2024 Interim Research Report (Year 1)

for the

Saskatchewan Barley Development Commission

Project Title: Enhanced Barley Variety Trials 2024-2025

Principal Investigators: Mike Hall[1] and Ahsan Rajper[1]

Collaborators: Brianne McInnes[2], Chris Holzapfel[3], Jessica Enns[4], Kayla Slind[4], Bryan Nybo[5], and Amber Wall[5]

[1]East Central Research Foundation, Yorkton, SK.
[2]Northeast Agriculture Research Foundation, Melfort, SK
[3]Indian Head Agricultural Research Foundation, Indian Head, SK
[4]Western Applied Research Corporation, Scott, SK
[5]Wheatland Conservation Area, Swift Current, SK

Correspondence: m.hall@suncrectcollege.ca or (306) 621-6032

Project Identification

1. **Project Number:**
2. **Producer Group Sponsoring the Project:** SaskBarley
3. **Project Location(s):** Yorkton, SK, Melfort, SK, Indian Head, SK, Scott, SK, Swift Current, SK
4. **Project start and end dates (month & year):** April 2024 to April 2026
5. **Project contact person & contact details:**

Mike Hall, Research Coordinator

East Central Research Foundation/Suncrest College
Box 1939, Yorkton, SK, S3N 3X3
Phone: 306-621-6032
Email: m.hall@suncrestcollege.ca

Objectives and Rationale

6. **Project objectives:**

The broad objective is to determine if 2 malt and 2 feed barley varieties differ in response to N fertility, PGR and fungicide.

The malt varieties to be screened include AAC Prairie, CDC Churchill and the feed varieties include CDC Durango and AB Wrangler. These varieties were selected because they are new malting and feed varieties that are either increasing their area of production or have the characteristics to do so.

Since it is not logistically practical to assess all combinations of these factors. The trial has been designed to assess all varieties with the following combination of factors:

1. Standard N fertility, No PGR with Fungicide (leaf disease timing)
2. Enhanced N fertility, No PGR with Fungicide (leaf disease timing)
3. Standard N fertility, PGR with Fungicide (leaf disease timing)
4. Standard N fertility, No PGR with no Fungicide

Thus, the more specific objectives are to compare the barley varieties as follows:

- at standard and enhanced rates of N fertility, when sprayed with Fungicide (comparison 1 vs 2)
  - allows comparison of fertility rates without limitations of disease
- with and without PGR, at a standard N fertility and sprayed with Fungicide (comparison 1 vs 3)
  - allows comparison of PGR without limitations of disease
- with and without Fungicide, at a standard N fertility (comparison 1 vs 4)

- with and without a combination of PGR and Fungicide at a standard N fertility (comparison 3 vs 4)

7. Project Rationale:

Methodology and Results

8. Methodology:

In order, to keep costs down but still achieve the objectives of the study, the trial design is unusual but innovative. Table 1 lists the treatments established at each location in a split-plot design with 4 replications. The main-plot factor was "Barley Management" and the sub-plot factor was "Barley Variety". However, the treatment list was analyzed as 4 separate split-plot trials. Management A acts as a check for managements B, C and D which helps to keep the trial size to a manageable level. The first-split plot analysis will compared Management A vs B. This compared varietal response to standard vs enhanced N fertility when all varieties have received fungicide at flag but no PGR. Standard and Enhanced rates of N varied by location group based on historic yield potential (SCIC data). The groupings are as follows:

-Group 1 = low yield potential: Swift Current: 100 vs 125 lb N/ac of soil + added N

- Group 2 = mid range yield potential: Indian Head, and Scott: 120 vs 150 lb N/ac of soil + added N

- Group 3 = high yield potential: Yorkton, and Melfort,: 130 vs 162 lb N/ac of soil + added N

If soil sampling to 24 inches was not possible, N available in a 12 inch depth was multiplied by 1.5 for an approximation of N present in a 24 inch depth. Phosphorous and potassium were applied evenly to all treatments in each trial so as to be non-limiting even at the highest rate of N.

The 2nd split-plot analysis compared Management A vs C to determine the varietal response to PGR, at a standard rate of N and fungicide at flag. The PGR applied was Moddus (trinexapac-ethyl) at GS30-32 (stem elongation). The 3rd split-plot analysis compared Management A vs D to determine the varietal response to fungicide applied at flag leaf. For this comparison, all varieties were compared at the standard rate of N and with no PGR. The fungicide applied was either Trivapro or Nexicor applied at flag leaf timing. Once a fungicide was selected, all locations used the same product which was Trivapro. A 4th split-plot comparison was also made between Management C and D to determine the varietal response to a combination of PGR and fungicide for varieties fertilized at a standard rate of N.
Herbicide and possibly insecticide selection were at the discretion of the site manager to ensure pests are non-limiting to yield. All trials are considered "small plot", but plot size will vary between locations based on available equipment. Depending on plot width, either the whole plot or only 4 or 5 centre rows were harvested using a small plot combine. Seeding rates for each variety were based on TKW and germination tests to target 300 live seeds/m^2. Dates of

operations are listed in Table 2.

Table 1. Treatment list for trial (Barley Management by Barley Variety)		
#	**Barley Management (A-D)**	**Barley Variety**
1	A. Standard[1] N Fertility – No PGR – Fungicide[3]	AAC Prairie
2	A. Standard[1] N Fertility – No PGR – Fungicide[3]	CDC Churchill
3	A. Standard[1] N Fertility – No PGR – Fungicide[3]	CDC Durango
4	A. Standard[1] N Fertility – No PGR – Fungicide[3]	AB Wrangler
5	B. Enhanced[1] N Fertility – No PGR – Fungicide[3]	AAC Prairie
6	B. Enhanced[1] N Fertility – No PGR – Fungicide[3]	CDC Churchill
7	B. Enhanced[1] N Fertility – No PGR – Fungicide[3]	CDC Durango
8	B. Enhanced[1] N Fertility – No PGR – Fungicide[3]	AB Wrangler
9	C. Standard[1] N Fertility – PGR[2] - Fungicide	AAC Prairie
10	C. Standard[1] N Fertility – PGR[2] - Fungicide	CDC Churchill
11	C. Standard[1] N Fertility – PGR[2] - Fungicide	CDC Durango
12	C. Standard[1] N Fertility – PGR[2] - Fungicide	AB Wrangler
13	D. Standard[1] N Fertility – No PGR – No Fungicide	AAC Prairie
14	D. Standard[1] N Fertility – No PGR – No Fungicide	CDC Churchill
15	D. Standard[1] N Fertility – No PGR – No Fungicide	CDC Durango
16	D. Standard[1] N Fertility – No PGR – No Fungicide	AB Wrangler

[1]Standard and Enhanced rates of N Fertility [soil (0-24") + added N] varied between locations based on historic yield potentials obtained from SCIC data. Sites will fall into the following groupings:
- Group 1 = low yield potential: Swift Current: 100 vs 125 lb N/ac of soil + added N
- Group 2 = mid range yield potential: Indian Head, Scott: 120 vs 150 lb N/ac of soil + added N
- Group 3 = high yield potential: Yorkton, Melfort: 130 vs 162 lb N/ac of soil + added N
All sites were fertilized with P and K levels so as to be not limiting, even for the high N rate based on soil test recommendations.

[2]PGR applied was Moddus (trinexapac-ethyl) at GS30-32 (stem elongation).

[3]Fungicide applied was either Trivapro or Nexicor applied at flag leaf

Table 2. Dates of operations in 2024 for Yorkton (ECRF), Melfort (NARF), Indian Head (IHARF), Scott (WARC), and Swift Current (WCA).					
Operation	Yorkton	Melfort	Indian Head	Scott	Swift Current
Soil Test		April 30	May 16		April 16
Pre-seed Herbicide	May 12 & May 19 *(Roundup Transorb @ 0.66 L/ac)*	May 14 *(StartUp (Glyphosate 540) @ 1 L/ac)*	May 14 & May 21 *(Roundup Weathermax @ 0.67 L/ac)*	May 9 *(Glyphosate 540 @ 1L/ac & AIM @ 35 ml/ac)*	May 13 *(RT540 @ 1.6 L/ac)*
Seeded Trial	May 17	May 27	May 16	May 14	May 28
Rolled	NA	NA	NA	May 14	NA
Emergence Counts	June 13 June 14	June 13	June 4	June 6	June 6
In-crop Herbicide	June 8 *(Axial +AMS)*	June 9 *(Enforcer M @ 510 ml/ac)*	June 14 *(Prestige XL @ 0.95 L/ac + Axial @ 0.5 L/ac)*	June 18 *(Buctril M @ 0.4 L/ac & Axial Xtreme @0.5L/ac)*	June 19 *(Buctril M @ 0.4 L/ac)*
	June 9 *(Prestige)*	June 9 *(Axial @ 500 ml/ac)*			
	June 15 *(Axial +AMS)*	July 4 *(Enforcer M @ 510 ml/ac)*			
Apply PGR at stem elongation Treatments 9 to 12	June 17 *(Moddus)*	July 4 *(Moddus)*	June 8 *(Moddus @ 0.42 L/ac)*	June 19 *(trt 10 & 11)* June 22 *(trt 9 & 12)*	July 1 *(Moddus @ 0.42 L/ac)*
Apply fungicide at flag leaf Treatments 1 to 12	July 3 *(Trivapro)*	July 9 *(Trivapro)*	July 7 *(Trivapro A @ 0.4 L/ac + Trivapro B @ 0.12 L/ac)*	July 5 *(Churchill & Durango)* July 11	July 8 *(Trivapro A @ 0.4L/ac & Trivapro B @ 0.12 L/ac)*

