Agriculture Demonstration of Practices and Technologies (ADOPT)
Project Final Report

The final project report should be made available electronically (MS Word). Additional data tables and or graphs may be submitted in spreadsheet format. Due to formatting, printing and distribution requirements, final reports will not be accepted as PDF documents. Completed reports must be returned by email to Evaluation.Coordinator@gov.sk.ca.

Project Title:	Demonstrating the response of hybrid brown mustard and composite yellow mustard to proper fertility recommendations
Project Number:	20220462
Producer Group Sponsoring the Project:	Saskatchewan Mustard Development Commission
Project Location(s):	Swift Current (WCA, RM #137), Indian Head (IHARF, RM #156), Redvers (SERF, RM #61)
Project start date *(month & year):*	4/1/2023
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Abstract *(maximum 200 words)*

This demonstration promotes soil testing and shows how mustard responds to differing fertility levels of macronutrients based on soil test recommendations. In this project, we are looking for ways to balance macro and micronutrients to prevent the need for higher nitrogen fertilizer levels when other nutrients aren't available in the required amount. Small-plot demonstrations were initiated near Indian Head, Redvers and Swift Current, SK in 2023. The demonstration was set-up as a split-plot design with four replications. Two varieties of mustard were selected, including AAC Yellow 80 and AAC Brown 18. Both were seeded at 237 seeds/m^2 with all fertilizer side-banded and nutrient rates based on soil test macronutrient recommendations, plus either Zinc, or Boron. Data collection consisted of plant density, lodging, days to maturity, and seed yield. Yields were not significantly different between the 2 varieties. As fertility rate

increased so did lodging and yield. The addition of Zinc, resulted in more of a yield response than the addition of Boron, but at Indian Head the additional macronutrients (125% RFR) resulted in the highest yielding treatment. This project was featured by Rick Mitzel, Executive Director of Sask Mustard and Cory Jacob, Provincial Oilseed Extension Specialist at the Annual Wheatland Conservation Area field day (80 attendees) on July 20, 2023 as well as at the Sask Mustard AGM presented by Amber Wall, held January 11, 2024 (150 attendees). Results will also be presented by Amber at the Online AgriARM Webinar on March 19, 2024. Key takeaways will be featured in the Sask Mustard Spring 2024 Newsletter. At Indian Head the project was also a part of the Annual Field Day, held on July 18, 2023 and presented by Chris Holzapfel, Research Manager at Indian Head Agricultural Research Foundation, and Cory Jacob. The trial was also a part of the Redvers field day, presented by Lana Shaw, Research Manager at South East Research Farm.

Project Objectives

The purpose of this project is to help mustard growers understand the fertility requirements of hybrid and composite mustard varieties. This project should help mustard growers to increase their yields and profitability.

Project Rationale

Many mustard producers are not soil testing to see what nutrients are available to the crop that growing season. In this project, we are looking for ways to balance macro and micronutrients to prevent the need for higher nitrogen fertilizer levels when other nutrients aren't available in the required amount. There may be a benefit to the addition of micronutrients, though no micronutrient deficiencies are noted in mustard in western Canada. Soil test recommendations for a micronutrient such as boron are difficult to be relied upon, but that is what is currently available and it possible that a response to micronutrients may be observed. This research project also supports the 4R Nutrient stewardship by encouraging soil testing and proper fertilizer use based on a soil test recommendation.

Until recently, mustard fertility recommendations have been based on 20 plus year-old data using open-pollinated varieties when Hybrid/composite mustard varieties were not yet available. Hybrid vigor (heterosis) enables superior performance such as increased yields, as it is produced in a breeding system that ensures female parents are only fertilized by male parents in seed production and only seed from female plants is harvested and sold as seed. Composite/synthetic varieties are produced under a breeding system that uses a mix of female plants and male plants in seed production and harvests seeds from both the male and female.

