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Strategic Field Program (SFP)
Project Progress Report

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Project Title:	Establishing nitrogen and seeding rate recommendations for composite yellow mustard production in Saskatchewan
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Abstract

This project was initiated to define upper and lower limits of applied nitrogen fertilizer and an optimal seeding rate to maximize yield of composite yellow mustard (AAC Yellow 80) compared to an open pollinated variety (Andante). The current recommended seeding rate for open pollinated mustard varieties is a target plant stand of 7 to 11 plants/ft^2. However, it is expected that the optimal seed and nitrogen rate for composite mustard may be different. To evaluate this, small-plot research trials were established in three different soil zones in Saskatchewan including Swift Current (WCA), Indian Head (IHARF) and Redvers (SERF). The project was comprised of two separate trials that included both AAC Yellow 80 and Andante yellow mustard. The first trial evaluated each variety at increasing nitrogen rates of 0, 60, 80, 100, 120, 140 and 160 lbs/ac (soil residual + nitrogen applied as urea). The second trial included each variety with balanced fertility at increasing seed rates of 108, 150, 194, 237, and 280 seeds/m^2. Data collection included plant density, vigor ratings, plant height, lodging, days to maturity, and seed yield. Nitrogen uptake was limited by moisture in each region. However, AAC Yellow 80 has indicated strong nitrogen use efficiency compared to Andante. AAC Yellow 80 also the ability to compensate with increased branching at a lower plant stand and appears to be successful at a lower seed rate than expected; possibly lower than treatments included in this project, especially in the dry brown soil zone. The field trial will be repeated for the third year and the project will be completed after the 2025 growing season.

Introduction

Previous mustard fertility recommendations are based on data generated from the 1970s to early 2000s. Composite mustard (AAC Yellow 80) was not available during those studies and heterosis (hybrid vigor) introduced with hybridity has resulted in a need to revisit these recommendations. Heterosis is typically associated with superior performance such as increased yields and vigor. In the case of composite mustard, it is produced under a breeding system that uses a mixture of female and male plants in seed production and harvests both the seed from the male and female plants. In composite varieties, at least 70% of the progeny result from crossing of the parent lines.

There is increasing interest in plant protein uses, as well as value-added uses of fractionated mustard seed. Increased demand is anticipated in the near future for mustard. This research would help to maximize productivity on land and mitigate inefficient use of crop inputs such as seed, or nitrogen fertilizer.

There is also anticipated uptake of composite mustard in the near future due to the threat of increased mustard production in regions outside of Canada (our competitors) by re-using the harvested seed from currently-registered AAFC mustard seed (i.e., bin-running). Composite seed reduces this threat, but does not eliminate it.

AAC Yellow 80 is the first commercially-available composite mustard (registered in 2020). Typically, mustard growers do not include canola in their rotation and as such are less familiar with the fertility and seeding rate requirements for crops with hybrid vigor or partial hybrid vigor in the case of composite mustard.

Yellow mustard production is approximately 50-60% of all mustard production in Saskatchewan and optimizing mustard productivity will directly contribute to Saskatchewan's 2020-2030 growth plan. Particularly in growing exports (greater output per area of land) by 50%, growing agri-food exports to $20 billion, increasing crop production to 45 million metric tonnes, engaging internationally to secure access and expand international markets (shifting to hybrid and composite varieties will combat bin running open-pollinated seed outside of Canada), and supporting the

transformation of the economy through innovation and technology. In 2021, Saskatchewan exported $75,001,729 (70,323 metric tonnes) of mustard seed to the world and Saskatchewan is the leading Canadian exporter of mustard seed, accounting for 71% of total Canadian mustard seed exports.

Objectives and Progress *(add additional lines as needed)*

Please list the original objectives and/or revised objectives if ministry-approved revisions have been made to original objectives. A justification is needed for any deviation from original objectives.

Objective	**Progress** *(i.e., completed/in progress)*
To establish nitrogen and seeding rate recommendations for composite yellow mustard in Saskatchewan.	In progress
To understand nitrogen requirements for composite yellow mustard compared to Andante (open-pollinated) yellow mustard.	In progress
To define upper limits of nitrogen fertilizer for composite yellow mustard.	In progress
To specify the required seeding rate the producers can use to maximize yield, keeping seed costs in mind.	In progress
To update the recommendation for Saskatchewan mustard producers (available via Sask Mustard's mustard production manual).	In progress

Project Changes

- Height, Maturity and Lodging were not measured at Redvers for the Seed Rate trial in 2023.
- The nitrogen trial was seeded around 2lbs/ac at Redvers due to a drill calibration error in 2024.
- The seed rate for the nitrogen trial was lowered from 237 seeds/m^2 (22 seeds/ft^2) to 194 seeds/m^2 (18 seeds/ft^2) in 2024 as the higher seed rate appears to be too high at all locations.

Methodology

Specific site operations are listed in Table 3 (appendices).

Fertility: Side-banded, with the exception of Indian Head, where part of the Phosphorus requirements (35 kg monoammonium phosphate/ha) were placed in-furrow.

Experimental design: Two separate RCBD trials (nitrogen rates and seeding rates) with 4 replicates.

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

Treatments: Part 1: (2 yellow mustard varieties x 7 Nitrogen Rates x 4 reps = 56 plots) and
Part 2: (2 yellow mustard varieties x 5 Seeding Rates x 4 reps = 40 plots)

Seed Rate Treatments: The seed rates treatments in this study assume 50% mortality. Therefore, seed rate calculations should be adjusted for your own region and soil conditions, and corrected for germination. Seed rates are listed in lbs/ac in Table 14.

For example: targeting **5 plants/ft^2**, assuming **50% mortality** (5/.50 =10 seeds/ft^2 or 437,061 seeds/ac). Seed Source: AAC Yellow 80 **thousand seed weight of 5.5 grams** or 0.0121254 lbs per 1000 seeds gives you a seed rate of (437,061 seeds per acre/1000*0.0121254 lbs=5.3) 5.3 lbs/ac. (Germination=98%, so 5.3/.98 = 5.4 lbs/ac)

Part 1		
Mustard Variety	Seed Rate*	Residual + Applied Nitrogen (lb N/ac)
AAC Yellow 80	194 seeds/m^2	Soil N[Z]
AAC Yellow 80	194 seeds/m^2	60
AAC Yellow 80	194 seeds/m^2	80
AAC Yellow 80	194 seeds/m^2	100
AAC Yellow 80	194 seeds/m^2	120
AAC Yellow 80	194 seeds/m^2	140
AAC Yellow 80	194 seeds/m^2	160
Andante	194 seeds/m^2	Soil N[Z]
Andante	194 seeds/m^2	60
Andante	194 seeds/m^2	80
Andante	194 seeds/m^2	100
Andante	194 seeds/m^2	120
Andante	194 seeds/m^2	140
Andante	194 seeds/m^2	160
Part 2		
Mustard Variety	Seed Rate	Residual + Applied Nitrogen (lb N/ac)[Y]
AAC Yellow 80	108 seeds/m^2	100
AAC Yellow 80	150 seeds/m^2	100
AAC Yellow 80	194 seeds/m^2	100
AAC Yellow 80	237 seeds/m^2	100
AAC Yellow 80	280 seeds/m^2	100
Andante	108 seeds/m^2	100
Andante	150 seeds/m^2	100
Andante	194 seeds/m^2	100
Andante	237 seeds/m^2	100
Andante	280 seeds/m^2	100

[Z] soil nitrogen varied at each site (Table 2).
[Y] applied nitrogen varied according to location (Table 3).
***Seed rate (part 1) 237 seeds/m^2 (2023), 194 seeds/m^2 (2024).**

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.
- Vigor ratings (completed at both the 3-4 leaf stage and again at budding)
- 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.
- Height – Averaged from two measurements at the front and the back of the plot (cm)
- Yield – Corrected for dockage and to uniform moisture content of 9.5%.

