2022 Annual Report
for the
Saskatchewan Ministry of Agriculture's
Agricultural Demonstration of Practices & Technologies (ADOPT) Program

Project Title: Canary Seed varietal response to agronomic inputs

Project # ADOPT20211062

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Project Identification

1. **Project Title:** Canary Seed varietal response to agronomic inputs
2. **Project Number:** ADOPT20211062
3. **Producer Group Sponsoring the Project:** Canary seed Development Commission of Saskatchewan
4. **Project Location(s):** Melfort (RM #428), Yorkton (RM #244), Swift Current (RM #137), and Indian Head (RM #458)
5. **Project Start and End Dates (Month & Year):** March 2022 to February 1, 2023
6. **Project Contact Person & Contact Details:**

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Objectives and Rationale

7. **Project Objectives:**
The main objective of the demonstration was to demonstrate the response of hairy versus hairless canary seed varieties to different agronomic inputs.

8. **Project Rationale:**

Canary Seed is often considered a low input cereal crop that grows best on heavy clay or clay loam soils, which is characteristic of the Saskatchewan black soil zone. As growers may look to continue to diversify their crop rotations, canary seed has become of increasing interest. For many decades canary seed has been grown and sold into the bird seed market and the varieties grown for this purpose are considered hairy or non-glabrous. In recent years, new varieties have been developed in hopes of a potential human food market. Theses varieties are hairless or glabrous and have been adopted by some canary seed producers in recent years. Many producers have been apprehensive to adopt glabrous varieties as they are often lower yielding than non-glabrous varieties. As there is currently no market advantage for growing glabrous varieties, this yield loss comes at a cost to producers. This has led to fewer producers growing hairless varieties, with much of the seeded acres in Saskatchewan being dominated by much older hairy varieties.

Many agronomic inputs have been investigated in canary seed in the past; however, this research has not included varietal comparisons (May et. al. 2012). Canary seed has been deemed relatively unresponsive to high nitrogen rates and high seeding rates; however, additions of potassium chloride have been found to increase seed yields (May et. al. 2012). May et al. 2012 also found that yields were maximized in canary seed at 45 kg/ha of applied potash, and at a higher seeding rate of 55 kg/ha. Furthermore, panicle density and seed density were greatest at the highest seeding rate used of 55 kg/ha. Increasing seeding rates in other cereal crops has often been investigated as a means to reduce tillering and hasten maturity of the crop. Canary seed has a much longer time to maturity as compared to other cereal crops, and thus hastening maturity in shorter season areas is of high importance.

It can be speculated that, as in other cereal crops where different market classes often respond differently to various agronomic inputs, the same may occur in different market classes of canary seed (Slowski et. al. 2019). As contrasting market classes of canary seed have different yield potentials, it is possible that yields will be maximized by different rates and combinations of agronomic inputs. This project was developed to demonstrate how each market class of canary seed responds to seeding rate and the addition of potash. Demonstrating different agronomic management in canary seed to optimize yields will help producers determine whether they need to tailor crop management to the specific variety of canary seed they are growing on their farm.

Literature Cited

May, W.E., Gan, Y., Lafond, G.P., Hucl, P., Holzapfel, C.B., Johnston, A.M, and C. Stevenson. 2012. Yield variability in Phalaris canariensus L. due to seeding rate and nitrogen fertilizer. Can J. Plant Sci. 92 (4): 651-669.

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Slowski, J., Brandt, S., Catellier, C., Holzapfel, C., Enns, J., Hall, M., and Nybo, B. 2019. Input Study: Intensive Wheat Management. Available at: ADF-20160210-Input-Study-Intensive-Wheat-Management-Final-Report.pdf (neag.ca)

Methodology and Results

9. **Methodology:**

The demonstration was conducted at three locations including Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022. (Table 1). Swift Current was the only site in the brown soil zone, with the remaining sites located within the black soil zone. Within the black soil zone one site was southern (Indian Head), one central (Yorkton), and one within the northern area (Melfort) of the province. These locations were selected to allow us to demonstrate responses across a wide range of environmental conditions.

The demonstration was set-up as a factorial combination with four replications at all locations. The factorial combination consisted of three factors, which were variety (Hairy vs. Hairless), seeding rate (400 seeds/m^2 vs. 620 seeds/m^2), and potash (0 kg/ha vs. 45 kg/ha) (Table 1). The hairy variety used was Keet and the hairless variety used was CDC Lumio. The same seed sources were used at all locations. The seeding rates for each variety took into account both percent germination and thousand seed weights (g/1000 seeds). All potash was side-banded at the time of seeding.