Producers who grow mustard say they cannot increase yield with the open-pollinated varieties. The hybrid and composite varieties change this with a 20% (hybrid) and 9% (composite) consistent yield advantages. The yield benefits of the hybrid and composite varieties over the open-pollinated mustard varieties are now well documented. Strong mustard prices make it a profitable crop worth considering, especially now with the long-standing mustard yield ceiling being broken with these new varieties available to producers.

https://saskmustard.com/wp-content/uploads/2019/10/Grow-Mustard-Fall-Issue-2019.pdf

Methodology

Specific site operations can be seen in Table 3 (appendices).

Experimental design: Split plot with 4 replicates

Locations: Swift Current (Dry Brown), Indian Head (Black), & Redvers (Black-long season)

Treatments: (2 mustard types x 6 Fertility Treatments x 4 reps = 48 plots)

NOTE: 100% recommended fertility rate (RFR) for each site are listed below.
Swift Current: 110-53-0-32 lbs/ac (brown) and 80-38-0-32 (yellow).

Indian Head: 142-39-0-5 lbs/ac (brown) and 92-29-0-5 (yellow).

Redvers: 117-46-0-9 lbs/ac (brown) and 82-35-0-9 (yellow).

#	Mustard Class (main plot)	Fertility Treatment [Z] (sub-plot)
1	AAC Brown 18	0% Soil test Rec. NPKS (0% RFR)
2	AAC Brown 18	50% Soil test Rec. NPKS (50% RFR)
3	AAC Brown 18	100% Soil test Rec. NPKS (100% RFR)
4	AAC Brown 18	100% Soil test Rec. NPKS + 5.6 kg B/ha (100% RFR + Zn)
5	AAC Brown 18	100% Soil test Rec. NPKS + 5.6 kg Zn/ha (100% RFR + B)
6	AAC Brown 18	125% Soil test Rec. NPKS (125% RFR)
7	AAC Yellow 80	0% Soil test Rec. NPKS (0% RFR)
8	AAC Yellow 80	50% Soil test Rec. NPKS (50% RFR)
9	AAC Yellow 80	100% Soil test Rec. NPKS (100% RFR)
10	AAC Yellow 80	100% Soil test Rec. NPKS + 5.6 kg B/ha (100% RFR + Zn)
11	AAC Yellow 80	100% Soil test Rec. NPKS + 5.6 kg Zn/ha (100% RFR + B)
12	AAC Yellow 80	125% Soil test Rec. NPKS (125% RFR)

[Z] Swift Current – Target 35 bu/ac for Brown & 25 bu/ac for Yellow in AGVISOR
[Z] Indian Head & Redvers – Target 40 bu/ac for Brown and 30 bu/ac for Yellow in AGVISOR

Data Collection:

- Composite soil samples (0-6”, 6-24”) submitted for residual nutrients and basic quality analyses (NO3-N, Olsen – P, K, S, micronutrients, OM, pH and CEC).
- Plant counts – Record the number of plants in a minimum of 2 x 1 m sections of crop row approximately 2-3 weeks after emergence is first noted.
- Lodging – Completed prior to harvest, rated on a scale of 1-9 where 1 is upright and 9 is flat.
- Maturity – Approximately 60% of the seeds have turned color from green to brownish/red or yellow, depending on the mustard type.
- Yield – Corrected for dockage and to uniform moisture content of 10%.

Results

General Conditions

Growing season temperatures and precipitation amounts for the 2023 growing season (May-August) relative to the long-term averages are provided in Table 1. All locations were above the long-term average temperature (Redvers: 108%, Swift Current: 109%, Indian Head: 109%) and below the long-term average precipitation (Redvers: 60%, Swift Current: 97%, Indian Head: 49%). Swift Current experienced a hail storm on July 22, 2023 that resulted in yield and quality loss due to pod shatter. It was important to note that AAC Brown 18 mustard resulted in higher shattering (%)

compared to AAC Yellow 80 and this created some variability in data collection. Overall weed and insect pressure was low, other than some broadleaf weeds, specifically volunteer canola that were not controlled at Indian Head.

