2022 Interim Report

for the

Saskatchewan Pulse Crop Development Board

Faba Bean Agronomy to Enhance Yield, Hasten Maturity, & Reduce Disease

(Project #AP-2205a)

Principal Investigator: Chris Holzapfel[1]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK, S0G 2K0

Collaborators: Brianne McInnes[2], Garry Hnatowich[3], Gursahib Singh[3], Robin Lokken[4], Bryan Nybo[5], Don Sluth[5], Amber Wall[5], and Michael Hall[6] and Heather Sorestad[6]

[2]Northeast Agriculture Research Foundation, Melfort SK, S0E 1A0; [3]Irrigation Crop Diversification Corporation, Outlook, SK, S0L 2N0; [4]Conservation Learning Centre, Prince Albert, SK, S6V 6J9; [5]Wheatland Conservation Area Inc., Swift Current, SK, S9H 4M7; [6]East Central Research Foundation, Yorkton, SK, S3N 3X3

Correspondence: cholzapfel@iharf.ca or (306) 695-7761

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2. **Project Title:** Faba bean agronomy to enhance yield, hasten maturity, and reduce disease.

3. **Principal Investigator with contact information**

Chris Holzapfel, Research Manager
Indian Head Agricultural Research Foundation
PO Box 156, Indian Head, SK, S0G 2K0
Mobile: 306-695-7761
Office: 306-695-4200
Email: cholzapfel@iharf.ca

4. **Collaborators with contact information**

Brianne McInnes, Northeast Agriculture Research Foundation (NARF), Melfort SK, S0E 1A0
Phone: 306-920-9393; Email: neag.agro@gmail.com

Gursahib Singh, Irrigation Crop Diversification Corporation (ICDC), Outlook, SK, S0L 2N0
Phone: 306-867-5405; Email: garry.icdc@sasktel.net

Robin Lokken, Conservation Learning Centre (CLC), Prince Albert, SK, S6V 6J9
Phone: 306-960-1834; Email: info@conservationlearningcentre.com

Bryan Nybo, Wheatland Conservation Area, Swift Current, SK, S9H 4M7
Phone: 306-773-4775; Email: wcanybo@sasktel.net

Mike Hall, East Central Research Foundation, Yorkton, SK, S3N #x#
Phone: 306-621-6032; Email: m.hall@parklandcollege.sk.ca

5. **Introduction** (background and rationale for project, include references to original research projects where necessary)

Although much of Saskatchewan has been drier than average the past several years, many pea and lentil growers continue to struggle with root disease and are interested in alternative pulse crop options such as faba bean. Marketing concerns aside, the Saskatchewan Pulse Growers have identified disease and maturity as two of the current challenges in producing this crop. The Agri-ARM sites also strive to promote diversity by working with numerous crop types, and this network is well-positioned to generate results applicable to all the major crop producing regions of Saskatchewan. This project was initiated to benefit farmers by demonstrating the capacity for basic agronomic practices and technologies to facilitate higher faba bean yields, reduce disease, and get the crop harvested as early as possible. An additional intended benefit was to bring attention to this less prominent crop and improve our understanding of its broader adaptation across a range of Saskatchewan environments.

Seeding dates have been evaluated on numerous occasions and generally show that faba beans should be seeded as early as possible to maximize yields and increase the likelihood that the crop will reach maturity in a timely manner. In a four-year study focussed on soybean adaptation relative to other pulse crops, faba beans seeded in early- to mid-May consistently yielded higher and matured earlier than later seeding dates and yield losses were occasionally severe when seeding was delayed until late-May or early-June (Holzapfel and Nybo, 2018). Early work in central Alberta evaluated seeding dates ranging from May 2 to June 11 and even minor delays from May 2 to May 15 resulted in a 43-47% yield loss. Delaying seeding to June 11 led to 83-85% yield losses (Kondra 1975). Over a two-year period in Winnipeg, delaying seeding from April 25 to May 23 led to yield reductions of 28-36% while May 9 seeding resulted in a significant yield loss relative to the earliest date in 1 of 2 years (McVetty et al. 1986).

Focussing on seeding rates, Shirtliffe et al. (2019) recently found that relatively low populations of 20-30 plants/m^2 were sufficient for maximum yield; however, these somewhat marginal populations could

sometimes delay maturity and lead to challenges with weed competition. Kondra (1975) tested rates of 100, 150, and 200 kg/ha and only reduced yields at the lowest rate; however, information on actual plant populations or seed size were not provided. McVetty, et al. (1986) looked at seeding rates of 23, 35, 46, and 58 plants/m^2, but only ever reported yield reductions at the lowest rate. In combination with varying row spacing treatments and under dry, low yielding conditions, Holzapfel (2018) saw a slight linear yield increase with seeding rates of 25, 45, and 65 seeds/m^2; however, the effect was small with only 139 kg/ha (7%) observed going from 25 to 65 seeds/m^2 rates. Increasing seed rate accelerated maturity by 3 days when averaged across row spacing treatments, under these conditions.

Faba bean response to fungicide is less well understood and the subject of current SPG funded research; however, several diseases can affect faba bean and have been observed in western Canada. Chocolate spot (*Botrytis spp.*) has traditionally been thought to be the most important of these; however, over the last two-years of monitoring and surveying, Stemphylium blight and Alternaria have also been present (i.e., Western Forum of Pest Management meetings 2019 and 2020). Ascochyta blight, powdery mildew, rust, and white mould can also occur, but have had limited prevalence in Saskatchewan to date. Yield increases with fungicide applications have been elusive in research to date; however, anecdotally, growers and agronomists have seen beneficial responses on occasion. There is also uncertainty surrounding the optimal timings of application and effects on maturity. Shirtliffe et al. (2019) frequently reduced disease severity with fungicide applications, but the most effective products only resulted in a 10% yield increase in 10% of the site-years. Under relatively dry conditions at Indian Head in 2015, dual fungicide applications (Headline followed by Priaxor 10 days later) did not significantly impact yield relative to the control but increased seed size from 398 g/1000 seeds to 416 g 1000/seeds (Holzapfel 2016). This increase in seed size coincided with visual differences in late-season disease severity and maturity but, without a yield response, was not economically viable.

Literature Cited

Holzapfel, C. 2016. Phosphorus fertilization and fungicide effects of faba bean establishment and yield. Report for the Saskatchewan Ministry of Agriculture ADOPT Program (Project #20140436). Online [Available]: https://iharf.ca/wp-content/uploads/2016/04/Phosphorus-Fertilization-and-Fungicide-Effects-on-Faba-Bean-Establishment-and-Yield.pdf (March 13, 2023).

Holzapfel, C. 2018. Seeding rate and row spacing effects on faba bean establishment, competitiveness with weeds, maturity, and yield. Report for the Saskatchewan Ministry of Agriculture ADOPT Program (Project #20170411). Online [Available]: https://iharf.ca/wp-content/uploads/2019/05/Seeding-rate-and-row-spacing-effects-on-faba-bean.pdf (March 13, 2023).

Holzapfel, C., and Nybo. B. 2018. Adaptation and establishment of soybean (Glycine max) under no-till in southern Saskatchewan: Non-confidential Summary of AIP-CL03: Activity 6.v10 (A9). Online [Available]: https://saskpulse.com/files/general/A9_Holzapfel_Y5_Non-confidential_Summary-FINAL.pdf (March 13, 2023).

Kondra, Z. 1975. Effects of row spacing, seeding rate, and date of seeding. Can. J. Plant Sci. 55: 211-214.

McVetty, P., Evans, L., and Nugent-Rigby, J. 1986. Response of faba bean (Vicia faba L.) to seeding date and seeding rate. Can. J. Plant Sci. 66: 39-44.

Shirtliffe, S., Pratchler, J., Weber, J., Holzapfel, C., Hnatowich, G., Nybo, B., Shaw, L., and Hall, M. 2019. Optimum seeding rate, row spacing, and disease management in faba bean varieties. Saskatchewan Pulse Growers Project #AGR1511 Summary. Online [Available]: https://saskpulse.com/files/general/AGR1511_%28Shirtliffe%29.pdf (March 3, 2023).

6. Objective(s) or purpose of the project

The objectives of the project are to demonstrate and investigate:

1. The ability of early seeding to optimize yield and allow for earlier faba bean harvest.
2. The effects of higher seeding rates on disease development, maturity, and yield.