Table 1. Treatments used in Canary Seed varietal response to agronomic inputs at Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022

Treatment #	Variety (End use)	Seeding Rate (seed/m^2)^x	Added Potash (kg/ha)
1	Hairless (Human)	400	0
2	CDC Lumio	400	45
3		620	0
4		620	45
5	Hairy (Birdseed)	400	0
6	Keet	400	45
7		620	0
8		620	45

^{x} 400 seeds/m^2 is approximately 35 kg/ha of seed while 620 seeds/m^2 is approximately 55 kg/ha

Seeding equipment and crop management varied by location (Table 2). All sites were seeded between May 5th and May 25th, and the demonstration was direct seeded into canola stubble at Melfort, Yorkton and Indian Head, and durum stubble at Swift Current. Weeds, insects, and disease were controlled using registered products with the specific products at each participating site varying at the discretion of the site managers. All fertility, aside from potash was applied as per soil recommendations for each site to be non yield limiting (Table 3). Desiccants were used if needed, and all plots were harvested between August 16th and September 28th.

Table 2. Agronomic information and dates of operation for Canary Seed response to Agronomic Inputs at Melfort, Yorkton, Indian Head and Swift Current, SK in 2022.

Factor/Operation	Melfort	Swift Current	Yorkton	Indian Head
Previous Crop	Canola	Durum	Canola	Canola
Pre-Emergent Weed Control	Glyphosate 540 1L/ac May 21	Glyphosate 540 1L/ac & Aim May 4	None	Glyphosate 540 0.67L/ac May 22 & 27
Seeding Date	May 25	May 5	May 24	May 23
Row Spacing (cm)	0.3048m	0.2096m	0.3048m	0.3m
Plot size	16.5m^2	17.25 m^2	30.7m^2	25.6m^2
Kg N-P_2O_5-S/ha (K_20 as per treatment)	56-22-0	34-17-7	52-34-0	90-35-0
Post-emergent herbicide	Prestige XL 947mL/ac June 28	Buctril M 400mL/ac June 9	Curtail M June 13	Prestige XL 0.8L/ac June 19
Emergence Counts	June 17	June 13	June 7 & 8	June 13
Lodging	September 26	August 16	August 17	September 3
Maturity	September 6	August 1	August 12	August 29-September 2
Foliar Fungicide	None	None	Tilt July 15	Trivapro A (o.4L/ac) Trivapro B (0.12L/ac) July 10
Foliar Insecticide	Cygon 480 on August 8 (Aphids)	None	Malathione August 12 (aphids)	Decis 5 EC 60mL/ac July 9 (grasshoppers) Lagon 480 202 ml/ac on August 3 (aphids)
Pre-harvest Application	None	None	None	Glyphosate 540 0.67L/ac September 12
Harvest Date	September 26	August 16	September 21	September 28

Table 3. Soil sample results for Canary Seed varietal response to agronomic inputs at Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022.

Depth	NO3-N (kg/ha)	Olsen-P (ppm)	K (ppm)	S (kg/ha)	pH	Organic Matter (%)	Salts (mmho/cm)	Chloride (Cl) (kg/ha)
Melfort								
0-15cm	44	13	453	36	5.8	9.5	0.35	--
15-30cm	34			49	6.1		0.38	--
Yorkton								
0-15cm	26	10	238	40	7.3	6.5	0.42	94 (0-60cm)
15-60cm	91			81	8.1		0.47	
Swift Current								
0-15cm	15	12	262	5	7.0	3.1	0.31	9 (0-30cm)
15-30cm	24			5	7.8		0.36	
Indian Head								
0-15cm	3.4	3	502	13.4	8.2	4.5	0.53	7 (0-60cm)
15-60cm	13.4			40.3	8.3		0.53	

Data collection at all sites consisted of plant density, days to maturity, lodging, and seed yield. Plant density was measured by counting the seedlings along two 1-meter sections of crop row per plot. Lodging was determined by rating every plot for severity of lodging prior to harvest. A scale of 0 to 9 was used where 0 equated to no lodging, and 9 equated to the whole plot laying flat. Days to maturity was noted by recording the day the majority of plants in a plot reached the hard dough stage (Zadoks 87). This was then converted to the days that it took each plot to reach maturity since the time of seeding. Seed yield was determined at each site by weighing each harvested plot sample and converting the grams per plot to a kg/ha equivalent, while correcting to consistent moisture. Lastly, statistical analysis was completed for each site separately using factorial analysis in Statistix 10.