Table 1. Mean monthly temperature and precipitation for the 2023 growing season (May-August) at Saskatchewan trial locations and long-term (10-year) averages.

Location	Year	May	June	July	August	Avg. / Total
		Mean Temperature (°C)				
Redvers	2023	14.5	19.7	17.6	17.9	17.4
	Long-term	**11.1**	**16.2**	**18.7**	**18.0**	**16.0**
Swift Current	2023	14.8	17.8	18.5	17.8	17.2
	Long-term	**10.9**	**15.4**	**18.7**	**17.7**	**15.7**
Indian Head	2023	14.0	19.4	16.7	17.7	17.0
	Long-term	**10.8**	**15.8**	**18.2**	**17.4**	**15.6**
		Precipitation (mm)				
Redvers	2023	70	25	11	49	155
	Long-term	**60**	**85**	**66**	**47**	**257**
Swift Current	2023	49	34	77	48	207
	Long-term	**44**	**74**	**52**	**43**	**214**
Indian Head	2023	13	50	16	41	119
	Long-term	**52**	**77**	**64**	**51**	**244**

Selected soil test results for each site are provided in Table 2 below. Redvers had the highest pH of 8.7, followed by Indian Head (8.1) and Swift Current (7.9). Organic matter was similar at Swift Current and Redvers (2.6 and 2.8%), but higher at Indian Head (6.1%). Residual P was considered medium at Swift Current, low at Indian Head and very low at Redvers. Residual Sulphur was high at both Indian Head and Redvers compared to medium at Swift Current. Overall residual N was low. Boron and Zinc residual levels varied with Swift Current having very low residual Boron (0.3) and low residual Zinc (0.52) Redvers also had low residual Zinc (0.34). Indian Head had medium-high levels of both Zinc and Boron.

Table 2. Soil residual nutrients (0-6", 6-24") and basic quality analyses (NO3-N, Olsen – P, K, S, micronutrients, OM, pH and CEC).

Depth	pH	OM%	CEC (meq/100g)	N (lbs/ac)	P (lbs/ac)	K (ppm)	S (lbs/ac)	Cl (lbs/ac)	B (ppm)	Zn (ppm)	Cu (ppm)
Swift Current 2023											
0-6"	7.0	2.6	16	6	22	239	8	16	0.3 (VL)	0.52 (L)	0.56 (M)
6-24"	7.9	-	-	12	-	-	24	-	-	-	-
Indian Head 2023											
0-6"	7.6	6.1	37.7	4	12	478	20	12	1.3 (H)	0.66 (M)	2.0 (H)
6-24"	8.1	-	-	9	-	-	72	-	-	-	-
Redvers 2023											
0-6"	8.1	2.8	33	8	4	243	14	16	1 (M)	0.34 (L)	0.76 (L)
6-24"	8.7	-	-	15	-	-	72	-	-	-	-

Plant Densities & Establishment

The combined analysis for all three sites indicated a plant density response to variety. AAC Brown 18 resulted in significantly higher establishment compared to AAC Yellow 80 (Table 8). The average plant density observed over 3

locations was 140 plants/m^2 (AAC Brown 18) and 129 plants/m^2 (AAC Yellow 80). When all 3 sites were combined, there was no significant interaction between fertility and plant establishment (Table 8). Indian Head (173 plants/m^2) and Redvers (169 plants/m^2) had similar plant establishment, significantly higher than Swift Current (79 plants/m^2, Table 4). However, high seed mortality and a negative relationship with increasing fertilizer rate was observed in Swift Current. This could be due to ammonia injury associated with high rates of side-banded N in cases where either soil conditions were extremely dry or separation between the seed and fertilizer was inadequate due to poor seed-bed conditions. Emergence at Swift Current averaged 32% and had a negative relationship with increasing fertilizer rate. At Indian Head, emergence averaged 72% and resulted in increasing plant densities up to about 100% of the recommended fertilizer rate, but decreased at 125% of the recommended rate. Emergence at Redvers also averaged 72% and increased with fertilizer rates with the exception of AAC Brown 18 with 125% of the recommended fertilizer rate applied.

