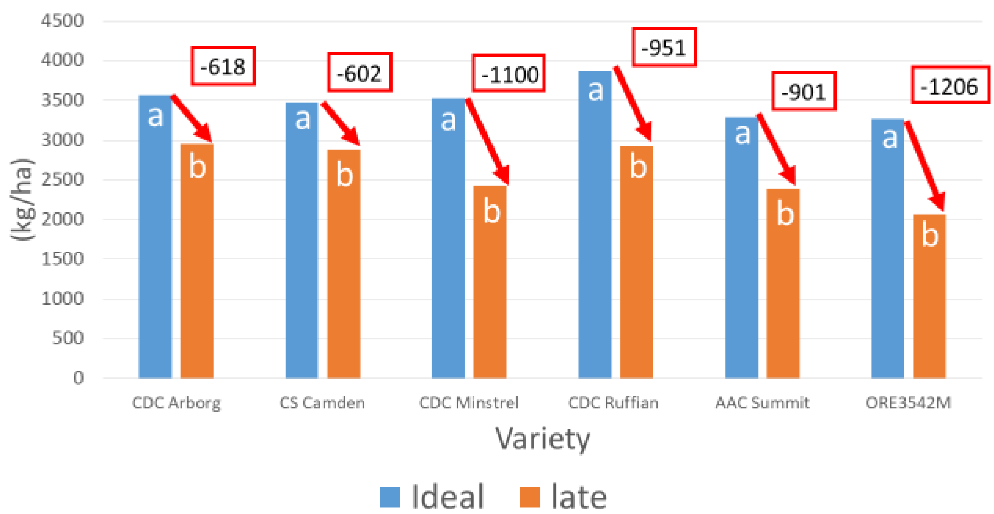


Figure 6. Effect of harvest timing on oat varieties at Indian Head in 2021.

*Conclusions*

The varietal differences between ideal and late harvest timings varied across locations. No one variety stood out as having the best of all attributes when harvested late. However, CDC Arborg probably had the least number of major concerns. It was resistant to lodging at Melfort, maintained a yield potential at Indian Head and generally had an acceptable test weight. CDC Ruffian showed moderate lodging at Melfort by late harvest and maintained a relatively good yield potential at Indian Head. AAC Summit frequently had the highest test weight regardless of harvest timing. Unfortunately, the yield tended to be on the low side.

*Acknowledgements*

Funding for this project was provided by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement and Saskatchewan Oat Development Commission.

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

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*Description*

The objectives of this 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. Field trials with faba bean were established at Indian Head, Melfort, Outlook, Prince Albert, Redvers, Swift Current, and Yorkton in 2021. The treatments were a factorial combination of two seeding dates (early vs. delayed), two seed 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. The fungicide was either Priaxor® or Dyax®, depending on product availability, 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. The eight treatments were arranged in a split-plot design with seeding dates as the main plots and seed rate and fungicide treatments as the sub-plots. Each treatment was replicated four times.

*Results*

The seeding date responses were often unexpected with many sites experiencing dry springs, but a relatively wet August combined with a warm fall with no major frost events prior to faba bean maturity. As such, delayed seeding often performed better than expected. Establishment was either not affected or only slightly affected by seeding date and seeding date had no meaningful effects on disease or response to fungicide. Yields were not affected by seeding date at Indian Head, Melfort, Outlook, Redvers, and Yorkton, higher with early seeding at Swift Current, and higher with delayed seeding at Prince Albert (Table 25). Across all sites, utilizing higher seed rates consistently increased the number of plants/m$^2$; however, for the 45 seeds/m$^2$ and 65 seeds/m$^2$ rates evaluated, there was not much for advantages beyond this. Furthermore, seeding this crop at 45 seeds/m$^2$ can already be a challenge due to the large seed size and an increase in seed rates this large can substantially increase input costs. Focussing on yield, there were no effects of seed rate for 6/7 locations but a positive response to the higher rates at Prince Albert. The Prince Albert site was, however, flagged for having high yield variability and potentially unreliable yield results. Under the dry conditions, we did not expect to see much benefit to fungicide applications, and this was usually the case. There was no yield advantage to fungicide for 5/7 locations. Swift Current and Yorkton responded positively to the foliar fungicide application but, ironically, these were two of the driest, lowest yielding locations where essentially no disease was observed.