				(Prairie & sprayed trt 14 & 15 accidentally)	
Lodging (0-9)	July 12	September 10	August 9 (1-9 scale)	August 21	August 1
Height (cm) – average of 6 plants/plot	August 2	August 21	July 30	August 7	August 1
Percent leaf disease coverage of penultimate leaf. Rate 10 leaves/plot for treatments 1-4 and 13-16.	August 2	July 18	July 19	July 24	July 26
Seed Yield	August 22 *(100s + 200s)* August 23 *(300s + 400s)*	September 10	August 25 *(Reps 3 & 4)* August 26 *(Reps 1 & 2)*	August 26	August 13
Send 500g from every plot to CMBTC	October 1	September 18		October 29	October 2

9. Results:

Growing season temperatures were near long-term averages for all sites except Prince Albert, which experienced a cool season. For all locations, June was unseasonably cool, but July and August were warmer than average. Precipitation was average to well above average for all locations in May and June. Wet conditions created difficulties during seeding for Prince Albert. July and August were drier than normal at all locations except Indian head were August was wetter than average. Yields averaged 74, 72, 64, 75, and 70 bu/ac at Yorkton, Prince Albert, Scott, Melfort, and Indian Head, respectively.

Table 3. Mean monthly temperatures and precipitation amounts for 2024 along with long-term normals for Yorkton (ECRF), Melfort (NARF), Indian Head (IHARF), Scott (WARC), and Swift Current (WCA), Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
			----------*Mean Temperature (°C)* ----------			
Yorkton	2024	10.5	14.2	20.3	17.7	15.7
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
Melfort	2024	10.1	13.2	19.4	17.4	15.025
	Long-term	***10.1***	***15.2***	***17.8***	***16.7***	***14.95***
Indian Head	2024	10.6	13.6	19.5	17.9	15.4
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Scott	2024	9.8	13.3	18.9	17.4	14.9
	Long-term	***10.8***	***14.8***	***17.3***	***16.3***	***14.8***
Swift Current	2024	10.6	14.3	21.3	19.4	16.4
	Long-term	***11.5***	***16.3***	***19***	***18.6***	***16.4***
			---------- *Precipitation (mm)* ----------			
Yorkton	2024	56	120.4	22.9	42.3	241.6
	Long-term	***51***	***80***	***78***	***62***	***271***
Melfort	2024	73	84	36.1	31.9	225
	Long-term	***33.4***	***79.5***	***69.6***	***45.9***	***228.4***
Indian Head	2024	63.7	74.9	37.4	71.8	247.8
	Long-term	***51.7***	***77.4***	***63.8***	***51.2***	***244.1***

Scott	2024	74.2	112.0	26.7	42.8	255.7
	Long-term	***38.9***	***69.7***	***69.4***	***48.7***	***226.7***
Swift Current	2024	73.6	52.1	18.6	18.2	162.5
	Long-term	***43.4***	***60.5***	***56.4***	***40.4***	***200.7***

Scott

At Scott there were a couple of issues regarding fungicide that created confounding when interpreting the data. Firstly, Trivapro was sprayed on CDC Churchill and CDC Durango on July 5 whereas, AAC Prairie and AB Wrangler were sprayed much later on July 11. Secondly, treatment 14 and 15 were accidently sprayed with fungicide. While all results have been tabulated, any discussion of fungicide that involves management D has been omitted.

Statistical analysis

Data were analyzed with the R statistical program, version 4.2.2 (R Core Team 2022), using the *lme4* package (Bates et al. 2015) for fitting mixed-effects models, the *lmerTest* package (Kuznetsova et al. 2017) for assessing model fit and treatment differences, and the *emmeans* package (Length 2023) for means separation. Data from all site-years were combined for a multi-site analysis. To assess the overall response across environments and determine the presence of significant site interactions, mixed effects models were fitted for each response variable (plant density, disease, height, lodging, yield, and protein) with fixed effects being Site, Variety and Management, all two-way interactions, and the three-way interaction. Random effects were Replicate within Site, and Management within Replicate within Site (Management was blocked in the split-plot design). If a significant three-way interaction was identified, then sites were analyzed separately, with Variety, Management, and the interaction as fixed effects, and Replicate and Management within Replicate (split-plot design) as random effects. Estimated marginal means were determined and if significant treatment effects were identified, means were separated using multiple pairwise comparisons with the LSD method for P-value adjustment and the Satterthwaite method for determining degrees of freedom. Treatments were considered significantly different at $P<0.05$.

Study Results

When referencing tables, an “a” after the table number indicates it is located in the Appendices.

Table 4. F-test results of mixed-effects model analysis of crop response variables assessing the presence of site interactions with Management and Variety. Effects are considered significant if $P<0.05$ and significant effects are bolded for emphasis.

	Plant density	Height	Lodging	Yield	Protein	Leaf disease	Test wt	Plump*	TKW*
Fixed effects	---------- *Pr(>F)* ----------								
Site (S)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Management (M)	**0.038**	**<0.001**	**<0.001**	**0.001**	**<0.001**	0.245	0.607	**0.078**	0.983
M x S	0.589	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.010**	**0.001**	**<0.001**
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.695	**<0.001**	**<0.001**	**<0.001**
V x S	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.830	**<0.001**	**<0.001**	**0.001**
M x V	0.685	0.217	**<0.001**	0.267	0.751	0.997	**0.007**	0.928	0.396
M x V x S	0.600	0.490	**<0.001**	0.272	0.932	0.467	**0.035**	0.593	0.591

*Malt varieties only

While significant effects of management and variety were determined for most of the parameters measured, significant management by site and variety by site interactions were also detected for the majority of the parameters (Table 4). This means effects should be evaluated on a site by site basis. When referencing tables, an "a" after the table number indicates it is located in the Appendices.

Plant density

While plant densities differed between varieties at all locations (Table 5), the relative ranking between varieties differed between locations (Table 1a). However, there was some consistency. For example, CDC Durango had the highest emergence at all sites and AAC Prairie had the lowest emergence at all sites except Yorkton, where AAC Prairie and AB Wrangler were tied for the lowest emergence (Table 1a). The relatively low emergence of AAC Prairie could have had some agronomic effects at Melfort, Swift Current and Scott. Management did not have a significant effect on emergence at any of the sites except Yorkton where a significant management by variety interaction was detected. While the relative emergence at Yorkton varied between each individual treatment (Table 1a), the variance was small and not likely to be agronomically consequential.

On average, plant densities at Melfort, Yorkton, Swift Current, Scott and Indian Head were 249, 305, 201, 261 and 321 plants/m^2, respectively. Populations were a little on the low side at Swift Current, but that region is typically drought prone and lower populations may benefit yield by reducing inter-plant competition for soil moisture. Populations at the other sites were certainly high enough to maximize yield potential.

Table 5. F-test results of mixed-effects models of **plant density** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	0.167	0.241	0.374	0.82	0.783
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
M x V	0.841	**0.033**	0.622	0.609	0.572