Lodging

There was minimal lodging incidence recorded at all three sites. Although, the combined analysis indicated a lodging response to variety with AAC Brown 18 (3) having higher lodging incidence compared to AAC Yellow 80 (1). It was expected that with high nitrogen rate applications (125% RFR) the risk of lodging would increase. This was true at Indian Head for AAC Brown 18, but overall lodging incidence was low. When all 3 sites were combined, there was no significant interaction between fertility and lodging (Table 8). Mean lodging incidence followed the order of Swift Current (1), Indian Head (2) Redvers (3)(Table 5). At Swift Current, fertility treatments did not affect lodging incidence. At Indian Head, fertility had no lodging effect on AAC Yellow 80 and ratings for AAC Brown 18 increased from 2 to 4 with increasing fertility. Lodging incidence was the highest at Redvers, where AAC Brown 18 lodging incidence ranged from 2 to 4, but had no effect on AAC Yellow 80.

Days to Maturity

Maturity ratings were largely affected by drought and high temperatures at each site, averaging 75-76 days (Table 8) compared to the expected 84 days (https://saskseed.ca/interactive-seed-guide/). In the combined analysis, there were no changes in maturity due to fertility level, but AAC Yellow 80 matured one day earlier than AAC Brown 18. Redvers was the earliest maturing of the sites (74), followed by Indian Head (76) and lastly, Swift Current (77, Table 6). At Indian Head and Redvers there was a trend for higher fertility treatments to delay maturity by one, or two days.

Yield

Overall yield potential was negatively affected by limited moisture and above average temperatures at all three sites. In the combined site analysis there was no variety effect on yield (Table 8). AAC Brown 18 yielded 1177 lbs/ac, followed by AAC Yellow 80 at 1169 lbs/ac. Mustard yields increased as fertility rates increased, with the highest yield resulting from 125% RFR (1386 lbs/ac); not significantly different from 100% RFR + Zn (1358 lbs/ac). The addition of Boron to the 100% RFR also resulted in a yield increase (1262 lbs/ac) compared to 100% RFR, but was not significantly different (1245 lbs/ac). Mustard yields varied across each location with Indian Head averaging 1367 lbs/ac, followed by Redvers (1186 lbs/ac) and Swift Current (963 lbs/ac, Table 7). Swift Current yields were negatively affected by a hail storm on July 22, 2023. It was noted that AAC Brown 18 experienced higher pod shatter (20%) than AAC Yellow 80 (10%). However, there was a fertility effect at each site. At Swift Current the addition of Boron (1039 lbs/ac) resulted in an 85lb/ac increase over the 100% RFR, but were not significantly different than one another. The addition of Zinc (1103 lbs/ac) resulted in a 149 lb/ac increase over the 100% RFR. Additional macronutrients (125% RFR) resulting in a yield response (1119 lbs/ac) compared to 100% RFR, but was not significantly different than 100% RFR + B, or 100% RFR + Zn. At Swift Current the

highest yield resulted from AAC Yellow 80 fertilized with 100% RFR + B (1198 lbs/ac), or + Zn (1170 lbs/ac). The highest yielding treatment at Indian Head was AAC Yellow 80 with 125% RFR (1720 lbs/ac). This response was expected as soil residual levels at Indian Head indicated low Nitrogen, but Zinc and Boron were at medium-high levels. At Redvers, the addition of Zinc resulted in 194 lb/ac increase over the 100% RFR and not significantly different than 125 RFR (1363 lbs/ac). The highest yielding treatment at Redvers resulted from AAC Brown 18 fertilized with 100% RFR +Zn (1466 lbs/ac) and AAC Brown 18 with 125% RFR (1409 lbs/ac). The highest AAC Yellow 80 yield resulted when fertilized with 100% RFR + Zn (1354 lbs/ac).