10. **Results:**

Environmental Conditions:

Throughout the 2022 growing season, all participating sites experienced above average temperatures (+0.2-1.4°C) alongside slightly below to above average precipitation (88-119% of the long-term average)(Table 3). Swift current was the site with the least amount of cumulative precipitation at 88% of the long-term average (187.0mm) along with the highest average growing season temperature at an average of 16.9°C, which was a 1.4°C increase from the long-term average. Melfort had above average precipitation at 106% of the long-term average (240.3mm) with an average growing season temperature of 15.5°C, which was only an increase of 0.3°C from the long-term average. Indian head also had above average precipitation at 117% of the long-term average (285.6mm) and an average growing season temperature of 15.8°C, which was a 0.2°C increase from the long-term average. Lastly, Yorkton had the greatest increase in precipitation at 119% of the long-term average (325.0mm) with an average growing season temperature of 16.0°C, which was a 0.8°C increase from the long-term average. Furthermore, Yorkton experienced a significant hail event on June 23rd, which damaged the canary seed plants and may have impacted treatment results, aside from plant density.

Table 4. Mean temperatures and precipitation collected from the Environment Canada Weather Station at Melfort, Yorkton, Indian Head, and Swift Current, SK for May to August 2022.

	May	June	July	August	Average/Total
--Temperature(°C)--					
Yorkton 2022	10.6	15.7	18.6	18.9	16.0
Long-Term[x]	10.4	15.5	17.9	17.1	15.2
Swift Current 2022	10.9	15.9	19.8	20.9	16.9
Long-Term[x]	10.9	15.3	18.2	17.6	15.5
Melfort 2022	9.9	15.2	18.2	18.7	15.5
Long-term[x]	10.7	15.9	17.5	16.8	15.2
Indian Head 2022	10.9	16.1	18.1	18.3	15.8
Long-term[x]	10.8	15.8	18.2	17.4	15.6
--Precipitation(mm)--					
Yorkton 2022	137.9	57.9	38.4	90.8	325.0(119%)
Long-Term[x]	51.0	80.0	78.0	62.0	272.0
Swift Current 2022	51.2	37.7	90.4	7.5	187.0 (88%)
Long-Term[x]	44.1	74.5	51.9	43.2	213.7
Melfort 2022	90.8	78.1	34.9	36.5	240.3 (106%)
Long-term[x]	42.9	54.3	76.7	52.4	226.3
Indian Head 2022	97.7	27.5	114.5	45.9	285.6(117%)
Long-term[x]	51.7	77.4	63.8	51.2	244.1

[x] Long-Term Climate Normal from each locations nearest Environment Canada Weather Station (1981-2010)

Plant Density

The one-way interaction for plant density was significant for variety (Var) at Yorkton (p=0.0139), Melfort (p=0.0095), and Swift Current (p<0.0001), for seeding rate (SR) at Yorkton (p<0.0001), Melfort (p<0.0001), Indian Head (p<0.0001), and Swift Current (p=0.0003), and for potash (KCl) at Swift Current (p=0.0164). The significant difference for variety was consistent across sites in that the hairy variety had significantly higher plant density than the hairless variety. The same trend was observed at Indian head; however, the result was not statistically significant. At significant sites, plant density was 31-87 plants/m^2 higher for the hairy variety than the hairless variety. The significant effect of seeding rates at all sites was, as expected, was such that plant density was increased at 620 seeds/m^2 as compared to 400 seed/m^2. The increase in plant density ranged from 50-127 plants/m^2. The significant effect of potash (P) at Swift Current was that plant density was 30 plants/m^2 higher when 45 kg/ha of potash was applied. There were also several significant two-way interactions for plant density where Var X SR was significant at Swift Current (p=0.0074) and Melfort (p=0.0095), and P X SR was significant at Swift Current (p=0.0124). The Var X SR interaction at Swift Current and Melfort was that there was a significant increase in plant density for the hairy variety at 620 seeds/m^2 as compared to the hairless variety; however, at the 400 seeds/m^2 seeding rate, there was no significant difference between the two varieties. For the KCl X SR interaction at Swift Current, there was a significant increase in plant density at the 620 seeds/m^2 seeding rate when potash was applied as compared to when no potash was applied. When no potash was applied, plant density at the 620 seeds/m^2 seeding rate was comparable to the 400 seeds/m^2 seeding rate. There was no significant difference between plant densities at the 400 seeds/m^2 seeding rate when potash was applied. Lastly, there were no significant 3-way interactions for plant density at any of the locations.