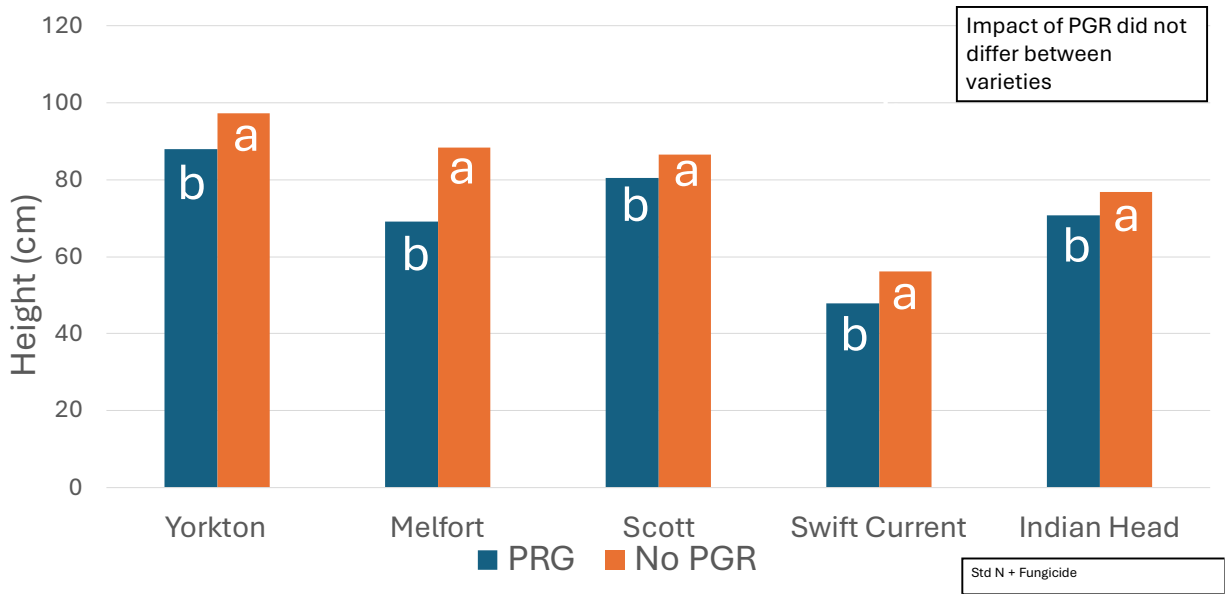
Crop Height

Significant main effects of management and variety were detected at all locations without any interactions (Table 6). At all locations, the use of PGR (management C vs A) significantly reduced crop height (Figure 1, Table 2a). The reduction in height was quite substantial at Melfort. The use of PGR in combination with fungicide (management C vs D) also reduced crop height (Table 2a). Neither enhancing N rate (management B vs A) or applying fungicide (management A vs D) significantly affected height at any location. The relative ranking of plant heights between varieties varied between locations as there was a significant variety by site interaction (Table 4). However, CDC Churchill and CDC Durango were frequently the shortest varieties and AB Wrangler and AAC Prairie were frequently the tallest varieties (Table 2a).

Table 6. F-test results of mixed-effects models of **height** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	**0.002**	**<0.001**	**<0.001**	**<0.001**
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
M x V	0.116	0.579	0.531	0.390	0.832

Figure 1. Effect of PGR on Barley Height



Lodging

No differences in lodging between levels of management or varieties were detected at Swift Current as there was a drought at this location and the crop was very short. For the rest of the sites, significant main effects of management and variety were detected at all locations (Table 7). At Scott, application of PGR (management C vs A) significantly decreased lodging and lodging was significantly less for AAC Prairie (Table 3a). This is incongruent with past study, as AAC Prairie only has a "fair" resistance rating to lodging. The relative lodging between varieties differed with management at Melfort, Indian Head and Yorkton, as significant management by variety interactions were detected at these locations (Table 7). However, the interaction also differed between sites, as indicated by a significant variety by site interaction (Table 4). At Melfort, lodging was significantly reduced by PGR for all varieties except CDC Durango, which experienced little lodging with or without the aid of PGR (Table 3a). This is congruent with past study, as CDC Durango is purported to have "Very Good" resistance to lodging whereas, the other varieties are rated as having only "fair" or "Good" resistance. Like Melfort, PGR at Yorkton greatly reduced lodging for AAC Prairie and CDC Churchill and had a more modest effect on CDC Durango (Table 3a). Again, "very good" resistance for CDC Durango was expected but AB Wrangler is also resisting lodging better than anticipated based on its "fair" rating. Figure 2 shows an aerial view of the trial site at Yorkton. Areas traced in black have received PGR and clearly have less lodging compared to the rest of the trial. At Indian Head, PGR only significantly reduced lodging levels for Churchill and Wrangler (Table 3a). It is a little incongruent that lodging was comparatively low for AAC Prairie since it is only rated as having "fair" resistance to lodging. The expression of lodging resistance between varieties differed somewhat between locations, indicating that the expression of this resistance is a complex process involving environmental, and possibly managerial influences. However, the results from

this study were relatively “in step” with published resistance ratings of “Fair” for AAC Prairie and AB Wrangler, “Good” for CDC Churchill and “Very Good" for CDC Durango.

Table 7. F-test results of mixed-effects models of **lodging** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	**0.003**	**NS**	**0.004**	**<0.001**
Variety (V)	**<0.001**	**<0.001**	**NS**	**<0.001**	**<0.001**
M x V	**<0.001**	**0.023**	**NS**	0.862	**<0.001**

Figure 2. Aerial view of Yorkton site. Areas traced in black received PGR.

Leaf disease

Percent leaf disease coverage on the penultimate leaf was very low in this study. No effects of

management or variety were detected at either Melfort or Scott (Table 8). However, a few significant differences were detected at the remaining sites. At Yorkton, there was a strong trend (p=0.066) for a management by variety interaction (Table 8). While the application of fungicide significantly reduced the presence of leaf disease for all varieties (management A vs D), it was more effective on CDC Durango (Table 4a). At Swift Current, the presence of leaf disease was extremely low due to the drought. However, disease ratings taken from all levels of management, found significantly more disease when pgr was applied (Table 4a, management C vs A). PGR is known to cause added stress to plants during drought and this may be the reason for slightly elevated levels of leaf disease or leaf senescence. At Indian Head, there was a weak trend (p=0.085) for less leaf disease when fungicide was sprayed. Although differences were low, CDC Churchill had significantly more leaf disease than the other varieties (Table 4a). Overall, levels of leaf disease were very low in this study, so the effects of variety selection and fungicide were minimal.

Table 8. F-test results of mixed-effects models of **leaf disease** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	1	0.061	**0.018**	0.147	0.085
Variety (V)	0.114	0.747	0.746	0.841	**<0.001**
M x V	0.212	0.066	0.995	0.721	0.551

Yield +Grain Protein+Test weight+kernel plumpness+1000 kernel weight

Main effects of variety on yield were significant at all locations, whereas main effects of management were only significant at Melfort and Yorkton (Table 9). No interactions between management and variety were detected at any location. However, there was a significant variety by site interaction, indicating that the relative ranking of variety by yield differed between locations. For grain protein, significant effects of management were detected at all locations except Swift Current and significant differences between varieties were detected at all locations except Yorkton (Tables 10). No interactions between management and variety were detected at any location. A substantial number of significant main effects were also detected for test weight, kernel plumpness, test weight, and 1000 kernel weight (Tables 11-13). Significant effects of management were detected for test weight and kernel plumpness at Melfort and Swift Current, and for 1000 kernel weight at Melfort. Differences in test weight between varieties was detected at all locations. Kernel plumpness significantly differed between varieties at all locations except Swift Current. For 1000 kernel weight, differences between varieties were only detected at Melfort, Scott and Indian Head. No interactions were detected between management and variety for test weight, kernel plumpness or 1000 kernel weight for all locations except Yorkton. At

Yorkton, a significant management by variety interaction found the test weight for AAC Prairie was comparatively lower compared to the other varieties when PGR and Fungicide were applied. The reason for this is unclear and the implications are minor.

Table 9. F-test results of mixed-effects models of **grain yield** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**0.002**	**0.006**	0.13	0.261	0.247
Variety (V)	**<0.001**	**0.044**	**<0.001**	**<0.001**	**,0.001**
M x V	0.421	0.332	0.256	0.489	0.172

Table 10. F-test results of mixed-effects models of **grain protein** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	**0.004**	0.590	**0.025**	**0.007**
Variety (V)	**<0.001**	0.151	**<0.001**	**0.001**	**<0.001**
M x V	0.219	0.545	0.989	0.776	0.582

Table 11. F-test results of mixed-effects models of **test weight** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	0.129	**0.05**	0.565	0.202
Variety (V)	**<0.001**	**<0.001**	**0.003**	**<0.001**	**<0.001**
M x V	0.179	**0.027**	0.472	0.106	0.172

Table 12. F-test results of mixed-effects models of **kernel plumpness** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	0.457	**0.044**	0.074	0.081

Variety (V)	**0.026**	**0.007**	0.709	**<0.001**	**0.034**
M x V	0.723	0.205	0.941	0.586	0.646