Results

General Conditions

Growing season temperatures and precipitation amounts for the 2023 and 2024 growing seasons (May-August) relative to long-term (10-year) averages are provided in Table 1. In 2023, all locations were above the long-term average temperatures (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 was the only site that followed the same trend in 2024. However, yield potential was very limited in both years due to extreme drought and heat conditions throughout July at all locations both years. Swift Current also experienced a hail storm on July 22, 2023 that resulted in yield losses due to pod shatter (estimated 20% yield loss). In 2024, early spring topsoil moisture conditions improved at all locations after receiving precipitation in April and seeding was off to an early start. Conditions remained cool and windy throughout spring, but plots were seeded into good soil moisture. Redvers did experience a number of frost events after seeding, but no damage was observed. Varying stages of development existed heading into June and there were some crops behind the normal stages and development due to the cooler temperatures experienced and delays to seeding from rainfall. Heavy winds were observed, but no crop damage was noted through May and June. Overall weed and insect pressure was low. At Indian Head, supplemental hand-weeding was completed prior to flowering; however, the vast majority of weeds were eliminated by the pre-seed burn-down and in-crop herbicide applications. Precipitation continued through June until the July long weekend when plots were already into flowering. July and August saw extreme heat and drought and soil conditions rapidly declined as kochia thrived. Warm temperatures rapidly advanced crop maturity causing yield potential to further decline as it negatively impacted pod fill. Flea beetles and grasshoppers were present, but pressure remained low as harvest quickly progressed. At Indian Head, the plots had to combine opposite to the direction the crop was leaning due to severe lodging and there were relatively high header losses particularly in the heavier, more lodged plots. 2023 was a higher yielding year compared to 2024.

Table 1. Mean monthly temperature and precipitation for the 2023 and 2024 growing seasons (May-August) at Saskatchewan trial locations and long-term (10-year) averages.

Location	Year	May	June	July	August	Avg. / Total	% of LT
				Mean Temperature (°C)			
Redvers	2023	15	20	18	18	17.4	109%
	2024	11	15	20	18	15.8	99%
	Long-term	**11**	**16**	**19**	**18**	**16.0**	
Swift Current	2023	15	18	19	18	17.2	105%
	2024	11	14	21	19	16.4	100%
	Long-term	**12**	**16**	**19**	**19**	**16.3**	
Indian Head	2023	14	19	17	18	17.0	109%
	2024	11	14	19	18	15.4	99%
	Long-term	**11**	**16**	**18**	**17**	**15.6**	
				Precipitation (mm)			
Redvers	2023	70	25	11	49	155	60%
	2024	92	156	13	39	301	117%
	Long-term	**60**	**85**	**66**	**47**	**258**	
Swift Current	2023	49	34	77	48	207	103%
	2024	74	52	19	18	163	81%
	Long-term	**43**	**60**	**56**	**40**	**201**	
Indian Head	2023	13	50	16	41	119	49%
	2024	64	75	37	72	248	102%
	Long-term	**52**	**77**	**64**	**51**	**244**	

Selected soil test results for each site are provided in Table 2. All sites had a similar soil pH. Organic matter varied and is consistently the lowest at Swift Current (2.4% to 2.6%) followed by Redvers (3.9% to 4.0%) and highest at Indian Head (3.9% to 6.1%). According to AgVise recommendations, residual Nitrogen was low at Swift Current and Indian Head in 2023, but very high at Swift Current in 2024 in the 6-24" depth. Indian Head had medium levels of residual nitrogen in 2024. Nitrogen levels at Redvers were high for both test years. Nitrogen rates were determined based on a spring soil test with the exception of Indian Head, where nitrogen fertilizer rates were based on a fall composite soil sample collected for the broader research site which showed 26 lbs NO3-N/ac.

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	0.5	0.6
6-24"	7.9	-	-	12	-	-	24		-	-	-
----------Swift Current 2024----------											
0-6"	6.9	2.4	16.9	10	20	275	6	20	0.3	0.7	0.7
6-24"	8.1	-	-	54	-	-	18		-	-	-
----------Indian Head 2023----------											
0-6"	7.6	6.1	44.2	9	14	611	20	32	1.3	0.8	2.2
6-24"	8	-	-	13	-	-	40		-	-	-
----------Indian Head 2024----------											
0-6"	8	3.9	48.6	10	8	462	4	19.9	1.2	0.2	2.1
6-24"	8.2	-	-	24	-	-	12		-	-	-
----------Redvers 2023----------											
0-6"	7.6	4.0	33	16	14	254	20	-	-	1.6	-
6-24"	8.1	-	-	36	-	-	-	-	-	-	-
----------Redvers 2024----------											
0-6"	7.7	3.9	-	19	18	298	92	-	-	0.98	-
6-24"	8.1	-	-	36	-	-	-	-	-	-	-

Plant Densities & Vigor Ratings

In the nitrogen trial, Andante yellow consistently resulted in a higher plant stand than AAC Yellow 80 at each site (Table 4). In the combined site year analysis at Swift Current, Andante mean plant stand was 94 plants/m^2, significantly higher than AAC Yellow 80 (100 plants/m^2). In the combined site year analysis at Indian Head Andante mean plant stand was 187 plants/m^2, significantly higher than AAC Yellow 80 (172 plants/m^2). In the combined site year analysis at Redvers Andante mean was 117 plants/m^2 and AAC Yellow 80 was 106 plants/m^2. There was a seed rate mistake on the nitrogen trial at Redvers and 2024 and the plots were estimated to be seeded about 2lbs/ac. However, the resulting plant stand was acceptable (54 plants/m^2 to 101 plants/m^2), suggesting a seed rate lower than the treatments within this study could still be successful. Overall, nitrogen rate had little effect on the resulting plant stand at each individual location.