3. The capacity for foliar fungicide applications to reduce disease, enhance yield, and potentially delay maturity.

7. Materials and Methods – experimental design, methods used, details of growing the crop(s), materials used, sites, etc. Statistical analysis used

Over the 2021 and 2022 growing seasons, field trials with faba bean were established at 13 locations which were representative of a wide swath of the major grain producing regions of Saskatchewan. Two locations were in the Brown soil zone, Swift Current which was dryland and Outlook which was irrigated. Five locations were in the Black soil zone, which is generally best suited for faba bean production. These included two southern (Redvers and Indian Head), one central (Yorkton), and two more northern (Melfort and Prince Albert) locations. Redvers did not conduct field trials in 2022 and data from Outlook, Prince Albert, and Redvers in 2021 were excluded due to the data quality being compromised by unfavourable environmental conditions. Selected agronomic details and dates of operations are provided in Table 13 of the Appendices.

The treatments were a factorial combination of two seeding dates (early vs. delayed), two seeding rates (45 vs. 65 viable seeds/m^2), and two fungicide treatments (untreated vs. treated). Early seeding was targeted for April 25 to May 7 while delayed seeding was targeted for May 20-30; however, the actual dates fell outside of this range in 2022 due to wet spring conditions. The fungicide was either Priaxor® or Dyax®, applied approximately 7-10 days after the initiation of flowering. These products contain the same active ingredients but in different proportions, providing 75-99 g/ha of fluxapyroxad and 99-148 g/ha pyraclostrobin. While the original intent was to use Priaxor® at all sites, this product was discontinued prior to the 2021 growing season and not all sites had access to it. The eight treatments were arranged in a split-plot design with seeding date as the main plots and seeding rates and fungicide treatments as the sub-plots. Each treatment was replicated four times.

Seeding equipment and general crop management varied across locations, depending on equipment and other factors (i.e., specific crop pests encountered). The plots were always direct seeded into cereal stubble. Weeds were controlled using a combination of pre-emergent and in-crop herbicides. Pre-harvest herbicides or desiccants were applied at the discretion of individual site managers and the centre rows of each plot were straight combined when it was fit do so. The harvest dates were tailored to the two seeding dates whenever doing so was feasible and made logistic sense but, in many cases, all plots were harvested on the same date.

Various data were collected over the course of the growing season and from the harvested grain samples. Emergence was measured by counting plants in 4 x 1 m sections of crop row per plot and calculating the average number of plants/m^2. Days to flowering was recorded for each seeding date (not for individual plots), primarily as a reference point for timing the fungicide applications. The onset of flowering was defined as when approximately 10% of the plants had at least one flower open. Disease ratings were completed for each plot at two distinct times and with dates tailored to each seeding date. One set of ratings was completed just prior to the fungicide applications and again during pod filling, with the latter timing intended to be a minimum of 14 days after the fungicide applications but prior to senescence. The plots were rated on a scale of 0-9 where 0 = no disease, 1 = less than 10% of the plant affected, 2 = 10-20% of the plant affected, and 9 = greater than 90% of the plant infected. While these ratings are subjective, they were useful to confirm the presence of disease and the relative severity across treatments. Three location-years (Indian Head 2021 and 2022, Melfort 2022) submitted plant samples to the Saskatchewan Crop Protection Laboratory to confirm the presence of disease and identify the specific pathogens. The Julian date where each plot reached maturity was recorded and used to calculate days from seeding to maturity. Maturity was defined as where approximately 80% of the pods had at least started to turn colour and 33% of the pods had completely turned (dark brown to black). Seed weight was determined by counting and weighing a minimum of 200 whole seeds (i.e., no splits) per plot and calculating g/1000 seeds. Mean monthly temperatures and total precipitation amounts were compiled from the nearest Environment and Climate Change Canada weather stations.

Where appropriate, response data were statistically analyzed using the generalized linear mixed model (GLIMMIX) procedure of SAS Studio. For plant density and initial disease ratings, only the effects of seeding date (D), seeding rate (R), and the D x R interaction were included as fixed effects. For the remaining variables,

seeding date, seeding rate, fungicide (F), and all possible two and three-way interactions were included as fixed effects. Replicate and D x Replicate interactions were always included as random effects. The Tukey-Kramer multiple comparisons test was used to separate individual treatment means. Treatment effects and differences between means were generally considered significant at $P \leq 0.05$; however, P-values ≤ 0.10 are often highlighted as potentially important trends.

8. **Results & Discussion –** results presented and discussed in the context of existing knowledge and relevant literature or comparison to existing recommendations. Detail any major concerns or sources of error. Provide proper statistical significance.

Weather

Mean monthly temperatures and precipitation amounts for each location-year (site are presented relative to the long-term (1981-2010) averages in Tables 1 and 2, respectively. The weather in September will not always be relevant (depending on when the crop matured) and may be excluded from future reports. Averaged over the five-months, all locations were warmer than normal, ranging from 0.6-1.8 °C above the long-term (1981-2010) average. Compared to the long-term averages, the month of May was generally cool, June temperatures varied widely, and July through September were frequently warmer than average and never cooler. Total precipitation amounts were below average at 6/10 sites and close to or above average at 4/10 sites. Although IH-21 had above normal growing season precipitation, with extremely low initial soil moisture and high June and July temperatures, this location was still considered dry. Speaking broadly, all locations were considered warm and dry in 2021 while, in 2022, the more eastern locations (i.e., Indian Head, Melfort, Yorkton) received normal to above normal precipitation (102-107% of the long-term average) while the more western locations (i.e., Outlook, Prince Albert, and Swift Current were relatively dry (60-73% of the long-term average). The Outlook site received 155 mm as irrigation (June 1 to August 31), in addition to the reported monthly amounts. In general, plant disease is usually most severe with prolonged wet and hot conditions in late June through early August and, as such, disease pressure has generally been low. July precipitation amounts were only above average at two sites (IH-22 and SW-22); however, in both cases, precipitation amounts in June and August were well below average, likely reducing the potential for disease.

Table 1. Mean monthly temperatures along with long-term (1981-2010) averages for the applicable growing seasons at Indian Head, Melfort, Outlook, Prince Albert, Swift Current, and Yorkton, Saskatchewan.

Location	Year	May	Jun	Jul	Aug	Sep	Avg.
		---------- Mean Temperature (°C) ----------					
Indian Head	2021	9.0	17.7	20.3	17.1	14.5	15.7 (107%)
	2022	10.9	16.1	18.1	18.3	13.7	15.4 (105%)
	Long-term	10.8	15.8	18.2	17.4	11.3	14.7
Melfort	2021	9.6	18.2	20.1	16.9	14.0	15.8 (110%)
	2022	9.8	15.2	18.2	18.7	13.7	15.1 (106%)
	Long-term	10.7	15.9	17.5	16.8	10.8	14.3
Outlook	2022	11.8	16.3	19.7	20.5	15.2	16.7 (108%)
	Long-term	11.5	16.1	18.9	18.0	12.3	15.4
Prince Albert	2022	10.2	15.1	17.9	18.0	13.0	14.8 (104%)
	Long-term	10.4	15.3	18.0	16.7	10.5	14.2
Swift Current	2021	9.5	18.3	21.6	17.9	14.7	16.4 (109%)
	2022	10.8	15.7	19.7	20.9	16.0	16.6 (111%)
	Long-term	11.0	15.7	18.4	17.9	12.0	15.0
Yorkton	2021	8.9	19.1	21.0	17.3	14.6	16.2 (112%)
	2022	10.6	15.7	18.6	18.9	13.5	15.5 (108%)
	Long-term	10.4	15.5	17.9	17.1	11.1	14.4

Table 2. Total monthly precipitation amounts along with long-term (1981-2010) for the applicable growing seasons at Indian Head, Melfort, Outlook, Prince Albert, Swift Current, and Yorkton, Saskatchewan.

Location	Year	May	Jun	Jul	Aug	Sep	Avg.
		Precipitation (mm)					
Indian Head	2021	81.6	62.9	51.2	99.4	0.4	296 (106%)
	2022	97.7	27.5	114.5	45.9	14.5	300 (107%)
	Long-term	51.7	77.4	63.8	51.2	35.3	279
Melfort	2021	31.4	37.6	0.2	69.3	7.5	146 (55%)
	2022	90.8	78.1	34.9	37.5	29.6	271 (102%)
	Long-term	42.9	54.3	76.7	52.4	38.7	265
Outlook	2022[Z]	35.7	75.2	53.2	7.0	5.1	176 (73%)
	Long-term	42.6	63.9	56.1	42.8	34.1	240
Prince Albert	2022	22.4	63.4	45.7	42.2	4.3	178 (60%)
	Long-term	44.7	68.6	76.6	61.6	43.4	295
Swift Current	2021	30.0	26.8	36.6	53.5	0.5	147 (66%)
	2022	43.2	31.2	83.5	6.7	4.6	169 (76%)
	Long-term	42.1	66.1	44.0	35.4	34.1	222
Yorkton	2021	24.6	18.1	35.2	69.7	15.0	163 (51%)
	2022	137.9	57.9	38.4	90.8	15.1	340 (107%)
	Long-term	51.3	80.1	78.2	62.2	44.9	317

[Z] Outlook site also received 155 mm of irrigation water between June-1 and August 31, 2022

Results Across Locations

At this time, multi-site data have not been combined for statistical analyses; however, data from all sites were analyzed and summarized individually. To help compare results across locations, overall F-test results for each response variable are presented across locations in Tables 14-19 of the Appendices. Aside from this, all results are organized by location-year and specific results will largely be discussed one site at a time. Again, data from Outlook, Prince Albert, and Redvers in 2021 were removed due to data quality issues that were primarily attributed to adverse environmental conditions. While yields from some sites in 2021 were quite low due to drought (i.e., Swift Current and Yorkton), the overall variability was low enough that the results were considered valid and data from these sites were retained.