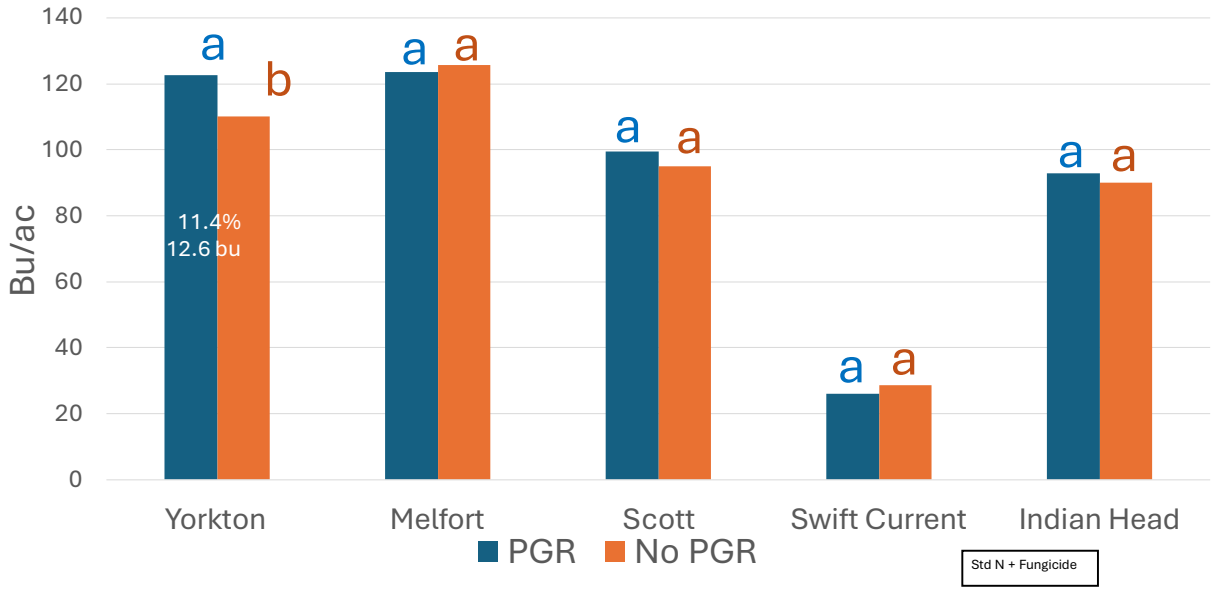
Table 13. F-test results of mixed-effects models of **1000 kernel weight** assessing the presence of Management and Variety interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Melfort	Yorkton	Swift Current	Scott	Indian Head
Fixed effects					
Management (M)	**<0.001**	0.123	0.166	0.070	0.269
Variety (V)	**<0.001**	0.079	0.399	**<0.001**	**0.035**
M x V	0.886	0.501	0.286	0.743	0.187

Impact of PGR

At Yorkton, the main effect of PGR (management C vs A) significantly increased yield by 11.4% or 12.6 bu/ac (Figure 3 and Table 5a). However, PGR did not significantly increase yield at any of the other locations in this study. In fact, PGR numerically decreased yield at Scott, Swift Current and Indian Head. A lack of a yield response to PGR was unanticipated at Melfort, as PGR greatly reduced lodging at this location (Table 3a). While not statistically significant, the use of PGR reduced grain protein by 0.94 percentage points at Yorkton through dilution as yield was substantially increased by PGR at this location (Figure 3, Tables 5a and 6a in appendix). PGR did not significantly affect grain protein at any other location. While PGR did not significantly affect yield at Melfort, it did significantly decrease kernel plumpness, test weight and 1000 kernel weight (Table 7a-9a). However, these effects were not significant at any of the other locations.

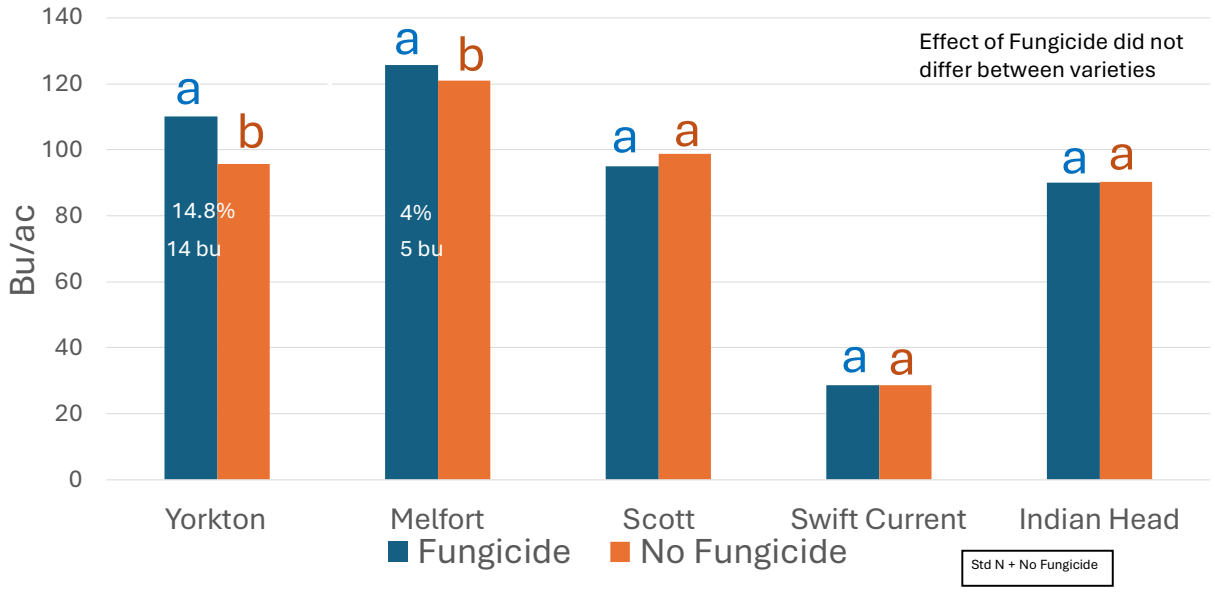
Figure 3. Effect of PGR on Barley Yield



Impact of Fungicide

The prevalence of leaf disease was low in this study. The Application of Fungicide (management A vs D) did not significantly reduce the level of leaf disease at any location (Table 4a). However, there was a strong trend (p=0.061) for reduced leaf disease when spraying fungicide at Yorkton. This translated into a significant yield response to fungicide of 14.8% or 14 bu/ac at Yorkton (Figure 4, Table 5a). Melfort also had a significant, albeit a smaller (3.9%) yield response to fungicide despite very low ratings for leaf disease. While the application of fungicide did not significantly affect grain protein at any location, a decline of 0.93 percentage points at Yorkton was observed and is likely the result of a significant yield response to fungicide (Tables 5a and 6a). Application of Fungicide had no effects on test weight, kernel plumpness or 100 kernel weight (Tables 7a -9a). No interactions between management and variety indicated that the effect of fungicide differed between varieties in terms of yield, grain protein, test weight, kernel plumpness or kwt.

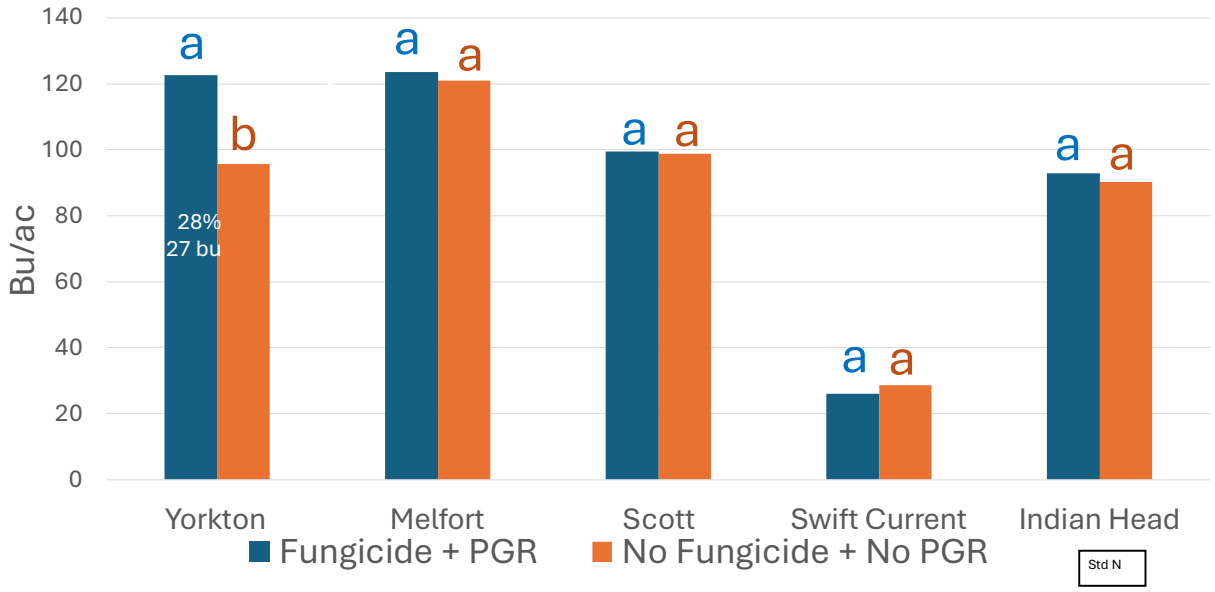
Figure 4. Effect of Fungicide on Barley Yield



Impact of Fungicide + PGR

The combination of Fungicide and PGR (management C vs D) significantly and substantially increased yield for Yorkton by 28% or 27 bu/ac (figure 5, Table 5a). However, significant increases were not detected at any of the other locations. The combination of Fungicide and PGR also significantly and substantially decreased grain protein at Yorkton by 1.87 percentage points (Table 6a), as yield was increased by 28% (Table 5a). This was particularly beneficial for the malt barley varieties which could have been rejected for malt otherwise due to excessive grain protein. Grain protein at Indian Head and Melfort were minorly but significantly increased by the application of fungicide and PGR. The reason for this unclear, as the PGR alone or in combination with fungicide did not significantly decrease yield. At Melfort, the combination of fungicide and PGR significantly reduced test weight, kernel plumpness and 1000 kernel weight. This likely the effect of the PGR, which had the same effects when applied alone. At Swift Current under drought conditions, the combination of fungicide and PGR significantly increased test weight and reduced kernel plumpness. Levels of kernel plumpness were extremely low in general at Swift Current.