Table 25. Overall tests of fixed effects for faba bean seed yields for Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Redvers (RV), Swift Current (SW), and Yorkton (YK) in 2021. The effect was significant when p ≤ 0.05.

| Source | IH | ME | OL | PA | RV | SW | YK |
|---|---|---|---|---|---|---|---|
| | ---------- p-values ---------- | | | | | | |
| Seeding Date (D) | 0.536 | 0.822 | 0.187 | **0.016** | 0.223 | **<0.001** | 0.888 |
| Seed Rate (R) | 0.295 | 0.691 | 0.199 | **0.048** | 0.481 | 0.382 | 0.778 |
| Fungicide (F) | 0.110 | 0.557 | 0.124 | 0.545 | 0.184 | **0.013** | **0.005** |
| D x R | 0.237 | 0.511 | 0.771 | 0.482 | 0.349 | 0.722 | 0.907 |
| D x F | 0.458 | 0.588 | 0.812 | 0.095 | 0.413 | 0.317 | 0.360 |
| R x F | 0.565 | 0.820 | 0.711 | 0.885 | 0.668 | 0.277 | 0.342 |
| D x R x F | 0.777 | 0.980 | 0.722 | 0.955 | 0.992 | 0.389 | 0.466 |

*Conclusions*

Overall, environmental conditions were not ideal for faba bean production due to widespread drought and heat stress, albeit to varying degrees depending on the location. At this stage, we would not change any of the current recommendations for seeding dates, seed rates, or fungicide recommendations. One area of interest, which we recognized prior to developing this project, is the uncertainty surrounding the optimal timing of fungicide application for faba beans; however, wetter conditions and higher disease pressure would be required to generate meaningful information on this subject.

*Acknowledgments*

This project was funded by Saskatchewan Pulse Growers.

## Agronomic and Economic Response of Lentil to Seeding Rate and Fungicides

Holzapfel, C. (IHARF), Enns, J. (WARC), and Nybo, B. (WCA)

*Description*

The objectives of this project were to demonstrate (1) 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) 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 initiated at Swift Current, Scott, and Indian Head in 2021. The treatments were a factorial combination of three seed rates and three fungicide management treatments. The treatments were replicated four times in an RCBD and are listed in Table 26.

Table 26. Lentil seeding rate and fungicide treatments.

| # | Seeding Rate | T1 Fungicide (early bloom) | T2 Fungicide (≈14 days after T1) |
|---|---|---|---|
| 1 | 130 seeds/m$^2$ | None applied | None applied |
| 2 | 130 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 3 | 130 seeds/m$^2$ | 395 ml Dyax/ha | 420 g Lance WDG/ha |
| 4 | 190 seeds/m$^2$ | None applied | None applied |
| 5 | 190 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 6 | 190 seeds/m$^2$ | 395 ml Dyax/ha | 420 g Lance WDG/ha |
| 7 | 250 seeds/m$^2$ | None applied | None applied |
| 8 | 250 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 9 | 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 1$^{st}$ flowers have appeared

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

*Results*

Emergence was generally quite good at all locations and, as expected, plant populations were affected by seeding rate at all three locations ($P < 0.001$). In all cases the response was linear ($P < 0.001$) while, at Scott, the quadratic response was also marginally significant ($P = 0.066$). While we utilized a pre-seed burn-down and registered in-crop herbicides, no pre-emergent residual herbicides were applied, and hand-weeding was not permitted. The visual weediness rates did show a subtle decline in weeds with increasing seed rate at both Indian Head and Scott (P < 0.001-0.007) but not at Swift Current ($P = 0.249$). The initial disease ratings were completed at the start of flowering and disease pressure was negligible at all three locations at this time. For the final disease ratings, completed approximately 7 days after the second fungicide treatments were applied, disease pressure was still extremely low with no meaningful treatment effects. At Indian Head, yields were affected by seed rate ($P < 0.001$; Figure 7) but not fungicide and there was no SR x FUNG interaction detected. The lack of an interaction tells that the effects of fungicide (or lack thereof) were consistent regardless of seed rate. Lentil yield was not affected by either seed rate or fungicide at both Scott and Swift Current locations. At Indian Head, test weight was affected by seed rate ($P = 0.001$) but not fungicide. At both Scott and Swift Current, neither seed rate nor fungicide was significant for test weight.