Indian Head 2021 (IH-21)

Main effect means for Indian Head 2021 (IH-21) are in Table 3 while two-way and three-way interactions are in Tables 20-21 of the Appendices. While the overall weather was not ideal for faba beans, everything went well and the data from this site is of acceptable quality and considered reliable.

Establishment was excellent and affected by seed rate ($P < 0.001$), but not date (P = 0.602), and the D x R interaction was not significant ($P = 0.807$). Averaged across dates, the final plant numbers were 42 and 62 plants/m^2 for the 45 seeds/m^2 versus 65 seeds/m^2.

Prior to the fungicide applications, disease levels were low. The seeding date effect was significant ($P = 0.002$), but seeding rate was not ($P = 0.397$). On a scale of 0-9, disease was higher with early (1.8) versus late seeding (0.5); however, it is possible that some of the reported symptoms were due to drought and environmental stressors as opposed to actual disease. For the final disease ratings, no treatment effects or interactions were significant ($P = 0.115$-0.933), but the trend was similar with slightly higher values recorded with early seeding. The plots were, however, damaged by hail, which was more severe with the early seeding date and difficult to distinguish from disease. The Saskatchewan Crop Protection Laboratory confirmed the presence of Chocolate Spot (*Botrytis spp.*) at this location.

Maturity at Indian Head was affected by seeding date ($P < 0.001$), seed rate ($P < 0.001$), and fungicide ($P < 0.001$); however, no interactions were detected ($P = 0.172$-0.779). Seeding date had, by far, the greatest effect on maturity, with the early seeded faba beans taking 5 days longer to mature compared to delayed seeding. This is a common occurrence with later seeding and generally attributable to more rapid establishment and early season growth due to warmer soils. Maturity was accelerated by 1.8 days with higher seeding rates and delayed by 0.9 days with fungicide.

With an overall mean of 1856 kg/ha, yields were below average, but reasonably consistent. Yields were not affected by any of the main effects or interactions ($P = 0.110$-0.777). Individual treatments ranged from 1741-1947 with a trend for the lowest yields with early seeding at the low seeding rate and no fungicide and the highest yields with delayed seeding and fungicide.

Seed weights were affected by seeding date ($P = 0.003$) and rate ($P < 0.001$), but not fungicide ($P = 0.575$). The seeds were larger with delayed seeding and at the lower seeding rate. The seeding date effect was likely attributable to the timing of precipitation being generally more favourable with delayed seeding. The lighter seeds at the higher seeding rate might be attributed to increased competition between seedlings at higher populations, particularly with moisture being limiting as limiting as it was. The D x R and R x F interactions were also significant (Table 18; $P < 0.001$-0.004). The D x R interaction was due to there being relatively little seeding rate effect with early seeding compared to delayed seeding. The R x F interaction appeared to be due to inconsistent trends for fungicide, depending on the seeding rate.

Table 3. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Indian Head 2021.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	52.8 A	1.8 A	2.2 A	103.2 A	1818 A	414.3 B
Delayed	51.7 A	0.5 B	0.9 A	98.1 B	1893 A	449.5 A
S.E.M.	1.30	0.15	0.41	0.16	89.0	2.90
Pr > F (p-value)	0.602	0.002	0.115	<0.001	0.536	0.003
Seeding Rate						
45 seeds/m^2	42.0 B	1.2 A	1.4 A	101.6 A	1835 A	442.6 A
65 seeds/m^2	62.4 A	1.1 A	1.7 A	99.8 B	1876 A	421.2 B
S.E.M.	1.30	0.15	0.32	0.16	72.9	2.81
Pr > F (p-value)	<0.001	0.397	0.284	<0.001	0.295	<0.001
Fungicide						
Control	—	—	1.6 A	100.2 B	1824 A	430.8 A
Treated	—	—	1.6 A	101.1 A	1887 A	433.0 A
S.E.M.	—	—	0.32	0.16	72.9	2.81
Pr > F (p-value)	—	—	0.933	<0.001	0.110	0.575

Indian Head 2022 (IH-22)

Main effect means for Indian Head 2022 (IH-22) are in Table 4 while two-way and three-way interactions are in Tables 22-23. In general, conditions were better than the previous season at this location and the yields were modest but considered approximately average.

Establishment was affected by both seeding date ($P = 0.026$) and rate ($P < 0.001$), but no interaction ($P = 0.785$). The date effect was due to better overall emergence with delayed (70 plants/m^2) versus early (59 plants/m^2) seeding. This difference was likely due to somewhat deeper placement with the early seeding due to wetter, softer soil followed by heavy rains post-seeding and better overall conditions for rapid establishment with the delayed seeding. Averaged across the two seeding dates, 54 and 74 plants/m^2 were

observed at 45 seeds/m^2 and 65 seeds/m^2 seeding rates, respectively. These plant populations were higher than the targeted number of live seeds/m^2, especially at the later seeding date. This could potentially be due to differences in how the seed flowed through the rollers during calibration versus the actual seeding operation, incorrect assumptions regarding seed size and/or germination, and/or variability in the plant densities within the plot.

Initial disease ratings were affected by seeding date (*P* = 0.034), but not rate (*P* = 0.685) and there was no D x R interaction (*P* = 0.114). The mean values were significantly higher with delayed (0.8) versus early (0.5) seeding; however, from a practical perspective, disease levels were extremely low overall, and this difference was not considered important. While the presence of Chocolate spot (*Botrytis spp.*) was confirmed by the Crop Protection Laboratory, disease levels were still low at the time of the final assessments, with an overall average of 1.1/9. Only the fungicide (F) effect was significant with overall averages of 1.3 in the control versus 0.9 with fungicide. This difference, and disease pressure in general, was likely too low to be of much practical importance.

Maturity at IH-22 was affected by seeding date (*P* <0.001), seeding rate (*P* < 0.001), and fungicide (*P* < 0.001); however, no interactions were significant (*P* = 0.104-0.962). Seeding date had, by far, the greatest impact on maturity, with the plots maturing in 98 days with delayed seeding compared to 110 days with early seeding. While such responses are quite common, having been seeded 21 days earlier, the early seeded faba beans were ready to spray approximately 9 days earlier than with delayed seeding.

Table 4. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Indian Head 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	58.5 B	0.5 B	1.2 A	110.2 A	3265 A	374.5 A
Delayed	69.7 A	0.8 A	1.0 A	98.1 B	3440 A	388.7 A
S.E.M.	1.92	0.06	0.15	0.38	130.6	4.44
Pr > F (p-value)	0.026	0.034	0.341	<0.001	0.402	0.109
Seeding Rate						
45 seeds/m^2	54.1 B	0.6 A	1.0 A	104.7 A	3296 B	389.5 A
65 seeds/m^2	74.1 A	0.7 A	1.2 A	103.6 B	3409 A	373.7 B
S.E.M.	1.71	0.06	0.14	0.37	97.5	3.53
Pr > F (p-value)	<0.001	0.685	0.060	<0.001	0.018	<0.001
Fungicide						
Control	—	—	1.3 A	103.4 B	3333 A	382.3 A
Treated	—	—	0.9 B	104.8 A	3372 A	380.9 A
S.E.M.	—	—	0.14	0.37	97.5	3.53
Pr > F (p-value)	—	—	0.012	<0.001	0.383	0.661

Seed yields at IH-22 were affected by seeding rate (*P* = 0.018), but no other response variables (*P* = 0.070-0.416). The seeding rate effect was small but significant, with a 113 kg/ha, or 3%, yield advantage to the higher seeding rate.

Seed weights at IH-22 were affected by seeding rate (*P* < 0.001) but not date (*P* = 0.109) or fungicide (*P* 0.661). Significant D x R (*P* = 0.020), D x F (*P* < 0.001), and D x R x F (*P* = 0.043) interactions were detected for this variable. The D x R interaction was due to a significant decline in seed weight at the higher seeding rate for early but not delayed seeding (Table 22). The D x F interaction was due to fungicide having a positive effect on seed weight with early seeding but a trend for the opposite with delayed seeding (Table 22). The three-way interaction was due to the observed fungicide effects, which varied with seeding date, being more

prominent at the higher seeding rate (Table 23). In any case, the observed variation in seed size did not consistently correlate with the seed yield trends.