Table 4. Nitrogen and variety effect on emergence for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (plants/m2), Nitrogen Rate x Variety (2023-2024)																		
emergence (plants/m^2)		Swift Current						Indian Head						Redvers				
		2 site years		2023		2024		2 site years		2023		2024		2 site years		2023		2024
Variety																		
AAC Yellow 80		94	b	84	b	103	a	172	b	171	b	174	b	106	ns	128	b	85	ns
Andante		100	a	90	a	109	a	187	a	189	a	186	a	117	ns	154	a	81	ns
LSD		5		5		7		5		5		2.1				9		9	
Nitrogen Rate																		
Soil N		98	ab	86	a	111	ab	182	ab	181	a	183	a	121	ns	154	a	88	ns
60N		104	a	89	a	118	ab	182	ab	182	a	182	a	112	ns	143	ab	88	ns
80N		105	a	89	a	121	a	179	ab	179	a	179	a	116	ns	138	ab	87	ns
100N		104	a	91	a	116	ab	185	a	185	a	186	a	113	ns	141	ab	87	ns
120N		98	ab	89	a	106	bc	180	ab	178	a	181	a	115	ns	143	ab	87	ns
140N		90	b	84	a	97	c	177	ab	174	a	179	a	107	ns	139	ab	75	ns
160N		78	c	83	a	74	d	173	b	176	a	170	a	99	ns	131	b	67	ns
LSD		9		9		13		9		14		4				16			
Variety x Nitrogen Rate																		
AAC Yellow 80	Soil N	95	cd	88	de	104	d	175	de	176	d	175	bcd	111	ns	147	c	76	ns
AAC Yellow 80	60N	103	b	90	cd	117	ab	175	de	177	d	174	cd	94	ns	125	ef	78	ns
AAC Yellow 80	80N	102	b	84	f	121	a	170	fg	174	d	166	d	115	ns	121	f	94	ns
AAC Yellow 80	100N	98	c	84	f	112	bc	180	c	175	d	185	ab	101	ns	110	g	97	ns
AAC Yellow 80	120N	98	c	92	bc	104	d	173	ef	165	ef	181	abc	115	ns	136	d	94	ns
AAC Yellow 80	140N	88	e	80	g	96	e	165	h	162	f	167	d	103	ns	131	de	75	ns
AAC Yellow 80	160N	71	f	74	h	69	g	167	gh	168	e	167	d	105	ns	130	de	80	ns
Andante	Soil N	102	b	86	ef	117	ab	188	ab	186	c	190	a	131	ns	161	b	101	ns
Andante	60N	104	b	88	de	120	a	188	ab	186	c	190	a	129	ns	161	b	97	ns
Andante	80N	108	a	95	ab	120	a	187	ab	184	c	191	a	117	ns	156	b	81	ns
Andante	100N	109	a	98	a	120	a	191	a	195	a	187	a	125	ns	172	a	78	ns
Andante	120N	97	c	86	ef	109	cd	186	b	192	ab	181	abc	115	ns	149	c	80	ns
Andante	140N	93	d	88	de	98	e	189	ab	187	bc	191	a	111	ns	147	c	76	ns
Andante	160N	85	e	91	cd	79	f	178	cd	183	c	174	cd	93	ns	131	de	54	ns
LSD		3		3		5		4		5		6				9			
CV%		15.1		12.6		15.0		8.8		9.5		6.3				14.1			

In the seed rate trial, Andante generally resulted in higher plant stands compared to AAC Yellow 80 and plant stand increased with increasing seed rate at all sites (Table 5). However, seed mortality increased as seed rate increased; lower seed rates had a higher percentage of surviving plants. This is likely a result of increased competition amongst mustard seedlings at the higher seeded rates. Due to environmental and soil conditions, emergence rates were the lowest at Swift Current, but above and below the targeted plant stand ranging from 59-124 plants/m^2, followed by Redvers (83-166 plants/m^2) and Indian Head (92-219 plants/m^2). Resulting emergence in each site year indicates significantly lower mortality rates when moisture is adequate.

Table 5. Seed rate and variety effect on emergence for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (plants/m^2), Seed Rate x Variety (2023-2024)												
emergence (plants/m^2)		Swift Current				Indian Head				Redvers			
		2 site years	2023		2024	2 site years	2023		2024	2 site years	2023		2024
Variety													
AAC Yellow 80		86 a	70 a		101 b	145 b	129 b		161 b	116 b	123 b		108 a
Andante		91 a	73 a		108 a	169 a	146 a		192 a	123 a	135 a		110 a
LSD		6	6		5	6	7		8	6	8		9
Seed Rate													
108 seeds/m^2		61 e	56 c		65 e	99 e	89 d		108 e	79 e	83 e		75 c
150 seeds/m^2		73 d	60 c		86 d	133 d	120 c		147 d	95 d	102 d		88 c
194 seeds/m^2		86 c	71 b		102 c	162 c	142 b		181 c	120 c	129 c		110 b
237 seeds/m^2		101 b	81 ab		120 b	188 b	168 a		208 b	145 b	158 b		133 a
280 seeds/m^2		120 a	89 a		150 a	204 a	169 a		240 a	157 a	172 a		141 a
LSD		8	10		9	10	11		12	10	13		15
Variety x Seed Rate													
AAC Yellow 80	108 seeds/m^2	59 h	59 e		59 h	92 l	83 h		100 j	83 h	83 i		82 g
AAC Yellow 80	150 seeds/m^2	70 g	58 ef		83 f	121 g	109 f		134 h	90 g	98 h		82 g
AAC Yellow 80	194 seeds/m^2	83 e	65 d		102 d	152 e	136 d		168 f	121 e	125 f		118 d
AAC Yellow 80	237 seeds/m^2	100 c	82 bc		119 c	172 d	156 b		187 r	137 d	148 d		127 c
AAC Yellow 80	280 seeds/m^2	115 b	87 ab		143 b	190 c	161 b		218 c	148 c	161 c		134 bc
Andante	108 seeds/m^2	62 h	53 f		71 g	106 h	96 g		117 i	76 l	83 i		68 h
Andante	150 seeds/m^2	76 f	62 de		90 e	145 f	130 e		161 g	100 f	106 g		94 f
Andante	194 seeds/m^2	90 d	77 c		102 d	172 d	148 c		195 d	118 e	134 e		102 e
Andante	237 seeds/m^2	101 c	81 c		121 c	204 b	179 a		228 b	153 b	168 b		138 b
Andante	280 seeds/m^2	124 a	91 a		157 a	219 a	177 a		261 a	166 a	184 a		148 a
LSD		4	5		4	4	5		5.0	4	6		7
CV%		16.0	16.8		9.6	10.5	9.8		7.9	13.4	11.5		15.9

In 2023, early in the season varieties were visually rated equally as vigorous with no difference resulting from nitrogen rate (data not shown). However, by mid-June vigor ratings were higher with increasing nitrogen at Redvers and Indian Head. In 2024, vigor increased with seed rate and nitrogen at all sites, likely do to receiving adequate moisture to start the growing season. Andante was rated as more vigorous than AAC Yellow 80 at all locations in 2024 (data not shown).

Height

Both varieties increased in height with increasing nitrogen up to the moderate rates (Table 6). In the 2-year site analysis for the nitrogen trial, AAC Yellow 80 resulted in taller plants (79cm at Swift Current, 116cm at Indian Head, 112cm at Redvers) than Andante (75cm at Swift Current, 105cm at Indian Head, 107cm at Redvers).