Lodging

For the one-way interaction lodging was significant for variety at Melfort (p=0.0063) and Swift Current (p=0.0019) and potash was significant at Yorkton (p=0.0193) and Swift Current (p=0.0277). Seeding rate had no significant effect on lodging at any sites. When the variety effect was significant, the hairless variety demonstrated a significant increase in lodging as compared to the hairy variety. The increase was small, ranging from a 0.4-1.9 average increase in severity at significant sites. When the potash effect was significant, there was an opposing result where the addition of potash increased lodging at Yorkton and decreased lodging as Swift Current as compared to when no potash was applied. For the two-way interaction Var X KCl was significant at Swift Current (p=0.0277), and the KCl X SR interaction was significant at Indian Head (p=0.0359). The Var X KCl interaction at Swift Current was that the addition of potash significantly reduced lodging for the hairless variety as compared to when no potash was applied; however, the difference was not significant for the hairy variety. The significant KCl X SR interaction at Indian Head was that lodging was significantly reduced at 620 seeds/m^2 when potash was applied as compared to when no potash was applied; however, at the 400 seeds/m^2 seeding rate there was no significant potash effect on lodging. Lastly, there was no significant three-way interaction at any of the sites for lodging.

Days to Maturity

The one-way interaction for maturity was significant for variety at Yorkton (p=0.0179) and Indian Head (p=0.0001), and for potash at Yorkton (p=0.005) and Indian Head (p=0.0028). There were no significant effects of seeding rate at any of the sites. The significant effect of variety at both Yorkton and Indian Head was that days to maturity was significantly prolonged for the hairy variety as compared to the hairless variety. The average difference was very small at 1.1 days at Yorkton and 0.9 days at Indian Head. The significant effect of potash was that the addition of potash reduced days to maturity. The difference between treatments was also very small at 1.3 days at Yorkton and 0.7 days at Indian Head. The only significant two-way interaction for maturity was a KCl X SR interaction at Indian Head (p=0.0427). The difference was that, at the 620 seeds/m^2 seeding rate, there was a significant reduction in days to maturity when potash was applied as compared to when no potash was applied; however, there was no significant difference for maturity due to potash for the 400 seeds/m^2 seeding rate. Lastly, there was a three-way interaction at Indian head (p=0.0114). The significant three-way interaction was such that the hairy variety at the 620 seeds/m^2 seeding rate had significantly increased days to maturity when no potash was applied as compared to when potash was applied. When reducing the seeding rate to 400 seeds/m^2 for the hairy variety there was no significant potash effect on days to maturity.

Grain Yield

The one-way interaction for variety was significant for grain yield at Yorkton (p=0.0003), Melfort (p=0.0033), Swift Current (p<0.0001), and Indian Head (p<0.0001). The interaction was consistent across three of the four sites where the hairy variety was significantly higher yielding than the hairless variety at Melfort, Swift Current, and Indian Head. The average yield increase across these locations ranged from 301 to 480 kg/ha. Yorkton demonstrated a different varietal response where the hairless variety was significantly higher yielding than the hairy variety. This may be an indication that there was a varietal difference in hail recovery that resulted in an opposing varietal effect to yield that was not demonstrated at the other sites. The only other significant one-way interaction was potash at Yorkton (p=0.0248). At Yorkton, yield was significantly increased when potash was applied as compared to when no potash was applied. At Yorkton, grain yield was increased by an average of 159kg/ha when potash was applied. Melfort and Swift Current also demonstrated average yield increases when potash was applied; however, the response was not significant. For the two-way interaction there was a significant Var X SR interaction at Swift Current (p=0.0463), a significant Var X KCl interaction at Indian Head (p=0.0113), and a significant KCl X SR interaction at Indian Head (p=0.0249). The significant Var X SR interaction at Swift Current was such that yield was only significantly increased with seeding rate for the hairy variety. The yield for the hairless variety was not significantly different between seeding rates. The significant Var X KCl interaction at Indian Head was such that yield declined when potash was applied for the hairless variety. There was no significant effect to yield when potash was applied to the hairy variety. The significant KCl X SR interaction at Indian Head was such that yield was significantly greater at the 400 seeds/m^2 seeding rate when no potash was applied as compared to all other KCl X SR combinations. Lastly, there was a significant three-way interaction at Indian Head (p=0.0338). The significant interaction was that yield was significantly reduced for the hairy variety when no potash was applied when the seeding rate was increased to 620 seeds/m^2 as compared to when the seeding rate was 400 seeds/m^2. There was no significant difference between the yield of the hairy variety at both seeding rates when potash was applied.