Melfort 2021 (ME-21)

Although this location is geographically well adapted to faba beans, the weather at Melfort in 2021 was hotter and drier than average, which was not ideal for this crop. Mean temperatures were 1.5 °C warmer than average and only 55% of the average precipitation was received for the five-month period. Nonetheless, things went well for the trial overall, and data was considered reliable for all variables. Main effect means for this location appear in Table 5 while means for the 2-way and 3-way interactions are in Tables 24 and 25, respectively.

Table 5. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Melfort 2021.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	38.8 A	0.7 A	0.1 A	95.0 A	2227 A	379.3 B
Delayed	43.5 A	0.0 B	0.1 A	89.5 B	2244 A	421.6 A
S.E.M.	1.40	0.07	0.03	0.67	67.8	4.95
Pr > F (p-value)	0.098	0.006	1.000	0.010	0.867	0.004
Seeding Rate						
45 seeds/m^2	36.1 B	0.3 A	0.1 A	91.8 A	2257 A	400.3 A
65 seeds/m^2	46.1 A	0.4 A	0.1 A	92.7 A	2214 A	400.6 A
S.E.M.	1.40	0.06	0.03	0.67	67.8	4.95
Pr > F (p-value)	<0.001	0.627	1.000	0.367	0.66	0.945
Fungicide						
Control	—	—	0.1 A	92.7 A	2267 A	398.9 A
Treated	—	—	0.0 A	91.8 A	2204 A	402.0 A
S.E.M.	—	—	0.03	0.67	67.8	4.95
Pr > F (p-value)	—	—	0.174	0.367	0.516	0.55

Plant densities at Melfort were affected by seeding rate ($P < 0.001$), while seeding date effects were marginally significant ($P = 0.098$) and there was no D x R interaction ($P = 0.211$). The seeding date trend showed slightly better establishment with delayed (44 plants/m^2) versus early seeding (39 plants/m^2) while the mean densities were 36 plants/m^2 at the 45 seeds/m^2 seeding rate and 46 plants/m^2 at 65 seeds/m^2. With these values, mortality was slightly higher at 65 seeds/m^2 (71% survival) compared to 45 seeds/m^2 (80% survival). This is not uncommon and attributed to increased competition for space and moisture between seedlings.

Initial disease ratings at ME-21 were affected by seeding date ($P = 0.006$) but not rate ($P = 0.627$) and there was no D x R interaction ($P = 0.871$); however, the values were extremely low with average ratings of 0.7 with early seeding and 0.0 with delayed seeding. Under the dry conditions, disease severity did not increase as the season progressed and, for the final ratings, all values were negligible with no significant main effects or interactions ($P = 0.174$-1.000).

Maturity was affected by seeding date ($P = 0.010$) but not rate ($P = 0.367$), fungicide ($P = 0.367$), or any interactions ($P = 0.367$-1.000). Like Indian Head, the faba beans took longer to mature when seeded early (95 days) than with delayed seeding (89.5 days); however, the early seeded crop was still ready to spray approximately 15 days earlier in the fall.

Seed yields in 2021 were considered below average for Melfort at 2236 kg/ha across treatments but were quite consistent. Nonetheless, no significant treatment effects or interactions were detected (*P* = 0.468-0.978). The observed range for individual treatments was 2158-2308 kg/ha.

Seed weights at Melfort were affected by seeding date (*P* = 0.004) but not seed rate (*P* = 0.945) or fungicide (*P* = 0.555) and no interactions were significant (*P* = 0.106-0.964). The seeding date effect was like Indian Head in that heavier seeds were observed with delayed seeding (422 g/1000 seeds) relative to early seeding (379 g/1000 seeds). Again, this was not necessarily expected but attributed to the timing of precipitation (i.e., above average rainfall in August) being more beneficial with delayed seeding.

Melfort 2022 (ME-22)

The 2022 season at Melfort was more typical than the previous season and more favourable for faba beans, with warmer than average temperatures (+ 0.8 °C) and approximately average precipitation amounts (271 mm or 102%). Main effect means for ME-22 are provided in Table 6 while two and three-way interactions are in Tables 26 and 27.

Table 6. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Melfort 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	54.8 A	0.5 A	0.9 A	112.3 A	4964 A	468.4 A
Delayed	51.6 A	0.3 A	1.0 A	98.0 B	3482 B	347.2 B
S.E.M.	1.65	0.08	0.06	0.08	78.5	3.55
Pr > F (p-value)	0.218	0.084	0.466	<0.001	<0.001	<0.001
Seeding Rate						
45 seeds/m^2	43.9 B	0.4 A	0.9 A	105.1 A	4207 A	411.4 A
65 seeds/m^2	62.4 A	0.4 A	0.9 A	105.3 A	4240 A	404.2 A
S.E.M.	1.65	0.07	0.06	0.08	78.5	3.55
Pr > F (p-value)	<0.001	0.597	0.492	0.089	0.749	0.136
Fungicide						
Control	—	—	1.1 A	105.1 A	4098 B	399.2 B
Treated	—	—	0.8 B	105.2 A	4349 A	416.4 A
S.E.M.	—	—	0.06	0.08	78.5	3.55
Pr > F (p-value)	—	—	0.001	0.556	0.025	0.002

Plant densities at ME-22 were affected by seeding rate (*P* < 0.001), but not date (*P* = 0.218) and there was no D x R interaction (*P* = 0.928). Establishment was excellent overall and the seeding rate effects were as expected with 44 plants/m^2 at 45 seeds/m^2 and 62 plants/m^2 observed at 65 seeds/m^2.

Initial disease levels were low, averaging only 0.4, and not affected by seeding date (*P* = 0.084), rate (*P* = 0.597), or the D x R interaction (*P* = 0.223). Despite the wetter conditions and higher yield potential, disease levels remained low all season long, as reflected by the final ratings. Focussing on main effects, final disease levels were affected by fungicide (*P* = 0.001), but not seeding date (*P* = 0.466) or rate (*P* = 0.492). Despite being significant, the averaged fungicide effect was extremely small; however, the D x F interaction (*P* = 0.024) showed that it was only observed with delayed seeding where the mean ratings were 1.2 in untreated versus 0.7 in the treated plots.

Maturity at ME-22 was affected by seeding date (P < 0.001) but not rate (*P* = 0.089), fungicide (*P* = 0.556), or any interactions (*P* = 0.089-0.556). The seeding date effect (*P* < 0.001) was due to delayed seeding shortening

the days to maturity relative to early seeding from 112 to 98 days; however, with 23 days between seeding dates, the early seeded plots were still ready to desiccate ~9 days ahead of the late seeded crop.

Seed yields were affected by seeding date ($P < 0.001$) and fungicide ($P = 0.025$), with an interaction between the two variables ($P = 0.041$). There was a large overall advantage to early seeding, with yields falling from 4964 kg/ha to 3482 kg/ha as seeding was delayed from May 9 to June 1, a reduction of 30%. The overall mean yield increase with fungicide was 251 kg/ha (6%); however, the D x F interaction showed that this response only occurred with delayed seeding. The magnitude of the yield increase with fungicide when seeding was delayed was 476 kg/ha, or 15%. This response was consistent with the previously discussed ratings, despite the observed disease levels being quite low.

Seed weight at ME-22 was affected by seeding date ($P < 0.001$) and fungicide ($P = 0.002$), but not seeding rate ($P = 0.136$) and there were no interactions ($P = 0.205$-0.698). The seed weight responses mimicked those observed for yield. There was a large reduction in seed weigh with delayed (468 g/1000 seeds) versus early seeding (347 g/1000 seeds) and a modest increase with fungicide (416 g/1000 seeds) over the untreated plots (399 g/1000 seeds). While, unlike seed yield, the D x F interaction was not significant for seed weight, the trends were consistent with response being larger and only statistically significant with delayed according to the multiple comparisons test; however, the trend was similar with early seeding.

Outlook 2022 (OL-22)

Outlook is in the Brown soil zone, outside of the traditional faba bean growing regions of Saskatchewan; however, with access to irrigation, the site has potential to produce consistently high yields. The season at OL-22 was 1.3 °C warmer than average and total precipitation was only 73% of average (176/240 mm); however, the site received an additional 155 mm as precipitation to bring the total to 331 mm. Main effect means for OL-22 are presented in Table 7 while the two and three-way interactions are provided in Tables 28 and 29 of the Appendices, respectively.