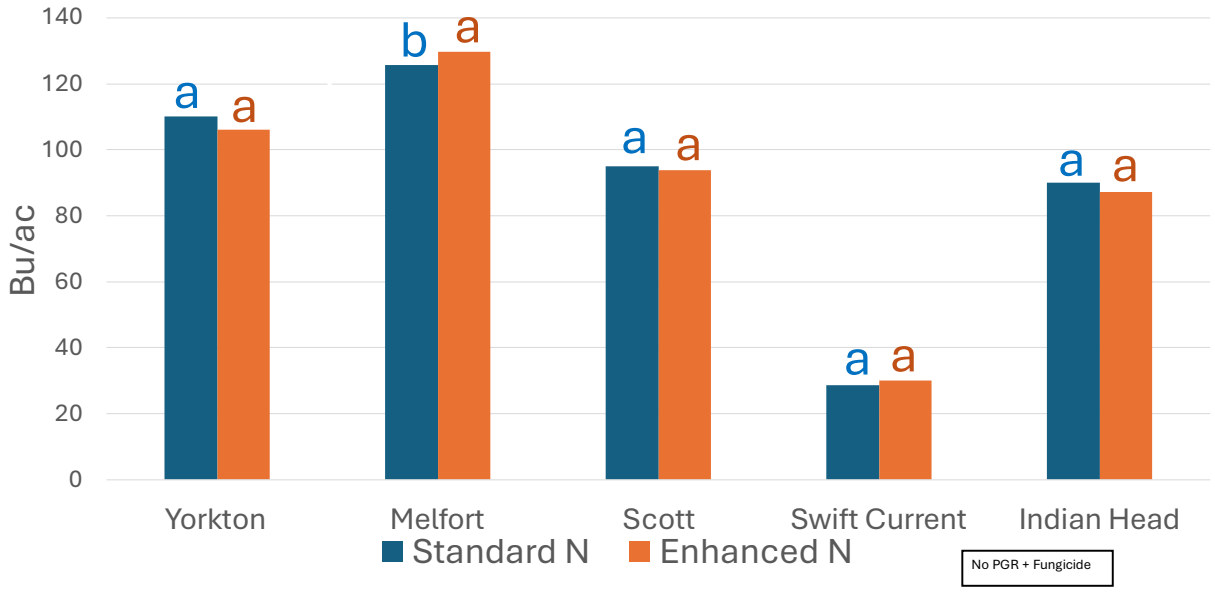
Figure 5 . Effect of Fungicide and PGR on Barley Yield



Enhancing N rate

At Melfort, enhancing N rate (management B vs A) significantly increased yield, albeit only by 3.3% (Figure 6, Table 5a). Enhancing N rate did not significantly increase yield at any other location. Enhancing N rate significantly increased grain protein at all locations except Swift Current where protein levels were extremely high and had likely plateaued in response to added N (Table 6a). Enhancing N rate did not significantly affect test weight, kernel plumpness and kwt at any location except Swift Current (Tables 7a-9a). At Swift Current, kernel pumpness increased in response to enhancing N.

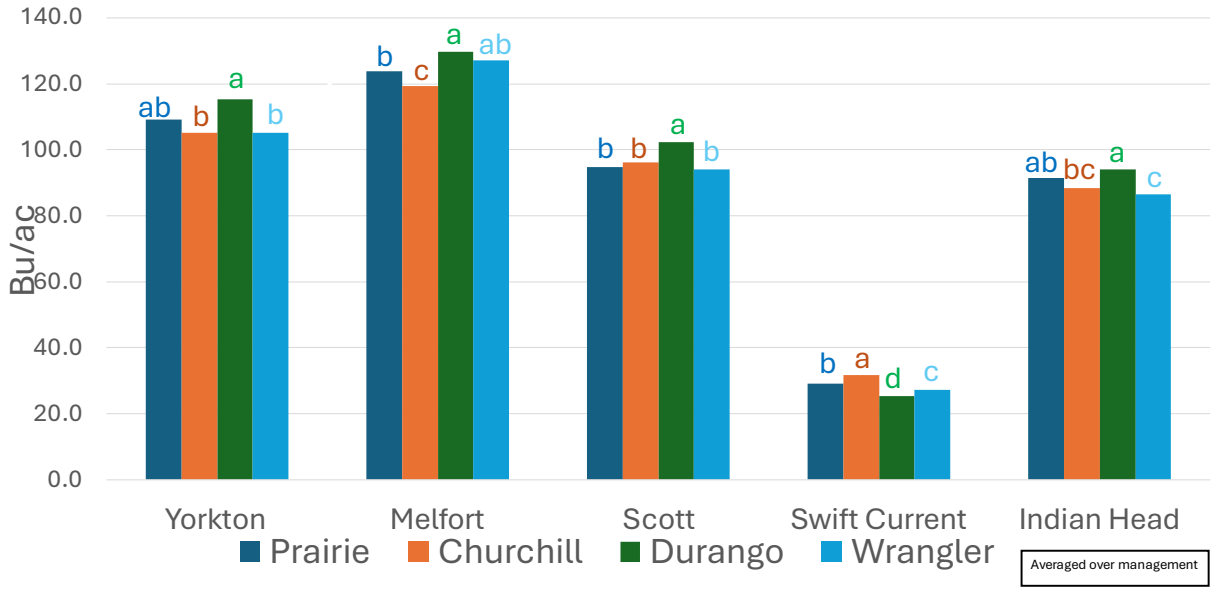
Figure 6. Effect of N rate on Barley Yield



Variety

While there were no significant management by variety interactions at any site for yield, protein, test weight, kernel plumpness and kwt (Tables 9 -13), there were significant site by variety interactions (Table 4). In other words, the relative value for each parameter varied between varieties and was not consistent between sites (Figure 7, Table 5a-9a). However, Durango (feed variety in green) was the highest yielding variety at all locations except Swift Current where it was the lowest yielding variety. In contrast, CDC Churchill was a relatively low yielding variety at all locations except Swift current where it was the highest. This result is curious and the author wonders if the drought at Swift Current favoured varieties with low yield potential and vice versa. The relative standing for AB Wrangler and AAC Prairie varied a lot between sites but neither variety was ever at the top of the pack. No significant grain protein differences were detected between varieties at Yorkton (Table 6a). There were differences at the remaining sites. However, differences were inconsistent and did appear related to yield potential.

Figure 7. Effect of Variety on Barley Yield



10. Conclusions and Recommendations

There was little evidence from this study to suggest barley varieties should be managed differently. Application of PGR reduced crop height at all 5 locations, and reduced lodging at 4 sites. Yorkton was the only site where PGR increased yield (11.4%) and in turn decreased protein (0.94 percentage points). While CDC Durango had very good resistance to lodging without PGR compared to the other varieties at Yorkton, it still benefited from the use of PGR like the other varieties. Disease levels were not high in this study and Fungicide did not significantly reduce leaf disease based on visual ratings. However, Fungicide significantly increased yield at Yorkton by 14.8% and at Melfort by 4%. This resulted in a reduction in grain protein of 0.94 percentage points at Yorkton. The combination of PGR + Fungicide did not affect yield at any location except Yorkton, where yield increased 28% and protein decreased 1.9 percentage points. Enhancing N rate only significantly increased yield at Melfort but significantly increased grain protein at all locations except Swift Current where grain protein had plateaued due to drought. While significant effects of management on yield and grain protein were detected at some locations, there were no interactions to indicate responses differed between varieties. There was little evidence in this study to suggest varieties should be managed differently. While the yield of varieties significantly differed at all locations, their relative standing between sites was not consistent. However, CDC Durango tended to be the highest yielding and Church the lowest yielding, except at Swift Current where the opposite was true under drought conditions.

Supporting Information

11. Acknowledgements:

This project was funded by SaskBarley.

Extension

A youtube video was created covering the results of this study. Enhanced Barley Variety Trials 2024

Results were presented at Top Notch Farming (February 12, 2024) in Moosomin.

Trial was viewed and discussed at ECRF/Suncrest College research farm tour July 23, 2024.