11. Conclusion and Recommendation:

The 2022 growing season brought about warmer than average temperatures along with total precipitation that was above average for most of the participating locations. Of the data collected there were frequently significant one-way interactions, including varietal differences in plant density, lodging, maturity, and yield. When variety was significant results were often consistent across sites where the hairy variety had greater plant densities, decreased lodging, longer days to maturity, and increased seed yields as compared to the hairless variety. The only significant effect of seeding rate was an increased plant density at the higher seeing rate of 620 seeds/m^2. The addition of potash had a significant effect on plant density, lodging, maturity, and yields. However, when results were significant they were only significant at one or two of the project locations, indicating less consistency in results across sites. When potash was significant, the addition of 45 kg/ha increased plant density, decreased days to maturity, and increased grain yield. Although significant, the impact of potash on lodging had opposing site results where potash reduced lodging at one site and increased lodging at the other site. Significant two-way interactions were also common amongst the data collected; however, similar to potash additions the result was usually only significant at one or two locations, indicating less consistency in results across sites. For the Var X SR interaction, plant density and grain yield were significantly increased for the hairy variety at the higher seeding rate. For the Var X KCl interaction, lodging and grain yield were reduced when potash was applied to the hairless variety, but there was no significant effect to the hairy variety when potash was applied. For the KCl X SR, interaction plant density was increased, lodging was reduced, and days to maturity was reduced at the higher seeding rate when potash was applied. The P X SR interaction for yield was that yield was significantly reduced at the lower seeding rate of 400 seeds/m^2 when potash was applied as compared to when no potash was applied at the same seeding rate. Lastly, there were significant effects of the three-way interaction for maturity and yield, which both occurred at Indian Head. The effect was that maturity was prolonged for the hairy variety at the higher seeding rate of 620 seeds/m^2 when no potash was applied as compared to when potash was applied, and yield was significantly reduced for the hairy variety at the higher seeding rate when no potash was applied as compared to when potash was applied. Overall, there were many significant differences amongst the data collected between the different market classes of canary seed; however, there were very rarely significant interactions that suggested these varieties respond differently to agronomic inputs consistently across different locations.

Supporting Information:

12. **Acknowledgements:** This project was funded under the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture. The Canary seed Development Commission of Saskatchewan and the Northeast Agriculture Research Foundation would like to express our gratitude to the Saskatchewan Ministry of Agriculture's ADOPT program for funding this demonstration and for providing signage. Thank you to all participating sites including the East Central Research Foundation, the Northeast Agriculture Research Foundation, the Indian Head Agricultural Research Foundation, and the Wheatland Conservation Area staff for their hard work in completing this demonstration.

13. **Extension:** The Northeast Agriculture Research Foundation presented this demonstration project at the East Central Research Foundation's Crop Plot Tour on July 14th, 2022 near Yorkton. The final project report will be shared on all participating sites websites by the late winter/early spring of 2023. Final project results will also be shared on NARF's social media accounts @NARF_Melfort on Twitter and the Northeast Agriculture Research Foundation on YouTube.

14. Abstract and Summary:

Canary Seed is often considered a low input cereal crop that grows best on heavy clay or clay loam soils. For many decades, canary seed has been grown and sold into the bird seed market, and the varieties grown for this purpose are considered hairy or non-glabrous. In recent years, new varieties have been developed in hopes of a potential human food market, which are known as hairless or glabrous varieties. Many producers have been apprehensive to adopt glabrous varieties as they are often lower yielding than the more traditional non-glabrous varieties. Like many other annual grain crops, it is possible that different market classes of canary seed may respond differently to agronomic inputs to maximize seed yields. To demonstrate this, a small-plot demonstration was initiated near Melfort, Yorkton, Indian Head, and Swift Current, SK in 2022. The demonstration was set-up as a three-way factorial with four replications. Two varieties of canary seed were selected, one hairy and one hairless, each of which were seeded at 400 seeds/m^2 (35kg/ha) or 620 seeds/m^2 (55kg/ha) and with or without the addition of 45 kg/ha of potash at seeding. Data collection consisted of plant density, lodging, days to maturity, and seed yield. When variety was significant, results were often consistent across sites whereby the hairy variety had greater plant densities, decreased lodging, longer days to maturity, and increased seed yields as compared to the hairless variety. Increasing seeding rate only significantly increased plant density, and the addition of potash only significantly increased yield at one site. The only significant varietal interactions were that the hairy variety was more responsive to increases in seeding rate as plant densities and yield were increased at the higher seeding rate. The addition of potash also decreased lodging in the hairless variety, and yield declined at one site when potash was applied to the hairless variety. In this demonstration, differences in varietal responses to agronomic inputs were less frequent than anticipated, as significant differences were more often a result of variety alone rather than the interaction between variety and agronomic inputs.