Extension

- Chris Holzapfel, IHARF Research Manager and Cory Jacob, Provincial Oilseed Specialist, at the Annual Indian Head Agricultural Research Foundation field day (160 attendees) on July 18, 2023.
- Rick Mitzel, Executive Director of Sask Mustard and Cory Jacob, Provincial Oilseed Extension Specialist at the Annual Wheatland Conservation Area field day (80 attendees) on July 20, 2023.
- Lana Shaw, SERF Research Manager at the Annual South East Research Farm field day (50 attendees) on July 27, 2023.
- Amber Wall, presented results at the Sask Mustard AGM, held January 11, 2024 (150 attendees).
- Amber Wall, presented results during the Online AgriARM Webinar on March 19, 2024 (attendees TBD).
- Key takeaways will be featured in the Sask Mustard Spring 2024 Newsletter.

Conclusions and Recommendations

This demonstration reiterates the importance of soil testing. Overall, there was a mustard yield response to Zinc in most cases, with the exception of AAC Brown 18 at Indian Head. Contributing factors to overall response were the medium-high residual Zinc levels, at two locations. This study did not demonstrate a strong response to Boron, but AAC Yellow 80 did show a small yield response, where soil residual Boron was low at Swift Current. As expected, there was a yield response to increased Sulphur and Nitrogen (125% RFR) where residual levels were low. However, in some cases the yield increases from added macronutrients (125% RFR) were not significantly different than added Zinc (100% RFR + Zn) showing that micronutrients should be considered in the overall picture to avoid over applying macronutrients, such as Nitrogen. Like macronutrients, mustard will respond to proper micronutrient management and this study has demonstrated that a composite soil test is very important to optimize yield and economic return.

Key takeaways:

- Yield response to Zinc where soil residual levels were low.
- Yield response to Boron where soil residual levels were low.
- Yield response to Sulphur and Nitrogen where soil residual levels were low
- This study has demonstrated the importance of soil testing.
- Micronutrients should be used to avoid over applying Nitrogen to optimize yield and economic return.
- Future research could look at the effect of Zinc and Boron applied in combination and seed row placement and if there is any effect on seed oil content, or protein.

Sustainable Canadian Agricultural Partnership (Sustainable CAP) Performance Indicators

a) List of performance indicators

Sustainable CAP Indicator	Total Number

Scientific publications from this project (List the publications under section b)	
• Published	0
• Accepted for publication	0
HQPs trained during this project	
• Master's students	0
• PhD students	0
• Post docs	0
Knowledge transfer products developed based on this project (presentations, brochures, factsheets, flyers, guides, extension articles, podcasts, videos). List the knowledge transfer products under section (c)	5

[1] Please only include the number of unique knowledge transfer products.

b) List of scientific journal articles published/accepted for publication from this project.

Title	Author(s)	Journal	Date Published or Accepted for Publication	Link (if available)

c) List of knowledge transfer products/activities developed from this project.

Knowledge Transfer Product or Activity	Event/Location Where Knowledge Transfer Was Conducted	Estimated Number of Producers Participated In Knowledge Transfer	Link (if available)
WCA Annual Field Tour	Swift Current	80	https://wheatlandconservation.ca/please-call-the-ministry-of-agriculture-office-at-306-778-8285-to-register/
IHARF Annual Field Tour	Indian Head	160	
SERF Annual Field Tour	Redvers	50	
Presentation	Sask Mustard AGM	200	https://wheatlandconservation.ca/project/demonstrating-the-response-of-hybrid-brown-mustard-and-composite-yellow-mustard-to-proper-fertility-recommendations/
Presentation	AgriARM Webinar	TBD	February 2024
Summary	SMDC Newsletter	SK Mustard Producers	Spring 2024

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Sustainable Canadian Agricultural Partnership

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- Rick Mitzel, Executive Director, Saskatchewan Mustard Development Commission

Appendices

Identify any changes expected to industry contributions, in-kind support, collaborations or other resources.

Nexus BioAg (provided in-kind) Zinc ($ZnSO_4$) and Boron (Granubor) fertilizer.