Table 6. Nitrogen rate and variety effect on height for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (cm), Nitrogen Rate x Variety (2023-2024)																		
height (cm)		Swift Current						Indian Head						Redvers				
		2 site years		2023		2024		2 site years		2023		2024		2 site years		2023		2024	
Variety																		
AAC Yellow 80		79	a	74	a	86	a	116	a	112	ns	120	a	112	a	127	a	98	a
Andante		75	b	72	a	79	b	105	b	95	ns	114	b	107	b	121	b	94	b
LSD		1		1		2		7				2		2		2		3	
Nitrogen Rate																		
Soil N		70	e	64	c	76	c	90	b	83	ns	98	c	93	d	113	d	73	c
60N		74	d	71	b	77	c	104	a	98	ns	111	b	105	c	120	c	91	b
80N		76	cd	75	a	78	c	109	a	100	ns	119	ab	112	b	127	ab	98	ab
100N		78	bc	75	a	82	b	126	a	129	ns	123	a	113	ab	125	bc	102	a
120N		80	ab	76	a	83	b	113	a	103	ns	124	a	113	ab	125	bc	102	a
140N		80	aab	75	a	85	ab	114	a	105	ns	124	a	115	ab	128	ab	101	a
160N		82	a	76	a	87	a	116	a	106	ns	127	a	117	a	132	a	103	a
LSD		3		2		3		13				2	a	4		6		8	
Variety x Nitrogen Rate																		
AAC Yellow 80	Soil N	73	g	66	h	80	e	94	g	86	ns	101	d	94	i	114	g	75	h
AAC Yellow 80	60N	76	ef	72	f	80	e	109	de	103	ns	116	bc	107	g	121	ef	93	f
AAC Yellow 80	80N	78	cd	75	cd	81	e	112	cd	106	ns	118	bc	113	de	127	cd	100	cd
AAC Yellow 80	100N	80	b	76	bc	84	cd	143	a	161	ns	125	ab	116	bc	129	bc	103	b
AAC Yellow 80	120N	80	b	76	bc	84	cd	117	bc	108	ns	126	ab	117	b	130	b	103	b
AAC Yellow 80	140N	80	b	76	bc	87	b	118	b	109	ns	127	ab	116	bc	131	b	101	bc
AAC Yellow 80	160N	84	a	79	a	89	a	122	b	112	ns	133	a	124	a	140	a	109	a
Andante	Soil N	67	h	62	i	72	g	87	h	79	ns	95	d	92	i	111	h	72	I
Andante	60N	72	g	70	g	75	f	100	f	94	ns	106	cd	104	h	120	f	88	g
Andante	80N	75	f	75	cd	75	f	106	e	94	ns	119	bc	111	ef	127	cd	96	e
Andante	100N	77	de	74	de	80	e	109	de	98	ns	121	ab	111	ef	121	ef	102	bc
Andante	120N	79	bc	76	bc	83	d	110	de	99	ns	121	ab	110	f	120	f	100	cd
Andante	140N	79	bc	74	de	83	d	111	de	101	ns	121	ab	114	cd	126	d	101	bc
Andante	160N	79	bc	74	de	85	c	110	de	99	ns	120	ab	110	f	123	e	98	de
LSD		1		1		1		5				3		2		2		2	
CV%		5.5		5.3		4.9		20.0				4.6		6.6		6.4		6.8	

Seed rate had no effect on mustard height in 2023 (only measured at Indian Head and Swift Current), but this measurement was affected by hail at Swift Current. In 2024, height decreased with increasing seed rate at 2 of 3 sites by 5-10 cm (not significant at Redvers, Table 7). Variability was high at Indian Head (2024) due severe lodging from wind, which broke off many stems and made the measurement difficult. In the combined analysis for each location, AAC Yellow 80 generally resulted in taller plants than Andante at all sites. At Indian Head, AAC Yellow 80 (126 cm) was significantly taller than Andante (118cm). At Swift Current, AAC Yellow 80 (82 cm) was slightly taller than Andante (79cm).

Table 7. Seed rate and variety effects on height for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (cm), Seed Rate x Variety (2023-2024)																	
height (cm)		Swift Current						Indian Head						Redvers			
		2 site years		2023		2024		2 site years		2023		2024		2 site years	2023	2024	
Variety																	
AAC Yellow 80		82	a	78	a	86	a	126	a	113	a	139	a	-		107	a
Andante		79	b	77	a	81	b	118	b	102	b	133	b	-		104	a
	LSD	2		3		2		2		2		2				3	
Seed Rate																	
108 seeds/m^2		83	ab	78	a	88	a	125	a	111	a	140	a	-		106	a
150 seeds/m^2		84	a	80	a	88	a	123	ab	107	a	137	a	-		106	a
194 seeds/m^2		80	b	77	a	83	b	122	ab	107	a	137	a	-		106	a
237 seeds/m^2		80	b	78	a	81	bc	121	b	107	a	133	b	-		105	a
280 seeds/m^2		76	c	75	a	78	c	120	b	107	a	133	b	-		103	a
	LSD	3		5		3		3		4		3				4	
Variety x Seed Rate																	
AAC Yellow 80	108 seeds/m^2	84	b	78	b	90	a	130	a	117	a	143	a	-		109	a
AAC Yellow 80	150 seeds/m^2	87	a	83	a	91	a	126	b	110	b	139	ab	-		109	a
AAC Yellow 80	194 seeds/m^2	82	c	77	b	88	b	126	b	112	b	140	ab	-		107	ab
AAC Yellow 80	237 seeds/m^2	82	c	78	b	85	d	125	bc	112	b	136	bc	-		106	bc
AAC Yellow 80	280 seeds/m^2	77	de	75	c	79	e	124	c	115	a	137	bc	-		105	bc
Andante	108 seeds/m^2	82	c	77	b	87	bc	121	d	104	c	137	bc	-		104	cd
Andante	150 seeds/m^2	81	c	77	b	86	cd	120	d	105	c	134	ccd	-		104	cd
Andante	194 seeds/m^2	78	d	77	b	78	ef	118	e	101	d	134	cd	-		104	cd
Andante	237 seeds/m^2	78	d	78	b	78	ef	116	f	101	d	131	de	-		105	bc
Andante	280 seeds/m^2	76	e	75	c	77	f	114	g	99	d	129	e	-		102	d
	LSD	1		2		1		1		2		4.0				2	
	CV%	6.0		6.9		4.6		3.6		4.2		2.4				5.1	

Lodging

Lodging was measured using a scale of 1-9, where 9 is completely lodged, or flat. Nitrogen rates did not affect lodging at Swift Current, or Redvers (Table 8). Although not significant due to high variability in the data, at Indian Head (2023) Andante was more prone to lodging (2) compared to Yellow 80 (1) and slightly increased with nitrogen rates. In 2024 at Indian Head, lodging was quite severe due to wind damage and increased with increasing nitrogen rates up to a rating of 5.

Table 8. Nitrogen rate and variety effect on lodging for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (lodging 1-9), Nitrogen Rate x Variety (2023-2024)																			
lodging (1-9, 9=flat)		Swift Current						Indian Head						Redvers					
		2 site years		2023		2024		2 site years		2023		2024		2 site years		2023		2024	
Variety																			
AAC Yellow 80		1	a	1	a	1	a	3	ns	1	ns	3	ns	1	a	1	a	1	a
Andante		1	a	1	a	1	a	0	ns	2	ns	3	ns	1	a	1	a	1	a
	LSD	0		0		0				0		0		0		0		0	
Nitrogen Rate																			
Soil N		1	a	1	a	1	a	1	ns	1	ns	2	ns	1	a	1	a	1	a
60N		1	a	1	a	1	a	2	ns	1	ns	2	ns	1	a	1	a	1	a
80N		1	a	1	a	1	a	2	ns	1	ns	3	ns	1	a	1	a	1	a
100N		1	a	1	a	1	a	2	ns	2	ns	3	ns	1	a	1	a	1	a
120N		1	a	1	a	1	a	3	ns	2	ns	3	ns	1	a	1	a	1	a
140N		1	a	1	a	1	a	3	ns	2	ns	4	ns	1	a	1	a	1	a
160N		1	a	1	a	1	a	4	ns	2	ns	5	ns	1	a	1	a	1	a
	LSD	0		0		0		0		0		0		0		0		0	
Variety x Nitrogen Rate																			
AAC Yellow 80	Soil N	1	a	1	a	1	a	1	ns	1	ns	1	ns	1	a	1	a	1	a
AAC Yellow 80	60N	1	a	1	a	1	a	2	ns	1	ns	2	ns	1	a	1	a	1	a
AAC Yellow 80	80N	1	a	1	a	1	a	2	ns	1	ns	3	ns	1	a	1	a	1	a
AAC Yellow 80	100N	1	a	1	a	1	a	2	ns	1	ns	3	ns	1	a	1	a	1	a
AAC Yellow 80	120N	1	a	1	a	1	a	2	ns	1	ns	4	ns	1	a	1	a	1	a
AAC Yellow 80	140N	1	a	1	a	1	a	3	ns	2	ns	5	ns	1	a	1	a	1	a
AAC Yellow 80	160N	1	a	1	a	1	a	3	ns	2	ns	5	ns	1	a	1	a	1	a
Andante	Soil N	1	a	1	a	1	a	2	ns	1	ns	2	ns	1	a	1	a	1	a
Andante	60N	1	a	1	a	1	a	2	ns	2	ns	2	ns	1	a	1	a	1	a
Andante	80N	1	a	1	a	1	a	2	ns	2	ns	3	ns	1	a	1	a	1	a
Andante	100N	1	a	1	a	1	a	3	ns	2	ns	3	ns	1	a	1	a	1	a
Andante	120N	1	a	1	a	1	a	3	ns	3	ns	3	ns	1	a	1	a	1	a
Andante	140N	1	a	1	a	1	a	3	ns	3	ns	4	ns	1	a	1	a	1	a
Andante	160N	1	a	1	a	1	a	4	ns	3	ns	5	ns	1	a	1	a	1	a
	LSD	0		0		0		0		0		0		0		0		0	
	CV%	0.1		0.0		0.0		30.0		24.5		19.2		0.0		0.0		0.0	