15. Appendices:

Table 5. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

1-way interaction	Yorkton	Melfort	Swift Current	Indian Head
Plant Density (plants/m²)^z				
Variety (Var)	0.0139*	0.0095*	<0.0001***	NS
Seeding rate (SR)	<0.0001***	<0.0001***	0.0003**	0.0001**
Potash (KCl)	NS	NS	0.0164*	NS
Grand Mean	312.5	329.7	324.8	420.7
CV	13.07	9.18	10.16	16.29
<u>Variety (Var)</u>				
Hairy	331.9a	345.2a	368.4a	429.2a
Hairless	293.1b	314.2b	281.3b	412.3a
<u>Seeding rate(SR)</u>				
400 seeds/m²	262.9b	266.3b	299.8b	360.7b
620 seeds/m²	362.1a	393.1a	349.9a	480.8a
<u>Potash (KCl)</u>				
45kg/ha Potash	307.7a	335.2a	340.0a	416.2a
No Potash	317.3a	324.2a	309.6b	425.3a

^{z}Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 6. Statistical analyses and treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

2-way interaction	Yorkton	Melfort	Swift Current	Indian Head
Plant Density (plants/m²)ᶻ				
Var X SR	NS	0.0095*	0.0074**	NS
Var X KCl	NS	NS	NS	NS
KCl X SR	NS	NS	0.0124*	NS
Grand Mean	312.5	329.7	324.8	420.7
CV	13.07	9.18	10.16	16.29
Var X SR				
400 Hairless	252.4b	261.0c	273.5c	343.7b
400 Hairy	333.8a	271.5c	289.0bc	377.7b
620 Hairless	273.3b	367.3b	326.0b	480.9a
620 Hairy	390.4a	418.9a	410.7a	480.6a
Var* KCl				
Hairless no potash	294.1a	324.2ab	259.2b	415.2a
Hairless potash	292.2a	304.2b	303.3b	409.3a
Hairy no potash	340.6a	324.2ab	360.0a	435.3a
Hairy potash	323.2a	366.2a	376.7a	423.0a
SR X KCl				
400 no	267.0b	267.4b	300.5b	366.2b
400 potash	258.8b	265.1b	299.0b	355.2b
620 no	367.7a	381.0a	318.7b	484.3a
620 potash	356.6a	405.3a	381.0a	477.2a

ᶻSignificance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 7. Statistical analyses and treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

3-way interaction	**Yorkton**	**Melfort**	**Swift Current**	**Indian Head**
Plant Density (plants/m^2)^z				
Var X SR X KCl	NS	NS	NS	NS
Grand Mean	312.5	329.7	324.8	420.7
CV	13.07	9.18	10.16	16.29
<u>Var*SR*KCl</u>				
400 Hairless no potash	256.7b	273.5c	275.0cd	343.7a
400 Hairless 45kg potash	248.1b	248.5c	272.0cd	343.7a
400 Hairy no potash	277.2b	261.2c	326.0bc	388.8a
400 Hairy 45kg potash	269.4b	281.7c	326.0bc	366.6a
620 Hairless no potash	331.4ab	374.8ab	243.4d	486.8a
620 Hairless 45kg potash	336.3ab	359.9b	334.7bc	474.9a
620 Hairy no potash	404.0a	387.1ab	394.0ab	481.9a
620 Hairy 45kg potash	376.9a	450.7a	427.4a	479.4a

^{z}Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 8. Statistical analyses and treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

1-way interaction	**Yorkton**	**Melfort**	**Swift Current**	**Indian Head**
Lodging (0-9)^z				
Var (p-value)	NS	0.0063**	0.0019**	NS
SR (p-value)	NS	NS	NS	NS
KCl (p-value)	0.0193*	NS	0.0277*	NS
Grand Mean	3.2	3.0	2.2	3.7
CV	42.00	60.18	13.66	21.39
<u>Variety (Var)</u>				
Hairy	2.7a	2.0b	2.0b	3.8a
Hairless	3.6a	3.9a	2.4a	3.5a
<u>Seeding rate(SR)</u>				
400 seeds/m^2	3.1a	3.1a	2.2a	3.7a
620 seeds/m^2	3.2a	2.8a	2.2a	3.7a
<u>Potash (KCl)</u>				
45kg/ha Potash	3.8a	3.1a	2.1b	3.6a
No Potash	2.6b	2.8a	2.3a	3.8a