Table 3. 2023 operations at each location.

Location	Swift Current	Indian Head	Redvers
Year	----------2023----------		
Stubble	Durum	Canary Seed	Barley
Seed Date	15-May	19-May	31-May
Seeded plot size	17.25m^2	22m^2	20m^2
Row Spacing	8.25 inches	12 inches	12 inches
Seed Rate	237 seeds/m2		
	AAC Brown 18 @8.4 lbs/ac		
	AAC Yellow 80 @11.6 lbs/ac		
Fertility	Sideband: 100% recommended fertilizer rate (RFR) based on AgVise soil test results		
AAC Brown 18	based on target yield of 35 bu/ac	based on target yield of 40 bu/ac	based on target yield of 40 bu/ac
AAC Yellow 80	based on target yield of 25 bu/ac	based on target yield of 30 bu/ac	based on target yield of 30 bu/ac
Product	Zinc provided as Nexus $ZnSO_4$ @5lbs/ac (14lbs product/ac)		
	Boron provided as Nexus Granubor @5lbs/ac (33lbs product/ac)		
Plant Density	13-Jun	09-Jun	15-Jun
Herbicide	Centurion/Amigo	Contender II/1% IPCO MSO	Arrow All In
Herbicide	-	Muster	-
Insecticide	Decis	Decis	-
Fungicide	-	Lance WDG	-
Lodging ratings	21-Aug	09-Aug	01-Sep
Desiccation	-	Roundup Weathermax	-
Harvest Dates	24-Aug	16-Aug	Brown: Sept-02, Yellow: Sept-06

Table 4. Plant density measured in plants per square meter for each treatment, variety and fertility rate at each location in 2023.

Plant Density		Swift Current		Indian Head		Redvers	
		----------(plants/m^2)----------					
	CV (%)	9.7		10.0		17.0	
	Grand Mean	76		173		169	
Variety x Fertility							
AAC Brown 18	0% Soil test Rec. NPKS	88	a	193	b	177	c
AAC Brown 18	50% Soil test Rec. NPKS	69	d	182	c	180	c
AAC Brown 18	100% Soil test Rec. NPKS	77	c	169	d	173	c
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Boron	68	d	204	a	192	b
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Zinc	70	d	190	b	204	a
AAC Brown 18	125% Soil test Rec. NPKS	69	d	189	bc	180	c
AAC Yellow 80	0% Soil test Rec. NPKS	91	a	144	g	146	e
AAC Yellow 80	50% Soil test Rec. NPKS	80	bc	157	ef	145	e
AAC Yellow 80	100% Soil test Rec. NPKS	81	b	158	ef	143	e
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Boron	80	bc	164	de	151	de
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Zinc	68	d	161	e	158	d
AAC Yellow 80	125% Soil test Rec. NPKS	77	c	152	f	179	c
	LSD	3		7		10	
Variety							
AAC Brown 18		74	a	190	a	185	a
AAC Yellow 80		79	a	157	b	154	b
	LSD	6		17		24	
Fertility Rate							
0% Soil test Rec. NPKS		89	a	179	ab	162	bc
50% Soil test Rec. NPKS		74	c	176	ab	162	bc
100% Soil test Rec. NPKS		79	b	158	c	158	c
100% Soil test Rec. NPKS + 5lbs actual Boron		74	c	184	a	172	abc
100% Soil test Rec. NPKS + 5lbs actual Zinc		69	d	176	ab	181	abc
125% Soil test Rec. NPKS		73	cd	170	b	179	ab
	LSD	4		10		153	

Table 5. Lodging incidence rated from 1 to 9 (9=flat) for each treatment, variety and fertility rate at each location in 2023.