In 2023, seed rate had no significant effect on lodging (only measured at Indian Head and Swift Current, Table 9). However, in 2024 at Indian Head, lodging was also severe due to wind damage and increased with increasing seeding rates up to a rating of 7.

Table 9. Seed rate and variety effect on lodging for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (1-9, 9=flat), Seed Rate x Variety (2023-2024)																	
lodging (1-9, 9=flat)		Swift Current						Indian Head						Redvers			
		2 site years		2023		2024		2 site years		2023		2024		2 site years		2023	2024
Variety																	
AAC Yellow 80		1	a	1	ns	1	a	2	b	2	ns	4	b	-		1	a
Andante		1	a	1	ns	1	a	5	a	2	ns	5	a	-		1	a
LSD		0		0		0		0		0						0	
Seed Rate																	
108 seeds/m^2		1	a	1	ns	1	a	2	c	2	ns	3	d	-		1	a
150 seeds/m^2		1	a	1	ns	1	a	3	b	2	ns	4	c	-		1	a
194 seeds/m^2		1	a	1	ns	1	a	3	b	2	ns	5	b	-		1	a
237 seeds/m^2		1	a	1	ns	1	a	4	a	2	ns	5	b	-		1	a
280 seeds/m^2		1	a	1	ns	1	a	4	a	2	ns	6	a	-		1	a
LSD		0		0		0		0		0		0				0	
Variety x Seed Rate																	
AAC Yellow 80	108 seeds/m^2	1	a	1	ns	1	a	2	d	1	ns	3	e	-		1	a
AAC Yellow 80	150 seeds/m^2	1	a	1	ns	1	a	3	c	1	ns	4	d	-		1	a
AAC Yellow 80	194 seeds/m^2	1	a	1	ns	1	a	3	c	1	ns	4	d	-		1	a
AAC Yellow 80	237 seeds/m^2	1	a	1	ns	1	a	3	c	2	ns	5	c	-		1	a
AAC Yellow 80	280 seeds/m^2	1	a	1	ns	1	a	4	b	2	ns	6	b	-		1	a
Andante	108 seeds/m^2	1	a	1	ns	1	a	3	c	2	ns	3	e	-		1	a
Andante	150 seeds/m^2	1	a	1	ns	1	a	3	c	2	ns	4	d	-		1	a
Andante	194 seeds/m^2	1	a	1	ns	1	a	4	b	2	ns	5	c	-		1	a
Andante	237 seeds/m^2	1	a	1	ns	1	a	4	b	2	ns	6	b	-		1	a
Andante	280 seeds/m^2	1	a	1	ns	1	a	5	a	2	ns	7	a	-		1	a
LSD		0				0		0				0				0	
CV%		17.6				1.0		24.2				0.8				0.0	

Days to Maturity

Maturity ratings were largely affected by drought and high temperatures at each site, especially in 2023 with the plots maturing early (70 to 80 days) compared to the expected 84 days.[1] In the Nitrogen trial, there were no varietal effects on maturity at Swift Current, or Redvers (Table 10). At Indian Head (2023) AAC Yellow 80 matured an average of 2 days later than Andante yellow mustard, but in 2024 maturity was not significantly different between varieties. Maturity was later in 2024 at both Indian Head and Redvers, compared to 2023. Overall, maturity was delayed when higher nitrogen was applied.

[1] https://saskseed.ca/interactive-seed-guide/

Table 10. Nitrogen rate and variety effect on maturity for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (days), Nitrogen Rate x Variety (2023-2024)																		
Maturity (days)		Swift Current						Indian Head						Redvers				
		2 site years		2023		2024		2 site years		2023		2024		2 site years		2023		2024	
Variety																		
AAC Yellow 80		79	a	78	a	79	a	79	a	77	a	81	a	81	a	70	a	91	a
Andante		79	a	78	a	79	a	78	b	75	b	81	a	80	A	70	a	91	a
	LSD	1		1		1		0		0		0		1		0		1	
Nitrogen Rate																		
Soil N		78	b	79	a	77	a	78	c	75	c	80	d	80	c	70	a	89	d
60N		78	b	77	a	79	a	78	c	76	b	80	d	80	c	70	a	90	cd
80N		78	b	77	a	78	a	78	c	76	b	81	c	80	b	70	a	91	bc
100N		78	b	77	a	79	a	78	c	76	b	81	c	80	c	70	a	91	bc
120N		80	a	79	a	81	a	79	b	77	a	82	b	80	c	70	a	91	bc
140N		80	a	79	a	81	a	80	a	77	a	82	b	81	b	71	a	92	ab
160N		79	ab	78	a	81	a	80	a	77	a	83	a	82	a	71	a	93	a
	LSD	1		2		4		0		0		0		1		1		1	
Variety x Nitrogen Rate																		
AAC Yellow 80	Soil N	78	c	80	a	77	f	78	d	76	c	80	d	80	c	70	b	90	d
AAC Yellow 80	60N	78	c	77	c	78	e	78	d	77	b	80	d	81	b	70	b	91	c
AAC Yellow 80	80N	78	c	78	bc	78	e	79	c	77	b	81	c	81	b	70	b	91	c
AAC Yellow 80	100N	78	c	77	c	79	c	79	c	77	b	81	c	81	b	70	b	91	c
AAC Yellow 80	120N	79	b	78	bc	81	a	80	b	77	b	82	b	81	b	70	b	91	c
AAC Yellow 80	140N	80	a	79	ab	81	a	80	b	78	a	83	a	81	b	71	a	91	c
AAC Yellow 80	160N	80	a	78	bc	81	a	81	a	78	a	83	a	82	a	71	a	93	a
Andante	Soil N	78	c	78	bc	77	f	77	e	75	d	80	d	80	c	70	b	89	e
Andante	60N	78	c	77	c	79	c	77	e	75	d	80	d	80	d	70	b	89	e
Andante	80N	78	c	77	c	79	c	78	d	75	d	81	c	80	c	70	b	90	d
Andante	100N	78	c	78	bc	79	c	78	d	76	c	81	c	80	c	70	b	90	d
Andante	120N	80	a	79	ab	81	a	79	c	76	c	81	c	80	c	70	b	90	d
Andante	140N	80	a	79	ab	80	b	79	c	76	c	82	b	81	b	70	b	92	b
Andante	160N	79	b	78	bc	80	b	80	b	76	c	83	a	82	a	71	a	92	b
	LSD	0		1		0		0		0		0		0		0		0	
	CV%	2.2		2.9		1.3		0.9		1.0		0.9		1.8		1.0		1.6	

Seeding rate did affect days to maturity in 2023 (only measured at Indian Head and Swift Current). At Swift Current increasing seeding rate delayed maturity by 6-7 days in 2023 and 2-3 days in 2024 (Table 11). At Indian Head, Andante was earlier maturing than AAC Yellow 80 by an average of 2 days and the lower seeding rates matured about 2-days later compared to the highest seeding rate. Seeding rate, or variety had no effect on days to maturity at Redvers in 2024.