12. Appendices

Table 1a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on plant density.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	245.9	307.9	201.2	261.1	323.3
B. Enhanced N Fertility-No PGR-Fungicide	239.9	286.4	189.5	258.1	320.0
C. Standard N Fertility-PGR-Fungicide	242.6	312.8	203.6	260.7	326.8
D. Standard N Fertility-No PGR-No Fungicide	266.8	312.9	209.0	264.0	314.8
$LSD_{0.05}$	0.167	NS	NS	NS	NS
Variety (V)					
AAC Prairie	207.7^{c}	293.6^{b}	141.8^{b}	209.6^{c}	261.6^{d}
CDC Churchill	245.9^{b}	311.3^{a}	217.1^{a}	257.6^{b}	306.3^{b}
CDC Durango	300.1^{a}	321.8^{a}	216.1^{a}	327.1^{a}	425.7^{a}
AB Wrangler	241.4^{b}	293.3^{b}	228.2^{a}	249.6^{b}	291.1^{c}
$LSD_{0.05}$	<0.001	13.2	20.0	14.0	15.1
M x V					
Management A. - AAC Prairie	202.2^{e}	307.9^{cde}	147.9^{c}	208.2^{d}	265.3^{de}
Management A. - CDC Churchill	246.5^{bcde}	315.3^{bcd}	226.1^{ab}	257.6^{b}	299.8^{bc}
Management A. - CDC Durango	299.4^{a}	319.0^{bc}	219.0^{ab}	323.3^{a}	439.2^{a}
Management A. - AB Wrangler	235.4^{bcde}	289.3^{def}	212.1^{ab}	255.4^{b}	288.7^{cd}
Management B. - AAC Prairie	198.9^{e}	274.4^{f}	144.7^{c}	205.7^{d}	252.2^{e}
Management B. - CDC Churchill	228.8^{cde}	288.8^{ef}	198.0^{b}	243.1^{bc}	302.2^{bc}
Management B. - CDC Durango	308.4^{a}	300.0^{cdef}	191.2^{b}	340.8^{a}	418.7^{a}
Management B. - AB Wrangler	223.5^{de}	282.2^{ef}	224.3^{ab}	242.8^{bc}	306.8^{bc}
Management C. - AAC Prairie	216.9^{e}	307.9^{cde}	137.5^{c}	206.2^{d}	266.6^{de}
Management C. - CDC Churchill	233.8^{bcde}	305.8^{cde}	224.6^{ab}	267.0^{b}	320.7^{b}
Management C. - CDC Durango	279.3^{ab}	322.3^{abc}	224.6^{ab}	321.4^{a}	429.0^{a}
Management C. - AB Wrangler	240.3^{bcde}	315.3^{bcd}	227.6^{ab}	248.3^{b}	290.8^{bcd}
Management D. - AAC Prairie	212.8^{e}	284.3^{ef}	137.2^{c}	218.3^{cd}	262.5^{de}
Management D. - CDC Churchill	274.4^{abc}	335.1^{ab}	219.8^{ab}	262.8^{b}	302.6^{bc}
Management D. - CDC Durango	313.3^{a}	345.9^{a}	229.7^{ab}	323.1^{a}	415.8^{a}
Management D. - AB Wrangler	266.6^{abcd}	286.4^{ef}	249.0^{a}	252.0^{b}	278.1^{cde}

$LSD_{0.05}$	0.841	26.4	39.9	28.0	30.2

Table 2a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on height.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	88.3^{a}	97.4^{a}	56.2^{a}	86.6^{a}	76.8^{a}
B. Enhanced N Fertility-No PGR-Fungicide	87.9^{a}	96.4^{a}	57.1^{a}	88.7^{a}	78.0^{a}
C. Standard N Fertility-PGR-Fungicide	69.1^{b}	88.0^{b}	47.9^{b}	80.4^{b}	70.7^{b}
D. Standard N Fertility-No PGR-No Fungicide	87.0^{a}	97.9^{a}	57.0^{a}	86.1^{a}	78.0^{a}
$LSD_{0.05}$	3.0	4.4	1.8	2.8	2.2
Variety (V)					
AAC Prairie	84.0^{b}	98.4^{a}	53.9^{b}	87.4^{a}	76.5^{b}
CDC Churchill	79.8^{d}	93.0^{b}	56.5^{a}	83.1^{b}	74.2^{c}
CDC Durango	81.9^{c}	94.6^{b}	53.6^{b}	84.3^{b}	73.6^{c}
AB Wrangler	86.5^{a}	93.7^{b}	54.1^{b}	87.0^{a}	79.2^{a}
$LSD_{0.05}$	1.7	1.8	1.5	2.0	1.4
M x V					
Management A. - AAC Prairie	90.2^{ab}	100.8^{ab}	55.7^{cd}	88.4^{abc}	77.5^{cd}
Management A. - CDC Churchill	84.3^{de}	95.0^{cd}	59.4^{a}	85.4^{cdefg}	75.7^{def}
Management A. - CDC Durango	86.7^{cd}	98.0^{bcd}	53.6^{d}	85.8^{cdefg}	73.8^{fg}
Management A. - AB Wrangler	91.9^{a}	96.0^{cd}	56.0^{cd}	86.7^{cdef}	80.3^{ab}
Management B. - AAC Prairie	89.3^{abc}	100.0^{ab}	56.0^{cd}	91.1^{ab}	79.0^{abc}
Management B. - CDC Churchill	84.3^{de}	95.5^{cd}	59.0^{ab}	83.5^{efg}	76.2^{def}
Management B. - CDC Durango	88.0^{bc}	95.5^{cd}	56.0^{cd}	88.8^{abc}	76.2^{cdef}
Management B. - AB Wrangler	90.0^{abc}	94.5^{d}	57.3^{abc}	91.3^{a}	80.8^{a}
Management C. - AAC Prairie	68.2^{g}	90.8^{e}	46.6^{f}	82.2^{gh}	71.8^{g}
Management C. - CDC Churchill	68.2^{g}	86.0^{f}	49.7^{e}	78.5^{h}	69.0^{h}
Management C. - CDC Durango	66.3^{g}	86.5^{f}	48.0^{ef}	78.3^{h}	67.6^{h}
Management C. - AB Wrangler	73.9^{f}	88.8^{ef}	47.1^{ef}	82.9^{fg}	74.6^{ef}
Management D. - AAC Prairie	88.3^{bc}	102.3^{a}	57.3^{abc}	88.1^{abcd}	77.9^{bcd}
Management D. - CDC Churchill	82.5^{e}	95.5^{cd}	58.0^{abc}	85.1^{cdefg}	76.1^{def}

Management D. - CDC Durango	86.7^{cd}	98.3^{bc}	56.7^{abc}	84.2^{defg}	76.9^{cde}
Management D. - AB Wrangler	90.3^{ab}	95.5^{cd}	56.2^{bcd}	87.1^{bcde}	81.3^{a}
$LSD_{0.05}$	3.3	3.5	3.0	4.0	2.8

Table 3a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on lodging.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	4.19^{a}	4.31^{a}	1	2.4^{a}	2.1^{b}
B. Enhanced N Fertility-No PGR-Fungicide	4.00^{a}	5.75^{a}	1	2.6^{a}	3.9^{a}
C. Standard N Fertility-PGR-Fungicide	0.00^{b}	0.68^{b}	1	1.5^{b}	1.1^{c}
D. Standard N Fertility-No PGR-No Fungicide	4.93^{a}	5.87^{a}	1	1.6^{b}	1.8^{b}
$LSD_{0.05}$	1.03	2.44	NS	0.6	0.7
Variety (V)					
AAC Prairie	3.22^{c}	5.06^{a}	1	1.6^{b}	1.3^{c}
CDC Churchill	5.28^{a}	5.31^{a}	1	2.1^{a}	2.8^{b}
CDC Durango	0.06^{d}	2.44^{c}	1	2.1^{a}	1.3^{c}
AB Wrangler	4.56^{b}	3.81^{b}	1	2.4^{a}	3.5^{a}
$LSD_{0.05}$	0.72	0.96	NS	0.4	0.4
M x V					
Management A. - AAC Prairie	4.38^{ef}	6.50^{ab}	1	2.3^{bcd}	1.3^{gh}
Management A. - CDC Churchill	6.25^{abcd}	6.00^{b}	1	2.5^{abc}	2.6^{de}
Management A. - CDC Durango	0.00^{g}	2.00^{efg}	1	2.3^{bcd}	1.3^{gh}
Management A. - AB Wrangler	6.12^{bcd}	2.75^{def}	1	2.8^{ab}	3.4^{c}
Management B. - AAC Prairie	3.38^{f}	5.50^{bc}	1	2.0^{bcd}	2.1^{def}
Management B. - CDC Churchill	7.25^{ab}	8.00^{a}	1	2.8^{ab}	5.4^{b}
Management B. - CDC Durango	0.00^{g}	4.00^{cd}	1	2.5^{abc}	1.9^{efg}
Management B. - AB Wrangler	5.38^{cde}	5.50^{bc}	1	3.3^{a}	6.3^{a}
Management C. - AAC Prairie	0.00^{g}	1.00^{fgh}	1	1.0^{e}	1.0^{h}
Management C. - CDC Churchill	0.00^{g}	1.00^{fgh}	1	1.5^{de}	1.0^{h}
Management C. - CDC Durango	0.00^{g}	0.00^{h}	1	1.8^{cde}	1.0^{h}