Lodging		Swift Current		Indian Head		Redvers	
		(1-9, 9=flat)					
	CV (%)	26.0		11.1		18.5	
	Grand Mean	1.0		2.0		3.0	
Variety x Fertility							
AAC Brown 18	0% Soil test Rec. NPKS	1	b	2	c	2	c
AAC Brown 18	50% Soil test Rec. NPKS	2	a	2	c	3	b
AAC Brown 18	100% Soil test Rec. NPKS	2	a	3	b	3	b
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Boron	2	a	3	b	4	a
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Zinc	2	a	3	b	4	a
AAC Brown 18	125% Soil test Rec. NPKS	2	a	4	a	3	b
AAC Yellow 80	0% Soil test Rec. NPKS	1	b	1	d	2	d
AAC Yellow 80	50% Soil test Rec. NPKS	1	b	1	d	2	c
AAC Yellow 80	100% Soil test Rec. NPKS	1	b	1	d	2	c
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Boron	1	b	1	d	2	c
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Zinc	1	b	1	d	2	c
AAC Yellow 80	125% Soil test Rec. NPKS	1	b	1	d	2	c
	LSD	0		0		0	
Variety							
AAC Brown 18		2	a	3	a	3	a
AAC Yellow 80		1	b	1	b	2	b
	LSD	0		0		0	
Fertility Rate							
0% Soil test Rec. NPKS		1	a	2	b	2	b
50% Soil test Rec. NPKS		1	a	2	b	3	a
100% Soil test Rec. NPKS		1	a	2	b	3	a
100% Soil test Rec. NPKS + 5lbs actual Boron		1	a	2	b	3	a
100% Soil test Rec. NPKS + 5lbs actual Zinc		1	a	2	b	3	a
125% Soil test Rec. NPKS		1	a	3	a	3	a
	LSD	0		0		0	

Table 6. Days to maturity for each treatment, variety and fertility rate at each location in 2023.

Days to Maturity		Swift Current		Indian Head		Redvers	
		----------(days)----------					
	CV (%)	3.0		1.0		2.0	
	Grand Mean	77		76		74	
Variety x Fertility							
AAC Brown 18	0% Soil test Rec. NPKS	76	c	76	b	73	bc
AAC Brown 18	50% Soil test Rec. NPKS	77	bc	75	c	73	bc
AAC Brown 18	100% Soil test Rec. NPKS	76	c	77	a	74	ab
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Boron	76	c	76	b	75	a
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Zinc	77	bc	76	b	74	ab
AAC Brown 18	125% Soil test Rec. NPKS	77	bc	77	a	75	a
AAC Yellow 80	0% Soil test Rec. NPKS	79	a	76	b	73	bc
AAC Yellow 80	50% Soil test Rec. NPKS	77	bc	75	c	72	c
AAC Yellow 80	100% Soil test Rec. NPKS	77	bc	76	b	73	bc
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Boron	78	ab	77	a	73	bc
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Zinc	77	bc	76	b	75	a
AAC Yellow 80	125% Soil test Rec. NPKS	76	c	77	a	75	a
	LSD	1		0		1	
Variety							
AAC Brown 18		77	a	76	a	74	a
AAC Yellow 80		77	a	76	a	73	b
	LSD	2		0		1	
Fertility Rate							
0% Soil test Rec. NPKS		77	a	76	b	73	b
50% Soil test Rec. NPKS		77	a	75	c	73	b
100% Soil test Rec. NPKS		76	a	76	b	73	b
100% Soil test Rec. NPKS + 5lbs actual Boron		77	a	76	b	74	ab
100% Soil test Rec. NPKS + 5lbs actual Zinc		77	a	76	b	75	a
125% Soil test Rec. NPKS		77	a	77	a	75	a
	LSD	1		0		1	

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Table 7. Seed yield measured in pounds per acre (lbs/ac) for each treatment, variety and fertility rate at each location in 2023.