^{z}Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 9. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

2-way interaction	Yorkton	Melfort	Swift Current	Indian Head
		Lodging (0-9)[z]		
Var X SR	NS	NS	NS	NS
Var X KCl	NS	NS	0.0277*	NS
KCl X SR	NS	NS	NS	0.0359*
Grand Mean	3.2	3.0	2.2	3.7
CV	42	60.18	13.66	21.39
Var X SR				
400 Hairless	3.6a	4.1a	2.4a	3.5a
400 Hairy	3.6a	2.1a	2.4a	3.8a
620 Hairless	2.6a	3.7a	2.0a	3.6a
620 Hairy	2.8a	1.9a	2.0a	3.9s
Var* KCl				
Hairless no potash	3.0ab	3.6a	2.6a	3.4a
Hairless potash	4.3a	4.2a	2.1b	3.6a
Hairy no potash	2.1b	2.0a	2.0b	4.1a
Hairy potash	3.3ab	2.0a	2.0b	3.6a
KCl * SR				
400 no	2.1b	3.1a	2.4a	3.4b
400 potash	4.1a	3.1a	2.3a	3.9b
620 no	3.0ab	2.5a	2.1a	4.1a
620 potash	3.4ab	3.1a	2.0a	3.3b

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 10. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

3-way interaction	Yorkton	Melfort	Swift Current	Indian Head
Lodging (0-9)[z]				
Var X SR X KCl	NS	NS	NS	NS
Grand Mean	3.2	3.0	2.2	3.7
CV	42	60.18	13.66	21.39
Var*SR*KCl				
400 Hairless no potash	2.5a	4.0a	2.8a	3.3a
400 Hairless 45kg potash	4.8a	4.3a	2.0b	3.8a
400 Hairy no potash	1.8a	2.3a	2.0b	3.6a
400 Hairy 45kg potash	3.5a	2.0a	2.0b	4.0a
620 Hairless no potash	3.5a	3.3a	2.5ab	3.6a
620 Hairless 45kg potash	3.8a	4.2a	2.3ab	3.5a
620 Hairy no potash	2.5a	1.8a	2.0b	4.6a
620 Hairy 45kg potash	3.0a	2.0a	2.0b	3.1a

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 11. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

1-way interaction	Yorkton	Melfort	Swift Current	Indian Head
Maturity (Days to)[z]				
Variety (Var)	0.0179*	--	NS	0.0001**
Seeding rate (SR)	NS	---	NS	NS
Potash (KCl)	0.005**	--	NS	0.0028**
Grand Mean	90.3	104.0	90.2	108.0
CV	1.37	--	0.86	0.53
Variety (Var)				
Hairy	90.8a	104.0	90.0a	108.5a
Hairless	89.7b	104.0	90.4a	107.6b
Seeding rate (SR)				
400 seeds/m^2	90.7a	104.0	90.4a	108.0a
620 seeds/m^2	89.8a	104.0	90.0a	108.1a
Potash (KCl)				
45kg/ha Potash	89.6b	104.0	90.1a	107.7b
No Potash	90.9a	104.0	90.4a	108.4a

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 12. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

2-way interaction	Yorkton	Melfort	Swift Current	Indian Head
Maturity (Days to)^z				
Var X SR	NS	--	NS	NS
Var X KCl	NS	--	NS	NS
KCl X SR	NS	--	NS	0.0427*
Grand Mean	90.3	104.0	90.2	108.0
CV	1.37	--	0.86	0.53
Var X SR				
400 Hairless	89.8b	104.0	90.5a	107.6bc
400 Hairy	89.6b	104.0	90.4a	108.4ab
620 Hairless	91.6a	104.0	90.4a	107.5c
620 Hairy	90.0ab	104.0	89.6a	108.6a
Var* KCl				
Hairless no potash	90.5ab	104.0	90.5a	107.9bc
Hairless potash	88.9b	104.0	90.4a	107.3c
Hairy no potash	91.4a	104.0	90.3a	108.9a
Hairy potash	90.3ab	104.0	89.8a	108.1ab
SR X KCl				
400 no	91.3a	104.0	90.6a	108.1ab
400 potash	90.1ab	104.0	90.3a	107.9ab
620 no	90.6ab	104.0	90.1a	108.6a
620 potash	89.0b	104.0	89.9a	107.5b