Management C. - AB Wrangler	0.00^{g}	0.75^{gh}	1	1.8^{cde}	1.5^{fgh}
Management D. - AAC Prairie	5.12^{de}	7.25^{ab}	1	1.0^{e}	1.0^{h}
Management D. - CDC Churchill	7.63^{a}	6.25^{ab}	1	1.8^{cde}	2.3^{def}
Management D. - CDC Durango	0.25^{g}	3.75^{cde}	1	1.8^{cde}	1.1^{gh}
Management D. - AB Wrangler	6.75^{abc}	6.25^{ab}	1	2.0^{bcd}	2.8^{cd}
$LSD_{0.05}$	1.43	1.91	NS	0.8	0.8

Table 4a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on leaf disease.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	0.018	3.16	0.29^{b}	5.3	1.31
B. Enhanced N Fertility-No PGR-Fungicide	N/A	N/A	0.36^{b}		N/A
C. Standard N Fertility-PGR-Fungicide	N/A	N/A	0.78^{a}		N/A
D. Standard N Fertility-No PGR-No Fungicide	0.018	7.01	0.41^{b}	3.6	1.56
$LSD_{0.05}$	NS	NS	0.29	NS	NS
Variety (V)					
AAC Prairie	0.00	5.19	0.46	5.3	1.25^{b}
CDC Churchill	0.03	5.41	0.58	3.9	2.31^{a}
CDC Durango	0.05	4.71	0.48	4.1	1.13^{b}
AB Wrangler	0.00	5.05	0.32	4.6	1.06^{b}
$LSD_{0.05}$	NS	NS	NS	NS	0.56
M x V					
Management A. - AAC Prairie	0.00	2.88^{bc}	0.48	6.9	0.93^{c}
Management A. - CDC Churchill	0.05	4.03^{b}	0.38	3.7	2.37^{a}
Management A. - CDC Durango	0.03	1.90^{c}	0.18	5.0	1.06^{c}
Management A. - AB Wrangler	0.00	3.88^{b}	0.13	5.6	0.88^{c}
Management B. - AAC Prairie	N/A	N/A	0.23	N/A	N/A

Management B. - CDC Churchill	N/A	N/A	0.68	N/A	N/A
Management B. - CDC Durango	N/A	N/A	0.33	N/A	N/A
Management B. - AB Wrangler	N/A	N/A	0.20	N/A	N/A
Management C. - AAC Prairie	N/A	N/A	0.78	N/A	N/A
Management C. - CDC Churchill	N/A	N/A	0.88	N/A	N/A
Management C. - CDC Durango	N/A	N/A	0.83	N/A	N/A
Management C. - AB Wrangler	N/A	N/A	0.63	N/A	N/A
Management D. - AAC Prairie	0.00	7.50[a]	0.35	3.6	1.56[bc]
Management D. - CDC Churchill	0.00	6.80[a]	0.38	4.1	2.25[ab]
Management D. - CDC Durango	0.08	7.53[a]	0.60	3.3	1.19[c]
Management D. - AB Wrangler	0.00	6.23[a]	0.33	3.6	1.25[c]
$LSD_{0.05}$	NS	1.92	NS	NS	0.79

Table 5a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on grain yield.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	6757[b]	5919[b]	1532	5113	4839
B. Enhanced N Fertility-No PGR-Fungicide	6983[a]	5706[bc]	1619	5044	4693
C. Standard N Fertility-PGR-Fungicide	6648[bc]	6595[a]	1392	5355	5000
D. Standard N Fertility-No PGR-No Fungicide	6501[c]	5152[c]	1542	5309	4856
$LSD_{0.05}$	185	656	NS	NS	NS
Variety (V)					
AAC Prairie	6659[b]	5865[ab]	1567[b]	5096[b]	4917[ab]
CDC Churchill	6421[c]	5654[b]	1699[a]	5171[b]	4756[bc]
CDC Durango	6977[a]	6198[a]	1356[d]	5502[a]	5064[a]
AB Wrangler	6832[ab]	5655[b]	1464[c]	5053[b]	4651[c]
$LSD_{0.05}$	234	427		201	173
M x V					
Management A. - AAC Prairie	6735[bcdef]	6044[bcd]	1522[bc]	4911[de]	4867[bc]

Management A. - CDC Churchill	6638^{bcdef}	5229^{defg}	1741^{a}	4985^{cde}	4695^{cde}
Management A. - CDC Durango	6782^{bcde}	6381^{abc}	1315de	5451^{ab}	5098^{ab}
Management A. - AB Wrangler	6871^{bcd}	6023^{bcd}	1552^{bc}	5106^{bcde}	4697^{cde}
Management B. - AAC Prairie	7032^{ab}	6515^{cdef}	1656^{ab}	4859^{e}	4969^{abc}
Management B. - CDC Churchill	6422^{def}	5482^{defg}	1769^{a}	5048^{cde}	4424^{e}
Management B. - CDC Durango	7458^{a}	5930^{bcde}	1505^{bc}	5528^{a}	4928^{bc}
Management B. - AB Wrangler	7019^{ab}	5699^{cdef}	1547^{bc}	4743^{e}	4450de
Management C. - AAC Prairie	6506^{cdef}	6597^{ab}	1555^{bc}	5329^{abc}	4840^{bc}
Management C. - CDC Churchill	6327^{ef}	6962^{a}	1533^{bc}	5355^{abc}	5096^{ab}
Management C. - CDC Durango	6909^{bc}	6754^{ab}	1206^{e}	5460^{ab}	5284^{a}
Management C. - AB Wrangler	6850^{bcd}	6066^{bcd}	1275de	5276^{abcd}	4779^{bcd}
Management D. - AAC Prairie	6363^{ef}	5106^{efg}	1533^{bc}	5285^{abcd}	4993^{abc}
Management D. - CDC Churchill	6295^{f}	4941^{fg}	1753^{a}	5296^{abcd}	4810^{bc}
Management D. - CDC Durango	6758^{bcdef}	5728^{cdef}	1398^{cd}	5570^{a}	4945^{abc}
Management D. - AB Wrangler	6588^{bcdef}	4833^{g}	1482^{c}	5086^{bcde}	4676^{cde}
$LSD_{0.05}$	469	853	166	401.4	347

Table 6a. Means, P-values, and LSD separations for the main and interaction effects of management and variety on grain protein.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	11.39^{bc}	13.27^{bc}	19.89	13.21^{b}	13.77^{bc}
B. Enhanced N Fertility-No PGR-Fungicide	12.10^{a}	14.26^{a}	19.38	13.87^{a}	14.80^{a}
C. Standard N Fertility-PGR-Fungicide	11.54^{b}	12.33^{c}	20.08	12.93^{b}	14.16^{ab}
D. Standard N Fertility-No PGR-No Fungicide	11.32^{c}	14.20^{ab}	20.05	12.86^{b}	13.37^{c}
$LSD_{0.05}$	0.19	0.98	NS	0.65	0.69
Variety (V)					
AAC Prairie	11.86^{a}	13.58	20.26^{a}	13.16^{b}	14.25^{ab}
CDC Churchill	11.25^{b}	13.80	19.20^{b}	13.04^{b}	14.02^{b}
CDC Durango	11.84^{a}	13.22	19.14^{b}	13.06^{b}	13.31^{c}
AB Wrangler	11.39^{b}	13.45	20.79^{a}	13.60^{a}	14.53^{a}

$LSD_{0.05}$	0.21	NS	0.56	0.29	0.50
M x V					
Management A. - AAC Prairie	11.80^{cd}	13.50^{bc}	20.40^{abc}	13.35^{bcd}	14.08^{bcd}
Management A. - CDC Churchill	11.05^{fg}	13.98^{ab}	19.20^{def}	12.98^{de}	13.60^{cde}
Management A. - CDC Durango	11.53^{de}	12.70^{cd}	19.23^{def}	13.13^{cde}	13.28^{de}
Management A. - AB Wrangler	11.18^{efg}	12.90^{cd}	20.75^{ab}	13.38^{bcd}	14.15^{bcd}
Management B. - AAC Prairie	12.35^{a}	14.33^{ab}	19.90^{b-e}	13.60^{bc}	14.93^{ab}
Management B. - CDC Churchill	11.80^{cd}	14.38^{ab}	18.85^{ef}	13.85^{ab}	14.85^{ab}
Management B. - CDC Durango	12.23^{ab}	14.10^{ab}	18.45^{f}	13.68^{bc}	14.00^{bcd}
Management B. - AB Wrangler	12.03^{abc}	14.23^{ab}	20.30^{a-d}	14.35^{a}	15.43^{a}
Management C. - AAC Prairie	11.83^{bcd}	12.43^{d}	20.63^{ab}	12.88^{de}	14.50^{abc}
Management C. - CDC Churchill	11.38^{ef}	12.13^{d}	19.25^{def}	12.65^{e}	14.67^{ab}
Management C. - CDC Durango	11.83^{bcd}	12.40^{d}	19.38^{c-f}	12.88^{de}	13.00^{e}
Management C. - AB Wrangler	11.13^{efg}	12.35^{d}	21.05^{a}	13.33^{bcd}	14.50^{abc}
Management D. - AAC Prairie	11.48^{de}	14.05^{ab}	20.13^{a-d}	12.83^{de}	13.50^{de}
Management D. - CDC Churchill	10.78^{g}	14.72^{a}	19.50^{c-f}	12.70^{e}	12.98^{e}
Management D. - CDC Durango	11.80^{cd}	13.70^{bc}	19.50^{c-f}	12.58^{e}	12.98^{e}
Management D. - AB Wrangler	11.23^{ef}	14.33^{ab}	21.08^{a}	13.35^{bcd}	14.03^{bcd}
$LSD_{0.05}$	0.41	1.00	1.11	0.58	1.00