Table 7. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Outlook 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	52.5 A	0.7 A	0.8 A	110.0	4897 A	446.5 A
Delayed	54.9 A	0.3 A	0.7 A	97.0	4254 B	335.6 B
S.E.M.	2.07	0.09	0.08	—	164.6	4.78
Pr > F (p-value)	0.467	0.070	0.327	—	0.026	<0.001
Seeding Rate						
45 seeds/m^2	45.9 B	0.5 A	0.7 A	103.5	4453 B	394.8 A
65 seeds/m^2	61.5 A	0.4 A	0.7 A	103.5	4698 A	407.3 A
S.E.M.	2.07	0.09	0.07	—	153.1	4.78
Pr > F (p-value)	<0.001	0.480	1.000	—	0.023	0.081
Fungicide						
Control	—	—	0.9 A	103.5	4552 A	401.1 A
Treated	—	—	0.5 B	103.5	4599 A	401.0 A
S.E.M.	—	—	0.07	—	153.1	4.78
Pr > F (p-value)	—	—	<0.001	—	0.633	0.985

Plant densities at OL-22 were affected by seeding rate ($P < 0.001$) but not seeding date ($P = 0.467$) or the D x R interaction ($P = 0.516$). Emergence was excellent, with an overall mean of 44 plants/m^2 at the 45 seeds/m^2 rate and 61 plants/m2 at 65 seeds/m^2.

Initial disease levels were low and not affected by seeding rate (*P* = 0.480), or the D x R interaction (*P* = 0.761). The seeding date effect was marginally significant (*P* = 0.070) with a trend for slightly higher values for early (0.7) versus late (0.3) seeding. For the final disease assessments, the absolute values only increased slightly, averaging approximately 0.8. At this time, the mean ratings were reduced from 0.9 to 0.5 with fungicide (*P* < 0.001), but neither the seeding date (*P* = 0.327), rate (*P* = 1.000), nor any interactions (*P* = 0.335-0.458) affected final disease levels.

Due to the lack of sufficient variation, maturity data were not statistically analyzed for OL-22; however, it was estimated that the early seeded faba beans matured in 110 days compared to 97 days with delayed seeding. With a 17-day difference between seeding dates, this suggests that the early seeded plots would have been ready to desiccate about 4 days earlier than with delayed seeding.

Seed yields were quite high at OL-2, averaging about 4576 kg/ha, with significant seeding date (*P* = 0.026), and rate (*P* = 0.023) effects, but no fungicide effects (*P* = 0.633) or interactions (*P* = 0.162-0.804). The seeding date effect saw yields fall from 4897 kg/ha to 4254 kg/ha as seeding was delayed from the end of April to the 3rd week of May, a reduction of 642 kg/ha or 13%. The seeding rate effect was positive, but modest, with yields increasing by 245 kg/ha or 6% going from 45 seeds/m^2 to 65 seeds/m^2.

Seed weights at OL-22 were affected by seeding date (*P* < 0.001) but not rate (*P* = 0.081), fungicide (*P* = 0.985), or any interactions (*P* = 0.479-0.883). The seeding date effect was due to a large decline in seed weight with delayed seeding, which was consistent with the observed effects on yield. The magnitude of the decline was 25% compared to 13% for yield. While not significant at the desired probability, the trend for seeding rate and seed size was also consistent with the observed yield response.

Prince Albert 2022 (PA-22)

While normally one of our cooler and wetter locations, Prince Albert received only 60% (178 mm, May-September) of its average precipitation in 2022 with slightly warmer than average temperatures. This was somewhat exaggerated by the September weather, however, which was especially warm and dry. Yields at this site were high, but quite variable; however, the results generally appear to make sense and are considered valid. Main effect means for PA-22 are in Table 8 while those for the interactions appear in Tables 30 and 31.

Plant densities were affected by seeding rate (*P* < 0.001), but not date (*P* = 0.433) and the D x R interaction was marginally significant (*P* = 0.064). The mean densities achieved at 45 seeds/m^2 at PA-22 was 52 plants/m^2 while, at 65 seeds/m^2, 68 plants/m^2 were observed. The marginally significant D x R interaction was due to there being considerably higher plant populations with delayed seeding at 45 seeds/m^2, but similar values between the two dates at 65 seeds/m^2. This is difficult to explain and may be largely due to random variation; however, the p-value was low enough to be worth acknowledging.

Initial disease levels were higher with early (0.9) versus delayed (0.2) seeding (*P* = 0.002) and with 65 seeds/m^2 (0.6) versus 45 seeds/m^2 (0.5; *P* = 0.041); however, disease pressure was considered low overall and, while significant, the seeding rate effect was too small to be of much importance. There was no D x R interaction for initial disease levels (*P* = 0.162). Disease pressure stayed low as the season progressed and, for the final ratings, the overall values averaged 0.2 and no main effects (*P* = 0.349-0.860) or interactions (*P* = 0.343-0.850) were significant.

Faba bean maturity at PA-22 was affected by seeding date (*P* = 0.007), but not rate (*P* = 0.475), fungicide (*P* = 0.239), or any interactions (*P* = 0.239-0.100). The seeding date effect saw days from seeding to maturity decline from 110.5 days with early seeding to 100 days with delayed seeding. With a 21-day spread between seeding dates, this meant the early seeded faba beans were ready to spray approximately 10 days earlier than with delayed seeding.

Yields were affected by seeding date (*P* = 0.051) and rate (*P* < 0.001), but not fungicide (*P* = 0.815), and no interactions were detected (*P* = 0.256-0.871). The seeding date effect was substantial, with an average of 7264 kg/ha with May 11 seeding falling by 17% to 6034 kg/ha when seeding was delayed to May 30. Despite

excellent establishment, yields increased by 8% from 6396 kg/ha to 6912 kg/ha when the seeding rate was increased from 45 seeds/m^2 to 65 seeds/m^2.

Seed weights were affected by seeding date (*P* = 0.001) and marginally affected by fungicide (*P* = 0.089), but not seeding rate (*P* = 0.429). The date effect was consistent with what was observed for yield with seed weights declining by 18%, from 534 g/1000 seeds to 440 g/1000 seeds, when seeding was delayed. A significant D x R interaction (*P* = 0.014) was subtle, but due to inconsistent trends for seeding rate effects, depending on the seeding date. With early seeding, seed weight increased slightly with seeding rates while the opposite occurred with delayed seeding. No other interactions were significant for seed weight at PA-22 (*P* = 0.161-0.868).

Table 8. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Prince Albert 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	59.0 A	0.9 A	0.2 A	110.5 A	7264 A	534.0 A
Delayed	61.4 A	0.2 B	0.2 A	99.8 B	6043 B	440.1 B
S.E.M.	1.86	0.059	0.05	1.16	413.9	5.23
Pr > F (p-value)	0.433	0.002	0.860	0.007	0.051	0.001
Seeding Rate						
45 seeds/m^2	52.2 B	0.5 B	0.2 A	105.3 A	6396 B	485.1 A
65 seeds/m^2	68.1 A	0.6 A	0.3 A	104.9 A	6912 A	489.0 A
S.E.M.	1.86	0.06	0.05	0.86	368.6	4.4
Pr > F (p-value)	<0.001	0.041	0.349	0.475	<0.001	0.429
Fungicide						
Control	—	—	0.3 A	104.8 A	6590 A	482.8 A
Treated	—	—	0.2 A	105.4 A	6718 A	491.3 A
S.E.M.	—	—	0.05	0.86	368.6	4.4
Pr > F (p-value)	—	—	0.349	0.239	0.185	0.089

Swift Current 2021 (SW-21)

When this project was initiated, Swift Current was recognized as a relatively poor environment for faba bean production due to frequent drought and heat stress – this was especially the case in 2021 with well above average temperatures (+ 1.4 °C) and only 147 mm of precipitation over the five months, 66% of average. That said, things went well for the trial with good establishment and relatively low variability for all response variables. Main effect means are in Table 8 and interactions appear in Tables 32 and 33, respectively.

Plant densities at SW-21 were affected by seeding rate (*P* < 0.001), but not date (*P* = 0.210), and there was no D x R interaction (*P* = 0.317). In general, establishment was fair with an overall average of 37 plants/m^2 at the 45 seeds/m^2 seeding rate and 53 plants/m^2 at 65 seeds/m^2.

As expected, given the conditions, disease was negligible both at the time of fungicide application and for the final ratings. The initial ratings averaged less than 0.1 and, for the final ratings, all values were zero, essentially indicating that there was no disease whatsoever.