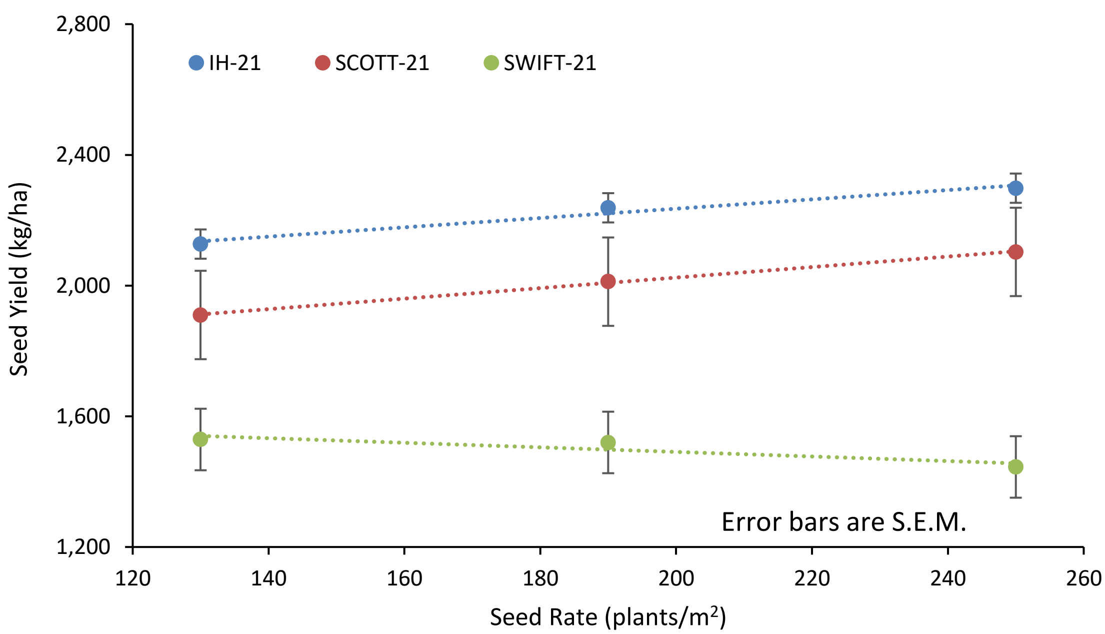


Figure 7. Seed rate effects on lentil seed yield at Indian Head, Scott, and Swift Current, Saskatchewan (2021).

*Conclusions*

At this stage, we would not revise any recommendations other than to say that, under dry conditions and in the absence of any visible disease, it is unlikely that there will be any benefit to even a single fungicide application and dual applications should not be considered. Deciding not to spray a crop like lentils for disease comes with a certain amount of risk and can be difficult for producers, however, and should be coupled with frequent scouting and monitoring of conditions. If conditions change (i.e. wetter weather commences, disease symptoms appear) it may be necessary to apply a foliar fungicide even if the crop is well into flowering/early pod fill in order to protect against yield loss.

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

## Can Farmer-Saved Seed of Wheat Perform as Well as Certified Seed?

Catellier, C. (IHARF), Enns, J. (WARC), and Pratchler, J. (NARF)

*Description*
The objectives of this study were (1) to compare the vigor and yield performance of various lots of farm-saved wheat seed relative to the same varieties of certified seed and (2) to determine the degree to which seed treatment can improve the vigor and yield potential of farm-saved and certified seed lots of wheat. Trials were conducted at Yorkton, Redvers, Indian Head, Swift Current, Scott, Outlook, Prince Albert and Melfort from 2019 to 2021. The treatments were arranged in a factorial RCBD with 4 replicates. The combined factorial treatments are listed in Table 27. The targeted seeding rate and date were 300 seeds/$m^2$ within the first three weeks in May. Seed treatment was applied shortly before seeding.