Table 11. Seed rate and variety effect on maturity for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (days), Seed Rate x Variety (2023-2024)										
Maturity (days)		Swift Current			Indian Head			Redvers		
		2 site years	2023	2024	2 site years	2023	2024	2 site years	2023	2024
Variety										
AAC Yellow 80		76 a	74 a	78 a	80 a	78 a	82 a	-		88 a
Andante		76 a	74 a	78 a	79 b	76 b	82 a	-		87 a
	LSD	2	4	1	0	0	0			1
Seed Rate										
108 seeds/m^2		74 b	70 b	80 a	80 a	78 a	83 a	-		87 a
150 seeds/m^2		74 b	70 b	79 ab	80 a	77 b	82 b	-		88 a
194 seeds/m^2		77 ab	76 ab	78 bc	79 b	77 b	82 b	-		88 a
237 seeds/m^2		78 a	77 a	78 bc	79 b	77 b	81 c	-		87 a
280 seeds/m^2		77 ab	77 a	77 c	79 b	76 c	81 c	-		86 a
	LSD	3	6	1	0	0	0			2
Variety x Seed Rate										
AAC Yellow 80	108 seeds/m^2	74 b	70 b	80 a	81 a	78 a	83 a	-		88 a
AAC Yellow 80	150 seeds/m^2	74 b	70 b	78 c	80 b	78 a	83 ab	-		89 a
AAC Yellow 80	194 seeds/m^2	77 a	76 a	78 c	80 b	77 b	82 ab	-		88 a
AAC Yellow 80	237 seeds/m^2	77 a	77 a	78 c	79 c	77 b	81 ab	-		88 a
AAC Yellow 80	280 seeds/m^2	77 a	76 a	77 d	79 c	77 b	81 b	-		86 b
Andante	108 seeds/m^2	74 b	69 b	79 b	80 b	77 b	83 ab	-		86 b
Andante	150 seeds/m^2	74 b	68 b	80 a	79 c	77 b	82 ab	-		88 a
Andante	194 seeds/m^2	77 a	76 a	78 c	79 c	76 c	81 b	-		88 a
Andante	237 seeds/m^2	78 a	78 a	78 c	79 c	76 c	81 b	-		87 ab
Andante	280 seeds/m^2	77 a	77 a	77 d	79 c	76 c	82 ab	-		86 b
	LSD	2	3	0	0	0	0			1
	CV%	7.7	8.9	1.9	0.7	0.5	11.3			2.7

Seed Yield

Yield potential was negatively affected by limited moisture and above average temperatures. Despite AAC Yellow 80 plant establishment being lower than Andante, average yields of AAC Yellow 80 are consistently and statistically higher compared to Andante for both the nitrogen and seed rate trials. This demonstrates the vigorous nature and improved genetics of AAC Yellow 80 composite mustard. Year 1 (2023) was a higher yielding year compared to 2024; even with the hail damage in 2023 (Swift Current). This is largely attributed to the very high emergence in 2024 as a result of adequate moisture at seeding. Unfortunately, this was followed by a very hot and dry growing season at all locations and seed quality and yield potential for plant stands higher than 5-8 plants/ft^2 were negatively affected. This indicated that if soil moisture conditions are adequate at seeding, seed rates even lower than treatments included within this project could be adequate.

Both mustard variety yields increased with increasing nitrogen, but optimal rates varied by location (Table 12). Combining 2 site-years of data at Redvers, AAC Yellow 80 resulted in a mean yield of 1422 lbs/ac from a total of 160lbs/ac of nitrogen, significantly higher than Andante mustard (1223 lbs/ac). Optimal seeding rate at Redvers varied, but the highest yielding AAC Yellow 80 treatment resulted from seeding 194 seeds/m^2 (1503 lbs/ac). However, in 2024 the highest yield resulted from lower seed rates ranging from 108-194 seeds/m^2 (1329-1360 lbs/ac). The highest Andante mustard yield resulted from the lowest seeding rate of 108 seeds/m^2 (1,420 lbs/ac). Optimal seeding rate at Redvers is unclear and more robust data is required to make a conclusion.

Table 12. Nitrogen rate and variety effect on yield for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ. Redvers (2024) treatments were seeded at a lower rate due to a drill calibration error.

Yellow Mustard Individual Means (lbs/ac), Nitrogen Rate x Variety (2023-2024)																	
yield (lbs/ac)		Swift Current					Indian Head					Redvers					
		2 site years		2023		2024	2 site years		2023		2024	2 site years		2023		2024	
Variety																	
AAC Yellow 80		932	a	1102	a	762	a	1451	a	1616	a	1286	a	1088	a	1189	a	986	a
Andante		800	b	870	b	731	b	1358	b	1539	b	1176	b	1001	b	1159	a	842	b
LSD		40		54		30		42		40		38		45		59		56	
Nitrogen Rate																	
Soil N		694	c	705	d	682	b	835	e	838	e	832	f	675	f	862	f	489	d
60N		833	b	902	c	764	a	1204	d	1336	d	1071	e	854	e	996	e	711	c
80N		881	ab	973	bc	789	a	1341	c	1489	c	1193	d	982	d	1098	d	867	b
100N		889	ab	1024	ab	754	a	1513	b	1732	b	1295	c	1095	c	1151	c	1039	a
120N		920	a	1084	a	755	a	1580	b	1789	b	1371	b	1168	bc	1302	b	1034	a
140N		919	a	1095	a	743	a	1665	a	1922	a	1409	ab	1213	b	1332	b	1094	a
160N		927	a	1117	a	736	ab	1693	a	1938	a	1448	ab	1323	a	1480	a	1166	a
LSD		75		101		57		78		75		71		85		110		106	
Variety x Nitrogen Rate																	
AAC Yellow 80	Soil N	760	f	822	f	699	f	855	l	784	k	926	i	693	j	856	g	530	h
AAC Yellow 80	60N	916	c	1035	c	798	a	1255	g	1413	h	1098	g	916	h	1071	e	761	f
AAC Yellow 80	80N	955	b	1116	b	794	a	1407	f	1588	g	1227	e	983	g	1093	e	873	e
AAC Yellow 80	100N	933	bc	1101	b	766	bc	1534	d	1715	f	1353	d	1169	de	1213	d	1124	b
AAC Yellow 80	120N	986	a	1200	a	772	bc	1593	c	1776	de	1410	c	1193	cd	1272	c	1114	b
AAC Yellow 80	140N	987	a	1214	a	759	cd	1751	a	2022	a	1479	b	1240	b	1337	b	1143	b
AAC Yellow 80	160N	985	a	1225	a	744	de	1762	a	2015	a	1509	a	1422	a	1484	a	1360	a
Andante	Soil N	628	g	589	h	666	g	814	j	891	j	737	j	658	k	868	g	449	l
Andante	60N	750	f	770	g	731	e	1152	h	1259	i	1045	h	791	i	921	f	661	g
Andante	80N	807	e	830	f	783	ab	1274	g	1389	h	1160	f	981	g	1102	e	860	e
Andante	100N	845	d	947	e	742	de	1493	e	1749	e	1237	e	1021	f	1089	e	954	d
Andante	120N	854	d	969	e	739	de	1567	c	1803	cd	1332	d	1142	ef	1332	b	953	d
Andante	140N	851	d	975	de	727	e	1579	c	1821	c	1338	d	1187	d	1328	b	1046	c
Andante	160N	869	d	1010	cd	728	e	1625	b	1862	b	1388	c	1223	bc	1475	a	971	d
LSD		28		38		21		29		28		27		32		42		40	
CV%		14.6		12.7		9		9.0		5.9		6.9		13.8		11.1		13.7	