^{z}Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 13. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

3-way interaction	**Yorkton**	**Melfort**	**Swift Current**	**Indian Head**
Maturity (Days to)[z]				
Var X SR X KCl	NS	--	NS	0.0114*
Grand Mean	90.3	104.0	90.2	108.0
CV	1.37	--	0.86	0.53
Var*SR*KCl				
400 Hairless no potash	90.3ab	104	90.5a	108.0b
400 Hairless 45kg potash	89.3b	104	90.5a	107.3b
400 Hairy no potash	92.3a	104	90.8a	108.3ab
400 Hairy 45kg potash	91.0ab	104	90.0a	108.5ab
620 Hairless no potash	90.8ab	104	90.5a	107.8b
620 Hairless 45kg potash	88.5b	104	90.3a	107.3b
620 Hairy no potash	90.5ab	104	89.8a	109.5a
620 Hairy 45kg potash	89.3b	104	89.5a	107.8b

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 14. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

1-way interaction	**Yorkton**	**Melfort**	**Swift Current**	**Indian Head**
Grain Yield (kg/ha)[z]				
Variety (Var)	0.0003**	0.0033**	<0.0001***	<0.0001***
Seeding rate (SR)	NS	NS	NS	NS
Potash (KCl)	0.0248	NS	NS	NS
Grand Mean	2524.8	2907.5	676.3	3071.2
CV	7.38	8.71	17.7	2.93
Variety (Var)				
Hairy	2381.4b	3058.0a	852.7a	3311.2a
Hairless	2668.2a	2757.1b	500.0b	2831.2b
Seeding rate (SR)				
400 seeds/m^2	2519.3a	2913.4a	667.2a	3103.9a
620 seeds/m^2	2530.3a	2901.7a	685.4a	3038.6a
Potash (KCl)				
45kg/ha Potash	2604.4a	2920.7a	693.1a	3056.1a
No Potash	2445.2b	2894.4a	659.6a	3086.1a

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 15. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

2-way interaction	Yorkton	Melfort	Swift Current	Indian Head
		Grain Yield (kg/ha)[z]		
Var X SR	NS	NS	0.0463*	NS
Var X KCl	NS	NS	NS	0.0113*
KCl X SR	NS	NS	NS	0.0249*
Grand Mean	2524.8	2907.5	676.3	3071.2
CV	7.38	8.71	17.7	2.93
Var X SR				
400 Hairless	2710.1a	2788.5a	535.7b	2840.2b
400 Hairy	2626.4ab	3038.4a	464.3b	3367.6a
620 Hairless	2328.6c	2725.8a	798.8a	2822.3b
620 Hairy	2434.2bc	3077.5a	906.6a	3254.9a
Var* KCl				
Hairless no potash	2615.5a	2729.4a	503.3b	2890.5b
Hairless potash	2721.0a	2784.9a	496.7b	2772.0c
Hairy no potash	2274.9b	3059.5a	815.9a	3282.1a
Hairy potash	2487.9ab	3056.4a	889.4a	3340.3a
SR X KCl				
400 no	2497.8ab	2923.0a	643.4a	3157.4a
400 potash	2540.9ab	2903.8a	691.0a	3050.4b
620 no	2392.6b	2865.9a	675.7b	3015.2b
620 potash	2668.0a	2937.5a	695.1b	3061.9b

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant

Table 16. Treatment means for Canary Seed varietal response to agronomic inputs in 2022. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

3-way interaction	Yorkton	Melfort	Swift Current	Indian Head
	Grain Yield (kg/ha)[z]			
Var X SR X KCl	NS	NS	NS	0.0338*
Grand Mean	2524.8	2907.5	676.3	3071.2
CV	7.38	8.71	17.7	2.93
Var*SR*KCl				
400 Hairless no potash	2646.1ab	2802.8a	520.0cd	2901.7c
400 Hairless 45kg potash	2774.0a	2774.2a	551.3bcd	2778.6cd
400 Hairy no potash	2349.5abc	3043.2a	766.8abc	3413.1a
400 Hairy 45kg potash	2307.7bc	3033.5a	830.7ab	3322.1a
620 Hairless no potash	2584.9abc	2656.1a	486.5cb	2879.3cd
620 Hairless 45kg potash	2667.9ab	2795.6a	442.0c	2765.3d
620 Hairy no potash	2200.3c	3075.7a	864.9a	3151.2b
620 Hairy 45kg potash	2668.1ab	3079.3a	948.2a	3358.5a

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001; NS= Not significant