Strategic Field Program (SFP)

Project Progress Report

Completed reports must be returned by email to Evaluation.Coordinator@gov.sk.ca

|  |  |
| --- | --- |
| Project Title: | Establishing nitrogen and seeding rate recommendations for composite yellow mustard production in Saskatchewan |
| SFP File Number: | 20220377 |
| Reporting Period: | April 2023 to January 2025 |

# Principal Investigator

|  |  |
| --- | --- |
| Full Name: | Amber Wall |
| Organization: |  Wheatland Conservation Area Inc. |
| Mailing Address: | PO Box 2015, Swift Current, SK. S9H 4M7 |
| Phone Number: |  306-773-4775 |
| E-mail: |  wcawall@sasktel.net |

# Collaborators and Co-Investigators (add additional lines as needed)

**Name Organization Mailing Address Phone Number Email**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Chris Holzapfel | Indian Head Agricultural Research Foundation | Box 156, #1 Government Road, Indian Head, SK S0G 2K0  |  306 695 7761  | cholzapfel@iharf.ca  |
| Lana Shaw | South East Research Farm | Box129, Redvers, SK S0C 2H0  | 306 452 7253  | lshaw.serf@gmail.com  |
| Cory Jacob | Ministry of Agriculture Crops and Irrigation Branch/Plant Industry unit  | 125 – 3085 Albert Street, Regina, SK S4S 0B1 | 306 787 4668  | cory.jacob@gov.sk.ca  |
| Shannon Chant  | Ministry of Agriculture Regional Services Branch  | 101-350 Cheadle Street West, Swift Current, SK S9H 4G3 |  306 778 8291  | shannon.chant@gov.sk.ca  |
| Samantha Marcino | Acting Provincial Specialist, Oilseed Crops | 38-5th Avenue N, Yorkton, SK S3N 0Y8 | 306 787 4668 | samantha.marcino@gov.sk.ca |
| Rick Mitzel | Mustard 21  | Box 37026 North Park PO Saskatoon, SK S7K 8J2  |  306 242 2121  | mustard21@mustard21.com  |
|  | Saskatchewan Mustard Development Commission  | Box 37026 North Park PO Saskatoon, SK S7K 8J2  | 306 975 6629  | info@saskmustard.com  |

# 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/ft2. 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/m2. 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, which has resulted in a need to revisit these recommendations. There is also 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 increased vigor.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

**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/m2 (22 seeds/ft2) to 194 seeds/m2 (18 seeds/ft2) 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/ft2**, assuming **50% mortality** (5/.50 =10 seeds/ft2 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 1Mustard Variety | Seed Rate\* | Residual + Applied Nitrogen (lb N/ac) |
| AAC Yellow 80 | 194 seeds/m2 | Soil NZ |
| AAC Yellow 80 | 194 seeds/m2 | 60 |
| AAC Yellow 80 | 194 seeds/m2 | 80 |
| AAC Yellow 80 | 194 seeds/m2 | 100 |
| AAC Yellow 80 | 194 seeds/m2 | 120 |
| AAC Yellow 80 | 194 seeds/m2 | 140 |
| AAC Yellow 80 | 194 seeds/m2 | 160 |
| Andante | 194 seeds/m2 | Soil NZ |
| Andante | 194 seeds/m2 | 60 |
| Andante | 194 seeds/m2 | 80 |
| Andante | 194 seeds/m2 | 100 |
| Andante | 194 seeds/m2 | 120 |
| Andante | 194 seeds/m2 | 140 |
| Andante | 194 seeds/m2 | 160 |
| Part 2Mustard Variety | Seed Rate | Residual + Applied Nitrogen (lb N/ac)Y |
| AAC Yellow 80 | 108 seeds/m2 | 100 |
| AAC Yellow 80 | 150 seeds/m2 | 100 |
| AAC Yellow 80 | 194 seeds/m2 | 100 |
| AAC Yellow 80 | 237 seeds/m2 | 100 |
| AAC Yellow 80 | 280 seeds/m2 | 100 |
| Andante | 108 seeds/m2 | 100 |
| Andante | 150 seeds/m2 | 100 |
| Andante | 194 seeds/m2 | 100 |
| Andante | 237 seeds/m2 | 100 |
| Andante | 280 seeds/m2 | 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/m2 (2023), 194 seeds/m2 (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/m2, significantly higher than AAC Yellow 80 (100 plants/m2). In the combined site year analysis at Indian Head Andante mean plant stand was 187 plants/m2, significantly higher than AAC Yellow 80 (172 plants/m2). In the combined site year analysis at Redvers Andante mean was 117 plants/m2 and AAC Yellow 80 was 106 plants/m2. 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/m2 to 101 plants/m2), 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.**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/m2, followed by Redvers (83-166 plants/m2) and Indian Head (92-219 plants/m2). 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.**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.**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.*****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.**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.*****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]](#footnote-2) 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.**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.**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.*****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/ft2 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/m2 (1503 lbs/ac). However, in 2024 the highest yield resulted from lower seed rates ranging from 108-194 seeds/m2 (1329-1360 lbs/ac). The highest Andante mustard yield resulted from the lowest seeding rate of 108 seeds/m2 (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.**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/m2 (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/m2 (AAC Yellow 80=901lbs/ac, Andante=775lbs/ac) and yield decreased with increasing seed rate, especially at higher rates of 237-280 seeds/m2. 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.** |

# 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.
* Lana Shaw, South East Research Farm, Annual field day (50 attendees) on July 24, 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.
 |

# Contributions and Support

|  |
| --- |
| Funded by the Government of Canada under the Sustainable Canadian Agricultural Partnership, a federal-provincial-territorial initiative.* 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**

****

**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.**



1. <https://saskseed.ca/interactive-seed-guide/> [↑](#footnote-ref-2)