Table 7a. Means, P-Values and LSD separations for the main and interaction effects of management and variety on test weights.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	334.0^{a}	304.6	275.6^{ab}	299.4	278.9
B. Enhanced N Fertility-No PGR-Fungicide	336.6^{a}	303.1	283.2^{a}	297.4	273.6
C. Standard N Fertility-PGR-Fungicide	328.4^{b}	296.5	280.0^{a}	301.7	276.4
D. Standard N Fertility-No PGR-No Fungicide	335.7^{a}	293.2	271.6^{b}	305.2	281.4
$LSD_{0.05}$	2.91	NS	8.26	NS	NS
Variety (V)					
AAC Prairie	335.2^{b}	298.4^{b}	280.0^{a}	307.3^{a}	281.6^{b}
CDC Churchill	330.9^{c}	292.1^{c}	278.3^{a}	288.8^{c}	267.8^{c}

CDC Durango	337.7[a]	314.2[a]	279.7[a]	307.1[a]	292.5[a]
AB Wrangler	330.9[c]	292.8[c]	272.5[b]	300.7[b]	268.3[c]
$LSD_{0.05}$	2.45	4.94	4.25	5.40	3.59
M x V					
Management A. - AAC Prairie	337.6[abc]	304.5[b]	278.7[abc]	300.8[cdef]	283.8[cd]
Management A. - CDC Churchill	332.5[defg]	292.6[def]	274.3[bcd]	284.6[gh]	265.6[fg]
Management A. - CDC Durango	335.1[bcde]	321.7[a]	280.9[ab]	306.1[abcde]	293.4[ab]
Management A. - AB Wrangler	330.9[efg]	299.6[bcde]	268.6[de]	306.3[abcde]	272.8[ef]
Management B. - AAC Prairie	337.0[abcd]	303.1[bc]	284.8[a]	301.2[cdef]	278.0[de]
Management B. - CDC Churchill	334.9[bcde]	298.0[bcde]	284.3[a]	282.9[h]	261.7[g]
Management B. - CDC Durango	341.3[a]	318.2[a]	283.5[a]	310.0[abc]	292.0[ab]
Management B. - AB Wrangler	333.2[cdef]	292.9[def]	280.3[abc]	295.5[ef]	262.5[g]
Management C. - AAC Prairie	327.7[gh]	294.6[cde]	284.5[a]	312.8[ab]	277.7[de]
Management C. - CDC Churchill	324.2[h]	295.4[bcde]	280.8[ab]	292.5[fgh]	271.7[ef]
Management C. - CDC Durango	333.4[cde]	301.9[bcd]	277.6[abc]	303.0[bcdef]	290.4[abc]
Management C. - AB Wrangler	328.3[fgh]	294.1[cdef]	277.0[abcd]	298.7[def]	265.7[fg]
Management D. - AAC Prairie	338.3[ab]	291.2[efg]	271.9[cde]	314.3[a]	286.9[bc]
Management D. - CDC Churchill	332.1[efg]	282.2[g]	273.8[bcd]	295.3[fg]	272.2[ef]
Management D. - CDC Durango	341.1[a]	314.9[a]	276.7[abcd]	309.1[abcd]	294.1[a]
Management D. - AB Wrangler	331.2[efg]	284.6[fg]	264.1[e]	302.2[bcdef]	272.3[ef]
$LSD_{0.05}$	4.90	9.88	8.50	10.80	7.19

Table 8a. Means, P-Values and LSD separations for the main and interaction effects of management and malt varieties on plumpness.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	97.02[a]	77.21	15.02[b]	61.51	52.89
B. Enhanced N Fertility-No PGR-Fungicide	96.54[a]	77.81	24.11[a]	57.97	45.37
C. Standard N Fertility-PGR-Fungicide	89.78[b]	79.07	11.82[b]	61.63	49.73
D. Standard N Fertility-No PGR-No Fungicide	96.42[a]	72.96	15.25[b]	70.03	59.50
$LSD_{0.05}$	1.72	NS	8.40	NS	NS
Variety (V)					

AAC Prairie	95.39[a]	79.28[a]	16.26	68.06[a]	54.89[a]
CDC Churchill	94.49[b]	74.25[b]	16.84	57.51[b]	48.85[b]
$LSD_{0.05}$	0.78	3.41	NS	5.15	5.53
M x V					
Management A. - AAC Prairie	97.52[a]	81.83[a]	15.29[b]	64.98[bc]	57.21[ab]
Management A. - CDC Churchill	96.53[ab]	72.59[bc]	14.74[b]	58.05[cd]	48.58[bc]
Management B. - AAC Prairie	96.71[ab]	78.59[ab]	23.98[a]	62.36[bcd]	50.26[bc]
Management B. - CDC Churchill	96.39[ab]	77.03[ab]	24.24[a]	53.59[d]	40.47[c]
Management C. - AAC Prairie	90.18[c]	79.75[a]	11.53[b]	69.58[ab]	50.55[abc]
Management C. - CDC Churchill	89.37[c]	78.40[ab]	12.10[b]	53.68[d]	48.91[bc]
Management D. - AAC Prairie	97.16[ab]	76.96[ab]	14.22[b]	75.33[a]	61.56[a]
Management D. - CDC Churchill	95.68[b]	68.96[c]	16.27[b]	64.73[bc]	57.44[ab]
$LSD_{0.05}$	1.55	6.83	6.62	10.29	11.05

Table 9a. Means, P-Values and LSD separations for the main and interaction effects of management and malt varieties on thousand kernel weights.

Management (M)	Melfort	Yorkton	Swift Current	Scott	Indian Head
A. Standard N Fertility-No PGR-Fungicide	49.15[a]	38.76	25.53	32.31	30.25
B. Enhanced N Fertility-No PGR-Fungicide	49.37[a]	39.05	26.89	31.69	29.14
C. Standard N Fertility-PGR-Fungicide	44.66[b]	39.39	27.22	33.81	30.23
D. Standard N Fertility-No PGR-No Fungicide	48.84[a]	36.07	25.13	34.71	31.19
$LSD_{0.05}$	1.29	NS	NS	NS	NS
Variety (V)					
AAC Prairie	49.16[a]	39.16	26.07	34.58[a]	30.74[a]
CDC Churchill	46.84[b]	37.47	26.31	31.69[b]	29.67[b]
$LSD_{0.05}$	0.82	NS	NS	1.02	0.98
M x V					
Management A. - AAC Prairie	50.35[a]	40.51	25.72	33.48[b]	31.29[a]
Management A. - CDC Churchill	47.96[b]	37.00	25.34	31.15[cd]	29.21[bc]

Management B. - AAC Prairie	50.75[a]	39.75	26.62	32.90[bc]	30.11[abc]
Management B. - CDC Churchill	47.98[b]	38.35	27.16	30.48[d]	28.17[c]
Management C. - AAC Prairie	45.68[c]	39.21	27.33	35.57[a]	29.93[abc]
Management C. - CDC Churchill	43.63[d]	39.56	27.10	32.05[bcd]	30.52[ab]
Management D. - AAC Prairie	49.86[a]	37.16	24.61	36.36[a]	31.62[a]
Management D. - CDC Churchill	47.81[b]	34.98	25.65	33.06[bc]	30.76[ab]
$LSD_{0.05}$	1.63	NS	NS	2.05	1.97

Abstract

Abstract/Summary:

Trials were conducted at Yorkton, Melfort, Indian Head, Scott and Swift Current to determine if the malt varieties AAC Prairie, CDC Churchill and feed varieties CDC Durango and AB Wrangler differ in their response to N Fertility, PGR and fungicide. In other words, should these varieties be manged differently. In terms of lodging, the response to PGR differed between varieties at several locations. While there were inconsistencies between locations, CDC Durango always had very good resistance to lodging compared to the other varieties with or without the use of PGR. CDC Durango was the only variety listed with “very good” resistance to lodging. In terms of leaf disease, application of fungicide did not significantly reduce the level of leaf disease at any location. Yorkton was the only location where the application of fungicide and PGR alone or in combination increased yield with a corresponding decline in grain protein. At Melfort, a significant yield response to fungicide was also detected. Enhancing N resulted in a significant yield response at Melfort and significant increases in grain protein at Yorkton and Indian Head. While significant effects of management on yield and grain protein were detected, there were no interactions to indicate responses differed between varieties. There was little evidence in this study to suggest varieties should be managed differently. While varieties did differ in terms of yield and grain protein, relative ranking between sites was inconsistent. However, CDC Durango tended to be the highest yielding and Church the lowest yielding, except at Swift Current where the opposite was true.