Table 27. Treatment list for farm-saved wheat seed vs certified wheat seed in trial in Saskatchewan.

| Trt # | Seed treatment | Variety pairing | Seed type |
|---|---|---|---|
| 1 | Untreated | A | Certified |
| 2 | Untreated | A | Farm-saved Seed |
| 3 | Untreated | B | Certified |
| 4 | Untreated | B | Farm-saved Seed |
| 5 | Untreated | C | Certified |
| 6 | Untreated | C | Farm-saved Seed |
| 7 | Treated | A | Certified |
| 8 | Treated | A | Farm-saved Seed |
| 9 | Treated | B | Certified |
| 10 | Treated | B | Farm-saved Seed |
| 11 | Treated | C | Certified |
| 12 | Treated | C | Farm-saved Seed |

*Results*
Positive effects of seed treatment on emergence, seedling vigor, and grain protein were observed at Swift Current. However, there were a couple instances at Yorkton and Indian Head where seed treatment adversely affected yield. In most instances seed treatment did not affect emergence, seedling vigor, yield, or grain protein of wheat. Overall, seed quality was very good for both farmer saved seed and certified seed lots. However, levels of seed borne disease tended to be more variable on farm-saved seed. One seed lot of farm-saved seed had total Fusarium levels beyond acceptable levels. Despite this, the overall vigor of farm-saved seed lots were no different from certified seed. Few significant

differences in emergence, seedling vigor, yield, or grain protein were observed between planting farm-saved seed and certified seed. As a result, growing farm-saved seed would have been more economical because of the added cost of purchasing certified seed.

*Conclusions*

While the study found there were no production risks from growing farm-saved seed in 2019, there is still value in purchasing certified seed as this assures quality (true to type) for end users and allows for the introduction of better genetics to help the farm stay competitive.

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## Hemp Seeding Date Demonstration for Grain Production

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*Description*

The main objective of this project was to determine the ideal seeding time for conventional hemp over multiple locations in Saskatchewan. Trials were conducted at Outlook, Melfort, Scott, and Indian Head in 2021. Outlook was the only irrigated site, whereas Melfort, Scott and Indian Head were non-irrigated. The project was seeded in a RCBD with fours replications. The treatments were arranged in a split-plot with seeding date as the main plots and three different hemp varieties as the sub-plots. The three seed dates used were late May, mid-June, and early July, and the three varieties used were Katani, Picolo, and X59.

*Results*

The growing conditions of 2021 were extremely hot and dry which ultimately affected the plant height, vigor and establishment at all sites. Seeding dates had a significant effect on yield at Outlook, Scott, and Indian Head sites with mid June having the highest yield (Table 28). Outlook had the highest yield among the four sites, but the seeding date effect was not significant, followed by Indian head. Due to poor growing conditions and lack of moisture, the lowest yields were recorded at Melfort. Varieties had a significant effect on yield at Melfort, Indian Head and Scott. Yield slightly varied among varieties, with Picola < Katani < X59 increasing in yield. The interaction between different seeding dates and varieties was only significant at Scott and Indian Head with all the three varieties yielding better under mid-June seeding date (Table 28).

Table 28. Seeding dates and varieties effect on mean hemp yield (kg/ha) measured at four sites in 2021.

| | | | | |
|---|---|---|---|---|
| *Seeding dates* | | | | |
| | *Melfort* | *Outlook* | *Scott* | *Indian Head* |
| Late (early-July) | 242.2 | 1111.1 | 525.4 | 1113.7 |
| Mid (Mid-June) | 201.2 | 1446.2 | 731.0 | 1221.4 |
| Early (Late-May) | - | 1147.4 | 489.9 | 918.0 |
| *Varieties* | | | | |
| Katani | 163.2 | 1178.6 | 554.8 | 1046.6 |
| Picola | 160.0 | 1139.1 | 541.4 | 1053.7 |
| X59 | 341.7 | 1387.0 | 650.1 | 1152.8 |
| *Seeding dates* Varieties* | | | | |
| Mid*X59 | - | - | 851.2 | 1302.3 |
| Mid*Picolo | - | - | 674.7 | 1194.0 |
| Mid*Katani | - | - | 667.0 | 1168.0 |
| Late*Picolo | - | - | 574.0 | 1153.8 |
| Late*Katani | - | - | 534.7 | 1151.3 |
| Early*X59 | - | - | 525.0 | 1120.3 |
| Late*X59 | - | - | 516.5 | 1036.0 |
| Early*Katani | - | - | 462.7 | 820.5 |
| Early*Picolo | - | - | 433.0 | 813.2 |

*Conclusions*

In year-one, we have found that the seeding date significantly affects yield and height. The maturity was more affected by varieties. With the extreme heat and lack of moisture in 2021 growing season these values may not represent the actual characteristics of hemp and the effect of seeding dates, so, weather permitting, years two and three will help focus on the values.