Maturity came relatively early at SW-21, not unexpected given the heat, drought, and low yield potential; however, variety may have also had an influence. Unlike the other locations where Snowbird was grown, the variety at Swift Current was CDC Snowdrop, a relatively small seeded and early maturing, but lower yielding, faba bean variety. Maturity was affected by seeding date (P = 0.007) and fungicide (*P* = 0.040), but not seeding rate (*P* = 0.470). The D x F effect was also significant (*P* = 0.040); however, this was not the case for any other interactions (*P* = 0.470-0.884). The seeding date effect was small, but consistent with the other

sites in that days to maturity was extended with early (93 days) versus delayed seeding (89 days); therefore, the early seeded plots were ready to spray approximately 20 days earlier than with delayed seeding. The fungicide effect showed a 1-day delay in maturity with fungicide. The D x F interaction showed that this delay in maturity was only observed with delayed seeding. Greening effects and subsequent delays in maturity are frequently observed with fungicide applications; however, such effects are generally more apparent when disease is present.

Table 9. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Swift Current 2021.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	46.8 A	0.1 A	0	93.4 A	1072 A	227.5 A
Delayed	43.0 A	0.0 A	0	88.9 B	427 B	219.3 A
S.E.M.	1.67	0.02	—	0.48	32.4	2.24
Pr > F (p-value)	0.210	0.057	—	0.007	<0.001	0.076
Seeding Rate						
45 seeds/m^2	36.8 B	0.0 A	0	91.0 A	764 A	226.5 A
65 seeds/m^2	53.0 A	0.1 A	0	91.3 A	734 A	220.3 A
S.E.M.	1.57	0.02	—	0.4	28.4	2.24
Pr > F (p-value)	<0.001	0.328	—	0.47	0.382	0.064
Fungicide						
Control	—	—	0	90.7 B	703 B	221.4 A
Treated	—	—	0	91.6 A	796 A	225.4 A
S.E.M.	—	—	—	0.4	28.4	2.24
Pr > F (p-value)	—	—	—	0.040	0.013	0.217

Seed yields at SW-21 were affected by seeding date ($P < 0.001$) and fungicide ($P = 0.013$), but not seeding rate ($P = 0.382$) or any interactions ($P = 0.277$-0.722). While yields were low for all treatments, this was especially the case with delayed seeding where the overall average was 427 kg/ha compared to 1072 kg/ha with early seeding, a 60% decline. The fungicide response was small in absolute terms, but substantial when expressed as a percentage of the control. Averaged across seeding dates and rates, yields were increased by 93 kg/ha, or 13%, with fungicide. Inspection of individual means and p-values for the interactions showed that this response was quite consistent. While a response was unexpected under the conditions, it may be that fungicide helped the crop cope with other stresses (i.e., flowering under extreme heat and/or drought stress).

In general, seed weights at SW-21 were quite low compared to other sites. While partly attributable to drought and heat, this was also a function of variety. CDC Snowdrop is the smallest seeded registered faba bean, averaging 323 g/1000 seeds compared to 448 g/1000 seeds for Snowbird, according to the 2022 Saskatchewan Seed Guide. Seed weights at this location were marginally affected by seeding date ($P = 0.076$) and rate ($P = 0.064$), but not fungicide ($P = 0.217$) or any interactions ($P = 0.221$-0.945). The seeding date effect on seed size was consistent with the yield response whereby seeds were larger with early (228 g/1000 seeds) versus delayed seeding (219 g/1000 seeds). The trend associated with seeding rates was for heavier seeds at the lower rate.

Swift Current 2022 (SW-22)

Hot, dry conditions at Swift Current persisted in 2022; however, precipitation in May, June, and especially July were higher than the previous season and, overall, conditions were more favourable for faba bean production. Main effect means for SW-22 are presented in Table 10 while means for the interactions are in Tables 34 and 35 of the Appendices.

Plant densities at SW-22 were affected by seeding rate ($P < 0.001$), but not seeding date ($P = 0.910$); however, the D x R interaction was significant ($P = 0.001$). Averaged across seeding dates, plant populations were 37 plants/m^2 at 45 seeds/m^2 and 53 plants/m^2 at 65 seeds/m^2, an estimated 82% survival in both cases. The interaction was difficult to explain but due to much greater separation in plant densities between seeding rates with early seeding (33 versus 66 plants/m^2) compared to delayed seeding (42 versus 51 plants/m^2).

Table 10. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Swift Current 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	46.8 A	0.7 A	1.2 A	100	1666 A	270 A
Delayed	46.5 A	0.3 B	1.2 A	90	1286 B	187 B
S.E.M.	1.72	0.09	0.12	—	86.7	3.85
Pr > F (p-value)	0.910	0.043	0.715	—	0.013	<0.001
Seeding Rate						
45 seeds/m^2	37.6	0.5 A	1.3 A	95	1477 A	230.9 A
65 seeds/m^2	55.8	0.6 A	1.1 A	95	1475 A	225.3 A
S.E.M.	1.72	0.09	0.12	—	81.9	3.85
Pr > F (p-value)	<0.001	0.564	0.099	—	0.959	0.317
Fungicide						
Control	—	—	1.2 A	95	1465 A	226.7 A
Treated	—	—	1.2 A	95	1486 A	229.5 A
S.E.M.	—	—	0.12	—	81.9	3.85
Pr > F (p-value)	—	—	0.361	—	0.624	0.611

Initial disease levels were low, with rating below 1 in all cases, and the values varied with seeding date ($P = 0.043$), but not rate ($P = 0.564$), and there was no D x R interaction ($P = 0.421$). The date effect was such that initial disease ratings were slightly higher with early (0.7) versus delayed seeding (0.3), when averaged across seeding rates. With relatively dry conditions, disease levels remained low through the entire growing season and had an overall average of 1.2 in final ratings. At this time, none of the main effects were significant ($P = 0.099$-0.715); however, there was a subtle R x F interaction ($P = 0.035$). The interaction was due to inconsistent trends for fungicide treatment, depending on the seeding rate; however, the differences were too small to be important and appeared to be somewhat random.

There was not enough variation in the maturity dates recorded at SW-22 for this data to be statistically analyzed; however, the estimated time from seeding to maturity was 100 days with early seeding and 90 days with delayed seeding. This trend was consistent with most other sites and, with 20 days between seeding dates, meant that the early seeded faba beans would have been ready to spray approximately 10 days earlier than with delayed seeding.

Seed yields were higher than the previous year at Swift Current and affected by seeding date ($P = 0.013$), but not rate ($P = 0.959$), or fungicide ($P = 0.624$). No two or three-way interactions were significant ($P = 0.101$-0.964). The seeding date response was consistent with the previous year, where yields averaged 1666 kg/ha with early seeding and 1286 kg/ha with delayed seeding. As such, delaying seeding from May 3 to May 23 resulted in a 380 kg/ha, or 23% yield loss. There were no other noteworthy trends, and the data were reasonably consistent overall.

Seed weights were affected by seeding date ($P < 0.001$), but not rate ($P = 0.317$), or fungicide ($P = 0.611$), and no interactions were significant ($P = 0.141$-0.612). The seeding date effect for seed weight was consistent with what was observed for yield in that seed weights declined from 270 g/1000 seeds with early seeding to

187 g/1000 seeds with delayed seeding, a reduction of 31%. Like yield, no other trends were notable for this variable and the data were quite consistent overall.

Yorkton 2021 (YK-21)

Yorkton was amongst the driest locations in 2021 and, as such, both disease pressure and yields were low; however, establishment was excellent, and the data generally appeared to be of good quality. Across the five months, temperatures at YK-21 were 1.4 °C above average while precipitation was 51% of average at only 163 mm. Main effect means for YK-21 are in Table 11 while those for the interactions are in Tables 36 and 37.

Table 11. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Yorkton 2021.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	50.3 B	0.4 A	0.2 a	96.6 B	1077 A	425.7 A
Delayed	59.8 A	0.0 A	0.0 b	100.4 A	1098 A	403.2 A
S.E.M.	1.81	0.07	0.04	0.63	71	10.73
Pr > F (p-value)	0.013	0.042	0.011	0.005	0.847	0.206
Seeding Rate						
45 seeds/m^2	46.1 B	0.2 A	0.2 a	98.2 B	1098 A	417.2 A
65 seeds/m^2	64.1 A	0.2 A	0.1 a	98.8 A	1077 A	411.7 A
S.E.M.	1.81	0.07	0.04	0.59	61.9	8.68
Pr > F (p-value)	<0.001	0.294	0.319	0.041	0.778	0.379
Fungicide						
Control	—	—	0.2 a	98.3 A	971 B	422.5 A
Treated	—	—	0.1 a	98.8 A	1204 A	406.4 B
S.E.M.	—	—	0.04	0.59	61.9	8.68
Pr > F (p-value)	—	—	0.319	0.095	0.005	0.017

Plant densities were affected by both seeding date ($P = 0.013$) and rate ($P < 0.001$), with a marginally significant D x R interaction ($P = 0.068$). The seeding date effect revealed an average of 50 plants/m^2 with early seeding and 60 plants/m^2 when seeding was delayed. The reason for this difference is not clear, but may have been related to warmer soils, better seed placement, or more timely precipitation with delayed seeding. The rate effect was as expected with 46 and 64 plants/m^2 achieved with target seed rates of 45 and 65 seeds/m^2, respectively. The marginally significant interaction was due to populations being similar across dates at the lower seeding rate but substantially higher with delayed seeding at the higher seeding rate.