Seed Yield		Swift Current		Indian Head		Redvers	
		----------(lbs/ac)----------					
	CV (%)	19.8		10.9		20.3	
	Grand Mean	963		1369		1186	
Variety x Fertility							
AAC Brown 18	0% Soil test Rec. NPKS	723	e	621	h	726	g
AAC Brown 18	50% Soil test Rec. NPKS	860	d	1279	e	1159	d
AAC Brown 18	100% Soil test Rec. NPKS	883	d	1596	bc	1376	bc
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Boron	880	d	1517	d	1372	bc
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Zinc	1037	c	1530	d	1466	a
AAC Brown 18	125% Soil test Rec. NPKS	1108	b	1644	b	1409	ab
AAC Yellow 80	0% Soil test Rec. NPKS	695	e	711	g	971	f
AAC Yellow 80	50% Soil test Rec. NPKS	850	d	1135	f	975	ef
AAC Yellow 80	100% Soil test Rec. NPKS	1025	c	1536	d	1057	e
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Boron	1198	a	1554	cd	1053	ef
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Zinc	1170	ab	1591	bc	1354	bc
AAC Yellow 80	125% Soil test Rec. NPKS	1131	b	1710	a	1317	c
	LSD	66		52		83	
Variety							
AAC Brown 18		915	a	1364	a	1251	a
AAC Yellow 80		1011	a	1373	a	1121	a
	LSD	161		127		204	
Fertility Rate							
0% Soil test Rec. NPKS		709	d	666	d	849	d
50% Soil test Rec. NPKS		855	c	1207	c	1067	c
100% Soil test Rec. NPKS		954	b	1566	b	1216	b
100% Soil test Rec. NPKS + 5lbs actual Boron		1039	ab	1535	b	1213	b
100% Soil test Rec. NPKS + 5lbs actual Zinc		1103	a	1561	b	1410	a
125% Soil test Rec. NPKS		1119	a	1677	a	1363	a
	LSD	93		73		118	

Table 8. Combined site analysis, 2023.

Combined Site Analysis		plants/m^2		lodging (1-9)		DTM (days)		yield (lbs/ac)	
Variety	CV(%)	14.0		19.7		2.3		19.0	
AAC Brown 18		149	a	3.0	a	76	a	1177	a
AAC Yellow 80		129	b	1.0	b	75	b	1169	a
	LSD	4		0.0		0		44	
Fertility Rate									
0% Soil test Rec. NPKS		138	a	2.0	a	75	a	741	e
50% Soil test Rec. NPKS		137	a	2.0	a	75	a	1043	d
100% Soil test Rec. NPKS		134	a	2.0	a	75	a	1245	c
100% Soil test Rec. NPKS + 5lbs actual Boron		143	a	2.0	a	76	a	1262	bc
100% Soil test Rec. NPKS + 5lbs actual Zinc		142	a	2.0	a	76	a	1358	ab
125% Soil test Rec. NPKS		141	a	2.0	a	76	a	1386	a
	LSD	10		0.0		1		109	
Variety x Fertility									
AAC Brown 18	0% Soil test Rec. NPKS	153	a	2.0	b	75	b	690	h
AAC Brown 18	50% Soil test Rec. NPKS	144	b	2.0	b	75	b	1099	e
AAC Brown 18	100% Soil test Rec. NPKS	140	c	3.0	a	75	b	1285	c
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Boron	155	a	3.0	a	76	a	1257	c
AAC Brown 18	100% Soil test Rec. NPKS + 5lbs actual Zinc	155	a	3.0	a	76	a	1344	b
AAC Brown 18	125% Soil test Rec. NPKS	146	b	3.0	a	76	a	1387	a
AAC Yellow 80	0% Soil test Rec. NPKS	123	f	1.0	c	76	a	792	g
AAC Yellow 80	50% Soil test Rec. NPKS	129	e	1.0	c	75	b	987	f
AAC Yellow 80	100% Soil test Rec. NPKS	128	e	1.0	c	75	b	1206	d
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Boron	131	e	1.0	c	76	a	1268	c
AAC Yellow 80	100% Soil test Rec. NPKS + 5lbs actual Zinc	129	e	1.0	c	76	a	1372	ab
AAC Yellow 80	125% Soil test Rec. NPKS	136	d	2.0	b	76	a	1386	a
	LSD	3		0.0		0		35	