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## Establishing Nitrogen and Seeding Rate Recommendations for Hybrid Brown Mustard Production in Saskatchewan

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*Description*

The objectives of this project were (1) to understand nitrogen requirements of a hybrid mustard compared to Centennial brown and define upper and lower limits of N for hybrid brown mustard and (2) 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. The field demonstrations were conducted at Swift Current, Indian Head, and Redvers from 2020 – 2021. Part one consisted of 7 nitrogen rates applied to both Centennial brown mustard and hybrid brown mustard and included 4 replicates with RCBD. Part two consisted of 5 seeding rates of both Centennial brown mustard and hybrid brown mustard and included 4 replicates with RCBD. The treatments are listed in Table 29.

Table 29. Treatment list for nitrogen and seeding rate recommendations for hybrid brown mustard production in SK trial.

| Part 1: Nitrogen Trial | | | |
|---|---|---|---|
| Trt # | Variety | Total Nitrogen | Seeds/ft2 |
| 1 | Hybrid Brown | 30 | 22 |
| 2 | Hybrid Brown | 60 | 22 |
| 3 | Hybrid Brown | 80 | 22 |
| 4 | Hybrid Brown | 100 | 22 |
| 5 | Hybrid Brown | 120 | 22 |
| 6 | Hybrid Brown | 140 | 22 |
| 7 | Hybrid Brown | 160 | 22 |
| 8 | Centennial Brown | 0 | 22 |
| 9 | Centennial Brown | 60 | 22 |
| 10 | Centennial Brown | 80 | 22 |
| 11 | Centennial Brown | 100 | 22 |
| 12 | Centennial Brown | 120 | 22 |
| 13 | Centennial Brown | 140 | 22 |
| 14 | Centennial Brown | 160 | 22 |
| Part 2: Seed Rate Trial | | | |
| Trt # | Variety | Total Nitrogen | Seeds/ft2 |
| 1 | Hybrid Brown | 90 | 10 |
| 2 | Hybrid Brown | 90 | 14 |
| 3 | Hybrid Brown | 90 | 18 |
| 4 | Hybrid Brown | 90 | 22 |
| 5 | Hybrid Brown | 90 | 24 |
| 6 | Centennial Brown | 90 | 10 |
| 7 | Centennial Brown | 90 | 14 |
| 8 | Centennial Brown | 90 | 18 |
| 9 | Centennial Brown | 90 | 22 |
| 10 | Centennial Brown | 90 | 24 |

*Results*

After two years of this study and multiple drought years, more robust data is essential to perform meaningful statistical analyses and acceptable recommendations for the optimum seeding rate and nitrogen fertilizer requirements of hybrid brown mustard. Crop establishment rates were often below the target plant stand of 7-11 plants/ft$^2$ and resulted in a wide range of results. Emergence rates for mustard generally range from 50-80% when soil moisture is not limiting. With the below average moisture received for 5-site years, we saw emergence rates range from 41% to 54% for hybrid brown mustard and 50% to 60% for Centennial brown mustard. Similar to previous research, the vigorous nature of the hybrids appeared to better utilize higher rates of nitrogen to promote branching, pod development, and higher yields, as hybrid plant stands were thin compared to the Centennial brown mustard. Even with the low emergence rates and available nitrogen dependent on precipitation, preliminary results revealed the highest yielding hybrid to result from 160 N (1602 kg/ha) and the highest yielding Centennial to result from 140 N (1402.3 kg/ha) with no significantly different increase with nitrogen available up to 160 N. The hybrid brown also appeared to result the highest yields when seeded around 10-18 seeds/ft$^2$, whereas the Centennial yielded best when seeded 14-22 seeds/ft$^2$.

*Conclusions*

The study will be conducted for another year in 2022. After two of three years, this trial demonstrated the vigor and the impressive elasticity bred into the hybrid brown mustard given the negative correlation between plant establishment and yield throughout both the nitrogen and seed rate trials, but given the poor conditions, data was variable.

*Acknowledgements*

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