Disease levels were negligible for both measurement times and, although the seeding date effect was significant for both periods ($P = 0.011$-0.042), the severity was too low for any effects to be considered important. Seeding rate and fungicide effects were not significant ($P = 0.294$-0.319) and nor were any interactions for the final disease ratings ($P = 0.319$-0.736).

Maturity was affected by seeding date ($P = 0.005$) and rate ($P = 0.041$) with marginally significant fungicide ($P = 0.095$) and D x R effects ($P = 0.095$). The seeding date effect differed from the previously discussed locations in that the late seeded plots (100 days) took slightly longer to reach maturity than the early seeded plots (97 days). This may have been due to the August precipitation having a larger effect on the late seeded plots than the early seeded plots or slower establishment with delayed seeding due to the extremely dry weather. The seeding rate response was small, but also unusual in that maturity was delayed slightly at the higher seeding rate; however, the difference was less than 1 day so this was not considered important. The marginally significant fungicide effect was such that the treated plots matured, on average, o.5 days later than the untreated plots.

Yields at YK-21 were much lower than what might normally be achieved at this location, but not unexpectedly so given the extreme drought and heat. Interestingly and, perhaps surprisingly under the conditions, the only significant treatment effect was for fungicide (P = 0.005). Fungicides application resulted in a yield increase of 233 kg/ha, modest in absolute terms, but an increase of 24% when expressed relative to the control. Like SW-21, another severely drought affected location, this response appeared to be genuine with low overall variability and consistent fungicide effects when interactions and individual treatment means were inspected.

Seed weight was quite variable; however, like yield, was affected by fungicide (P = 0.017) but no other main effects or interactions (P = 0.206-0.652). The fungicide effect on seed weight was opposite of what was observed for yield in that the seeds were lighter (i.e., smaller) with fungicide (406 g/1000 seeds) than without (423 g/1000 seeds). While we do not have the data to confirm this and it is only speculation, it is possible that the fungicide applications helped the crop retain flowers and form pods while flowering under extreme heat and drought stress. As the dry conditions persisted, the pods may have filled better when there were fewer of them per plant or for a given area, ultimately leading to heavier/larger seeds. There were also trends for larger seeds with early seeding (which coincided with fewer plants) and at the lower seed rate; however, with relatively high variability, these trends were not significant. Like yield, the fungicide effects on seed weight were consistent across both seeding dates and seed rates.

Yorkton 2022 (YK-22)

While moisture conditions improved dramatically relative to the previous season at Yorkton, the faba beans at YK-22 were severely damaged by hail in late June and did not recover well. Heavy pea leaf weevil pressure was also observed and likely substantially reduced the yield potential. It is unclear whether the pea leaf weevil damage would have varied with seeding date or rate. These challenges resulted in relatively high variability and reduced yields but, again, it is uncertain whether the responses were otherwise affected. Otherwise, the growing season at YK-22 was 1.1 °C warmer than average with 340 mm of precipitation, 107% of the long-term average. This was somewhat skewed by the September weather which was 2.4 °C warmer and 66% drier than average. Ultimately, due to the challenges associated with hail damage and pea leaf weevil pressure, data from this site should probably be excluded from any future, combined analyses, but may provide an interesting case study.

Plant densities were affected by both seeding date (P = 0.033) and rate (P < 0.001) with no D x R interaction (P = 0.224). The seeding date effect was due to significantly better establishment with early (66 plants/m^2) versus delayed (56 plants/m^2) seeding. This could potentially be attributed to better seed bed conditions at the early date or more timely precipitation after seeding. The effect of seeding rate was as expected, with an overall average of 54 plants/m^2 at 45 seeds/m^2 and 68 plants/m^2 at 65 seeds/m^2. Like some other sites (i.e., IH-22), the observed populations were sometimes higher than the target seeding rates. Again, this could be potentially due to calibration error (i.e., differences in product flow between calibrating and seeding), variability in seed distribution within the plot, or differences between the actual thousand seed weights and germination and those used for calculating the seeding rates. With no D x R interaction, seeding rate effects were similar for both dates, despite the higher values with early seeding.

Initial disease levels were affected by seeding date (P = 0.027) but not rate (P = 0.117) and there was no D x R interaction (P = 0.224). The values were significantly higher with early (2) versus delayed seeding (1), but these ratings may have been confounded by the hail which likely had greater impact on the more advanced, early seeded plants. As further evidence of the initial ratings being confounded by hail, the estimated disease levels were negligible for the final assessments, averaging only 0.1 with no disease whatsoever observed in most plots. The seeding date effect was significant (P = 0.011); however, the difference was only 0.2 and the data was not very well suited for statistical analyses due to the lack of sufficient variation. No other main effects or interactions were significant (P = 0.319-0.331).

Maturity at YK-22 was not recorded and the days to first flower were also excluded from Table 13. Staging the crop was extremely difficult at this site due to the extensive hail damage. To the best of our ability, timing of the fungicide applications was based on undamaged plants.

Yields at YK-22 were relatively low and variable, due to the hail, averaging 2300 kg/ha across all treatments. Seeding date (P = 0.723) and rate (P = 0.485) had no effect on yield; however, a small yet significant fungicide

response was detected (P = 0.021). No two or three-way interactions for seed yield were significant (P = 0.342-0.907). The fungicide effect was such that yields were increased by 235 kg/ha, or 11%, over the control. One of the greatest concerns with the hail damage is that it is unclear how the impact may have differed between seeding dates. While the seeding date effect was not significant, it is quite plausible that the early seeded faba beans were impacted to a greater extent and less able to recover from the damage than the late seeded plots. The fungicide effect appeared to be reasonably consistent across both seeding dates and rates – an observation that is supported by the lack of significant interactions.

Seed weights at YK-22 were marginally affected by seeding rate (P = 0.053), but not date (P = 0.399), fungicide (P = 0.352), or any interactions. The seeding rate effect showed a slight but significant decline in seed weights (428 g/1000 to 415 g/1000 seeds), as the rate was increased from 45 seeds/m^2 to 65 seeds/m^2. The seeding rate response was small enough that it was only significant when averaged across both seeding dates and fungicide treatments, with no differences between means for either the D x R, R x F, or D x R x F interactions.

Table 12. Treatment means and tests of fixed effects for faba bean seeding date, seeding rate, and foliar fungicide effects at Yorkton 2022.

Main Effect	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	66.0 A	2.0 A	0.1 A	—	2368 A	424.3 A
Delayed	55.5 B	1.0 B	0.0 A	—	2232 A	418.2 A
S.E.M.	2.01	0.17	0.09	—	246.4	4.41
Pr > F (p-value)	0.033	0.027	0.391	—	0.723	0.399
Seeding Rate						
45 seeds/m^2	53.8 B	1.4 A	0.0 A	—	2334 A	427.7 A
65 seeds/m^2	67.7 A	1.6 A	0.1 A	—	2267 A	414.8 B
S.E.M.	1.8	0.12	0.09	—	180.4	4.41
Pr > F (p-value)	<0.001	0.117	0.331	—	0.485	0.053
Fungicide						
Control	—	—	0.0 A	—	2183 B	424.3 A
Treated	—	—	0.1 A	—	2418 A	418.3 A
S.E.M.	—	—	0.09	—	180.4	4.41
Pr > F (p-value)	—	—	0.331	—	0.021	0.352

9. Economic and Practical Implications For growers – is there any economic implications for growers

Although results have been variable and environmental conditions have not always been ideal for faba bean production or conducive to disease, we will attempt to identify some broad, practical implications for producers. Bear in mind that these results are still preliminary and subject to change as we add more data and potentially refine the statistical analyses.

The seeding date responses varied and were not always as expected; however, overall, we can confirm that seeding faba beans as early as possible will be the best option for producers. Seeding date had no effect on establishment 70% of the time and, when it did have an impact, the responses were inconsistent and usually minor. For yield, however, early seeding was advantageous 50% of the time and had no effect for the remaining sites. In some cases, the yield advantage to early seeding was quite substantial. Although the crop usually took fewer days to reach maturity when seeding was delayed, the early seeded crop was always ready to spray earlier in the fall and, as such, would have been ready to combine earlier and less susceptible to yield or quality loss associated with fall frost before the crop reached maturity, relative to delayed seeding.