Indian Head was the highest yielding site, despite challenging growing conditions each year. In the combined site year analysis, AAC Yellow 80 yield increased with up to 140lbs/ac of total nitrogen (1751 lbs/ac). The highest Andante mustard yield resulted when 160lbs/ac of total nitrogen was applied (1625 lbs/ac). In part 2, mustard yield at Indian Head decreased as seeding rate increased. This is likely a result of increased competition for moisture at the high seed rates. This result is more common at dry sites, such as Swift Current, but the 2023 growing season at Indian Head was unusually dry. Although 2024 showed similar results. At Indian Head, the combined site year analysis showed highest yields resulted from both AAC Yellow 80 and Andante mustard when seeded 108 seeds/m^2 (1704 lb/ac and 1560 lb/ac, respectively), suggesting that the optimal seed rate could be lower than the treatments included in this study.

Swift Current being the driest and potentially lowest yielding site did not utilize as much nitrogen as the other locations. AAC Yellow 80 yields increased up to 120lbs/ac of total nitrogen (986 lbs/ac), and Andante yields increased up to 100lbs/ac of total nitrogen (845 lbs/ac). Contributing factors to lower yields at Swift Current are differences in soil (low organic matter compared to other sites), low residual soil moisture and precipitation, and a hail storm in July 2023 (~20% yield loss). In part 2, the highest yields at Swift Current resulted from seeding 108 seeds/m^2 (AAC Yellow 80=901lbs/ac, Andante=775lbs/ac) and yield decreased with increasing seed rate, especially at higher rates of 237-280 seeds/m^2. This trend suggests the optimal seed rate could be lower than the treatments included in this study. Seed mortality is especially high at Swift Current and even more so the higher the seeding rate. Therefore, plant establishment was low compared to the other sites. Hail in 2023 may have also had more of a negative effect on higher seed rates compared to lower seed rates as higher seed rates were slightly more mature at that time, compared to lower seeding rates.

Table 13. Seed rate and variety effect on yield for individual and combined site years at each location (2023-2024). Means within a column followed by the same letter do not significantly differ.

Yellow Mustard Individual Means (lbs/ac), Seed Rate x Variety (2023-2024)											
yield (lbs/ac)		Swift Current			Indian Head			Redvers			
		2 site years	2023	2024	2 site years	2023	2024	2 site years	2023	2024	
Variety											
AAC Yellow 80		840 a	910 a	770 a	1601 a	1736 a	1466 a	1444 a	1576 a	1313 a	
Andante		720 b	677 b	763 a	1518 b	1680 b	1346 b	1395 a	1594 a	1197 b	
LSD		37	53	15	42	62	46	74	92	62	
Seed Rate											
108 seeds/m^2		838 a	896 a	780 a	1632 a	1765 a	1498 a	1432 a	1576 a	1287 a	
150 seeds/m^2		791 ab	811 b	770 a	1596 ab	1734 ab	1457 ab	1443 a	1610 a	1277 a	
194 seeds/m^2		792 ab	806 bc	777 a	1540 bc	1672 ab	1409 bc	1461 a	1644 a	1278 a	
237 seeds/m^2		746 b	732 bc	770 a	1528 c	1714 ab	1342 cd	1383 a	1557 a	1210 a	
280 seeds/m^2		734 b	723 c	735 b	1490 c	1654 b	1325 d	1380 a	1537 a	1222 a	
LSD		58	84	23	66	98	72	117	146	98	
Variety x Seed Rate											
AAC Yellow 80	108 seeds/m^2	901 a	1033 a	770 d	1704 a	1817 a	1590 a	1443 b	1527 c	1360 a	
AAC Yellow 80	150 seeds/m^2	840 b	908 b	772 cd	1656 b	1777 ab	1536 b	1444 b	1558 bc	1330 a	
AAC Yellow 80	194 seeds/m^2	856 b	923 b	789 ab	1594 c	1696 de	1492 c	1503 a	1677 a	1329 ab	
AAC Yellow 80	237 seeds/m^2	804 c	828 c	780 bc	1551 d	1743 bc	1359 e	1409 bc	1557 bc	1261 cd	
AAC Yellow 80	280 seeds/m^2	800 cd	862 c	739 f	1501 e	1648 f	1354 ef	1422 b	1558 bc	1285 bc	
Andante	108 seeds/m^2	775 d	760 d	790 a	1560 d	1713 cd	1406 d	1420 b	1625 a	1215 e	
Andante	150 seeds/m^2	742 e	717 e	767 de	1535 d	1692 def	1378 de	1442 b	1661 a	1223 de	
Andante	194 seeds/m^2	727 e	689 e	765 de	1487 e	1648 f	1326 fg	1420 b	1612 ab	1228 de	
Andante	237 seeds/m^2	689 f	618 f	759 e	1504 e	1685 ef	1324 fg	1358 cd	1557 bc	1159 f	
Andante	280 seeds/m^2	667 f	602 f	732 f	1479 e	1660 ef	1297 g	1337 d	1516 c	1158 f	
LSD		26	38	9	29	44	32	52	65	44	
CV%		12.6	12.5	2.1	6.9	6.8	6.0	13.9	10.9	9.2	

Interim Conclusions

This project is intended to provide updated seeding rate and fertility recommendations for a newly available composite mustard (first in the industry). Therefore, the project is to be repeated at the three sites over the course of three growing seasons from 2023-2025 (i.e., one more growing season). More robust data is essential to perform meaningful statistical analyses and acceptable recommendations for the optimum seeding rate and nitrogen fertilizer requirements of AAC Yellow 80 composite mustard. Preliminary results suggest the optimal seed rate could be lower than the treatments included in this study. However, yield potential was negatively affected by limited moisture and above average temperatures across site years.

Despite AAC Yellow 80 resulting in lower plant populations compared to Andante, average yields of AAC Yellow 80 are consistently and statistically higher than Andante in both the nitrogen and seed rate trials. This demonstrates the vigorous nature and improved genetics of AAC Yellow 80 composite mustard. Year 1 (2023) was a higher yielding year compared to 2024; even with the hail damage in 2023 (Swift Current). This is largely attributed to the very high emergence in 2024 as a result of adequate moisture at seeding. Unfortunately, this was followed by a very hot and dry growing season at all locations and seed quality and the yield potential of resulting high plant stands was negatively affected due to limited moisture. This suggests that if soil moisture conditions are good at seeding, seed rates lower than those included within this project could be adequate.

Upper nitrogen limits were not clearly defined as environmental conditions varied, but results indicate applying a total of 120N-160N resulted in the highest yielding treatments for site years that received average amounts of precipitation. When less than average precipitation was received, a total of 80-100N was sufficient. Yields were expected to increase with seeding and nitrogen rate, but due to higher than expected emergence rates and increased competition for moisture, the lower seeding rates have resulted in the highest yields and even suggest the optimal seed rate could be lower than the treatments included in this study if moisture conditions are adequate at seeding.

Knowledge Transfer Activities

- Amber Wall, “Walk the Plots” Radio Show with Glenda Lee Allan on CKSW (570) on June 20, 2023 (South West Saskatchewan).
- 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, South East Research Farm, Annual field day (50 attendees) on July 27, 2023.
- Sam Marcino, Acting Provincial Oilseed Specialist, at the Sask Mustard AGM, Crop Production Show, (100 attendees) on January 12, 2024.
- Amber Wall, “Walk the Plots” Radio Show with Glenda Lee Allan (Country 94.1, Magic 97.1, CKSW 570) on June 4, 2024 (South West Saskatchewan).
- Sam Marcino, Acting Provincial Oilseed Specialist, at Wheatland Conservation Area Annual Field Tour, (80 attendees) on July 18, 2024.
- Amber Wall, Wheatland Conservation Area, at the Sask Mustard AGM, Crop Production Show, (100 attendees)

on January 16, 2025.

- Amber Wall, Wheatland Conservation Area, Crops Winter Webinars 2025 (Crops Blog Posts), Government of Saskatchewan on March 27, 2025.
- The final results from this project will be included in the mustard production manual and will be presented on where possible for future crop research updates such as the Agronomy Research Update and the Sask Mustard AGM in Saskatoon.

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- Cory Jacob, Provincial Specialist, Oilseed Crops, Saskatchewan Ministry of Agriculture.
- Shannon Chant, Crops Extension Specialist, Saskatchewan Ministry of Agriculture.
- Sam Marcino, Acting Provincial Oilseed Specialist, Saskatchewan Ministry of Agriculture.

Seed provided in kind by Saskatchewan Mustard Development Commission and Mustard 21.

- Rick Mitzel, Executive Director, Saskatchewan Mustard Development Commission.
- Howard Love, Senior Scientist, Mustard 21

Appendices

Table 3. Site operations at Swift Current, Indian Head and Redvers, 2023 and 2024. NOTE: SR=SEED RATE TRIAL. NR=NITROGEN RATE TRIAL

Location	Swift Current	Indian Head	Redvers
Year	2023		
Stubble	Durum	Canary Seed	Barley
Seed Date	15-May	24-May	31-May
Seeded plot size	17.25m^2	22m^2	20m^2
Row Spacing	8.25 inches	12 inches	12 inches
Seed	**AAC Yellow 80** (5.5 g TSW, 99% germ), and **Andante** (6.3 g TSW, 99% germ)		
Seed rate trial	100N - 62P - 0K - 49S	120N - 36P - 10K - 10S	110N - 20P - 0K - 10S
	Seed rate varied by treatment		
Nitrogen rate trial	62P - 0K - 49S	36P - 10K - 10S	38P - 10K - 15S
	Nitrogen rate varied by treatment. All plots seeded at 237 seeds/m^2		
Plant Density	08-Jun	09-Jun	30-Jun
Herbicide	Centurion/Amigo	Contender II/1% IPCO MSO	Arrow All In
Insecticide	Decis	Decis	-
Fungicide	-	Lance WDG	-
Height	01-Aug	10-Aug	12-Aug
Lodging	21-Aug	10-Aug	-
Desiccation	-	Roundup Weathermax	-
Harvest Dates	24-Aug	16-Aug	01-Sep

Location	Swift Current	Indian Head	Redvers
Year	2024		
Stubble	Durum	Canary Seed	Mixed Forage
Herbicide	Glyphosate 540/AIM	Roundup Weathermax	Roundup/Authority
Seed Date	11-May	17-May	May 17 (NR), May 21 (SR)
Seeded plot size	17.25m^2	22m^2	9m^2
Row Spacing	8.25 inches	12 inches	12 inches
Seed	**AAC Yellow 80** (5.5 g TSW, 99% germ), and **Andante** (6.3 g TSW, 99% germ)		
Seed rate trial	100N - 50P - 35K - 30S	120N - 36P - 10K - 10S	100N - 60P - 0K - 49S
	Seed rate varied by treatment from 108-280 seeds/m^2		
Nitrogen rate trial	50P - 35K - 30S	36P - 10K - 10S	31P - 0K - 0S
	Nitrogen rate varied by treatment. All plots seeded at 194 seeds/m^2		
Plant Density	28-May	31-May	21-Jun
Herbicide	Assurell/Suremix	Poast Ultra/Merge	Arrow All In
Insecticide	Decis	-	-
Fungicide	-	Lance WDG/Headline EC	-
Height	06-Aug	07-Aug	15-Aug
Lodging	06-Aug	18-Jul	15-Aug
Desiccation	-	Roundup Weathermax	-
Harvest Dates	08-Aug	19-Aug	30-Aug

Table 14. Seed rate conversion from seeds/m² to lbs/ac. The same seed lot is used for each site year. Treatments in this study ranged from 10-26 seeds/ft².

Andante (TSW=6.3 grams, or 0.0138891 lbs/1000 seeds)										
Target plant stand		**Seed rate assuming 50% emergence**								**Seed weight per acre**
3	plants/ft^2	6	seeds/ft^2	or	65	seeds/m^2	or	263,046	seeds/ac	3.7 lbs/ac
5	plants/ft^2	10	seeds/ft^2	or	108	seeds/m^2	or	437,061	seeds/ac	6.1 lbs/ac
7	plants/ft^2	14	seeds/ft^2	or	150	seeds/m^2	or	607,029	seeds/ac	8.4 lbs/ac
9	plants/ft^2	18	seeds/ft^2	or	194	seeds/m^2	or	785,091	seeds/ac	10.9 lbs/ac
11	plants/ft^2	22	seeds/ft^2	or	237	seeds/m^2	or	959,106	seeds/ac	13.3 lbs/ac
13	plants/ft^2	26	seeds/ft^2	or	280	seeds/m^2	or	1,133,121	seeds/ac	15.7 lbs/ac
AAC Yellow 80 (TSW=5.5 grams, or 0.0121254 lbs/1000 seeds)										
Target plant stand		**Seed rate assuming 50% emergence**								**Seed weight per acre**
3	plants/ft^2	6	seeds/ft^2	or	65	seeds/m^2	or	263,046	seeds/ac	3.2 lbs/ac
5	plants/ft^2	10	seeds/ft^2	or	108	seeds/m^2	or	437,061	seeds/ac	5.3 lbs/ac
7	plants/ft^2	14	seeds/ft^2	or	150	seeds/m^2	or	607,029	seeds/ac	7.4 lbs/ac
9	plants/ft^2	18	seeds/ft^2	or	194	seeds/m^2	or	785,091	seeds/ac	9.5 lbs/ac
11	plants/ft^2	22	seeds/ft^2	or	237	seeds/m^2	or	959,106	seeds/ac	11.6 lbs/ac
13	plants/ft^2	26	seeds/ft^2	or	280	seeds/m^2	or	1,133,121	seeds/ac	13.7 lbs/ac