With respect to seeding rates, impacts on maturity were sometimes observed and/or significant, favouring the higher seeding rate; however, they were always minor (1-2 days) and unlikely to have much impact on when

the crop is ready to combine or how susceptible it would be to damage associated with fall frost. Yields were not affected by seeding rate 70% of the time but, when responses did occur, they favoured the higher seeding rate. While past research has mostly shown that maximum yields could often be achieved with 25-45 plants/m^2, benefits to higher rates are not unheard of and, in addition to maturity, can also be beneficial from a weed competition viewpoint. That said, given the potentially high cost of seed (especially if seed-applied inoculants or fungicides are applied), logistic challenges associated with the large seed size, and relatively low probability and magnitude of benefits to higher seeding rates, seeding rates of 45 seeds/m^2 are likely to be sufficient in most cases. Given the combination of past research and the occasional benefits to higher rates, we would not recommend using seeding rates below 45 seeds/m^2.

Focussing on fungicides, past and current research has not shown this crop to be especially responsive, even though disease is frequently present at low levels. Fungicide effects on maturity were rare and, when observed, minor. Yield responses to fungicide were observed 40% of the time and were always positive when they did occur. Interestingly, 2/4 of the responsive sites had essentially no disease and were severely limited by drought (i.e., SW-21 and YK-21). Another responsive site (YK-22) had minimal disease but was severely damaged by hail prior to the fungicide applications, which may have influenced the response. One of the responsive sites (ME-22) had relatively high yield potential and the presence of chocolate spot was confirmed by the crop protection lab; however, the observed level of disease was low according to the ratings. Notably, the fungicide response at this location was only observed with delayed seeding. Importantly, diseases such as chocolate spot (*Botrytis spp.*) can also potentially reduce seed quality, and this has not been assessed in the current project. The optimal fungicide application timing is still uncertain and the subject of another SPG funded project, however, due to the prolonged flowering period, slow canopy closure, and fact that chocolate spot (which appears to be the dominant disease), appears quite late in the season, it is likely at least a week into flowering, perhaps even later. Farmers should ideally choose a product that is registered for control of *Botrytis*; however, such options are limited with Priaxor® (BASF) being recently discontinued. While we expect the higher rate of Dyax® (BASF) to have some activity on this disease, it is not currently on the label for either control or suppression so this cannot be confirmed. Due to the relatively low frequency of response, producers are urged to scout for disease and base applications on the actual disease pressure and yield potential of the crop. While we did sometimes see responses under extreme drought conditions in two cases, overall yields were low, and it is unclear how repeatable responses under such conditions may be.

10. **Conclusions & Recommendations –** how do results relate to objectives or original research that project is based on; is there a need to refine current recommendation based on the results from this project?

    Overall environmental conditions have been highly variable, ranging from severe drought to above-normal precipitation levels. Three locations from 2021 were removed to extreme variability and concerns regarding the reliability of the data. Data quality from 2022 was generally better; however, YK-22 was identified as being potentially problematic, even though it was one of relatively few sites where a fungicide response was detected. The issue with this site was that the plots were severely damaged by hail late in June and never fully recovered. This resulted in major yield reductions and higher variability relative to what might have been expected under the conditions but, more importantly, it is unclear how the effects may have differed between seeding dates and how this might have influenced fungicide response. It is our belief that this site could potentially be useful to retain as a special case study but should likely be excluded from any combined analyses and the corresponding results should be interpreted cautiously.

    At this stage, we do not recommend any revisions to the protocol; however, the project will continue at six locations in 2023 which will improve the robustness of the results and hopefully add more sites with what might be considered average, or typical conditions, for the respective locations.

11. **Future research –** did the project identify need for future research for further work?

    It continues to be quite clear that early seeding is preferred for this crop and this project will provide good information on the frequency which yield losses might be expected when seeding is delayed. Looking at a larger number of seeding dates to narrow down the optimal windows for contrasting environmental

conditions and more current varieties would potentially be beneficial; however, such research can be difficult to implement successfully (for a variety of reasons), tends to be expensive, and does not always provide meaningful results unless it is conducted over many geographic locations and years.

Faba bean seeding rate responses are becoming increasingly well understood; however, research to investigate how, or if, the responses differ across some of the major types (i.e., zero tannin versus low tannin versus high tannin, small seed versus large seed) of faba beans may be worthwhile. Unfortunately, this research can be particularly difficult for very large-seeded varieties, depending on the seeding equipment.

One area of interest, which we recognized prior to developing this project and identified in the 2021 interim report, was the uncertainty surrounding the optimal timing of fungicide application for faba beans; however, this topic is being addressed in SPG funded research that is being led by NARF and was initiated in 2022. Regarding fungicides, expanding product labels to include Chocolate spot would be beneficial to faba bean growers. Since Priaxor® has been discontinued, our options for controlling this disease are limited. Although Dyax® includes the same active ingredients, the rates differ, and this disease is not on the product label.

12. Technology transfer activities – include presentations, extension material, field days, articles published

Extension activities have been limited to date as 2021 was the first year of the project and an extremely challenging year with low yields and disease levels. At Indian Head in 2021, the plots could not be shown during the Crop Management Field Day for logistic reasons but were visited by numerous farmers and industry representatives throughout the season during small, informal tours. This trial was on the agenda for the 2022 Indian Head Crop Management Field Day on July 19; however, the field tours were cancelled due to heavy rain. Nonetheless, the project was briefly discussed during indoor presentations by Chris Holzapfel and Sara Anderson, with approximately 120 attendees. The site was also visited by numerous farmers and industry representatives during informal site tours at Indian Head 2022. At Melfort 2021, a YouTube video highlighting the trial was prepared as part of NARF's virtual field day on July 27 (www.youtube.com/watch?v=TNc8PycX65o) and Brianne McInnes presented preliminary results for their site during the SIA Northeast Branch Ag Update on February 3, 2022 (virtual). At Outlook, the trial was not highlighted during the 2021 growing season as it was apparent that growth was atypical, and the plots may not be appropriate for viewing; however, it was shown in 2022 during various tours including the CSIDC Executive Management Tour and to Dr. Joyce Boye, Director General of AAFC Science and Technology Branch. At Prince Albert, the plots were visited by a subset of participants during the CLC Field Day on July 22 and Zoe Galbraith discussed the trial in a YouTube video uploaded August 17, 2021 (www.youtube.com/watch?v=wUpsOA3txzQ). At Swift Current in both years, the project was highlighted during "Walk the Plots" segments on CKSW Radio and in the Swift Current Online Podcast (https://podcastville.ca/shows/67/episodes/15344) in addition to informal site tours. At Yorkton, the project was not highlighted as part of any extension activities during the 2021 growing season but it was shown during the 2022 ECRF Field Day on July 14, 2022. The 2021 technical report has been available for viewing on the IHARF website (www.iharf.ca) and the current report will be made available in the coming months. Interim results may be incorporated into presentations and farm media articles as appropriate opportunities arise.

13. Funding contributions – acknowledge partners and contributors to the project

This project is a collaboration between multiple Agri-ARM organizations and the Saskatchewan Pulse Crop Development Board. Financial support for the project was provided exclusively by the Saskatchewan Pulse Crop Development Board. Several of the Agri-ARM organizations also have close working relationships and memorandums of understanding with Agriculture and Agri-Food Canada which should be acknowledged.

14. Appendices: detailed data tables, maps, photos, etc

Table 13. Selected agronomic information and dates of operations from faba bean agronomy demonstrations completed at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Redvers (RV), Swift Current (SW), and Yorkton (YK) in 2021 (21).

Site	Previous Crop	Variety	kg N-P_2O_5-K_20-S/ha	Seeding Dates	Plant Counts	Days to Flower	Fungicide App. Dates	Fungicide Products	Final Disease Ratings	Harvest Dates
IH-21	Oat	Snowbird	10-45-0-0	May-2 May-28	Jun-18 Jun-25	Jun-29 (58) Jul-11 (44)	Jul-5 Jul-18	Dyax	Jul-28 Aug-13	Sep-5 Oct-5
IH-22	Wheat	Snowbird	10-45-0-0	May-6 May-27	Jun-6 Jun-20	Jun-30 (55) Jul-10 (44)	Jul-10 Jul-21	Dyax	Aug-8 Aug-19	Sep-20 (all)
ME-21	Wheat	Snowbird	23-56-0-13	Apr-30 May-19	May-26 Jun-9	Jun-22 (53) Jul-5 (47)	Jun-28 Jul-13	Priaxor	Jul-12 Jul-26	Aug-31 Sep-7
ME-22	Wheat	Snowbird	12-56-0-0	May-9 Jun-1	Jun-3 Jun-22	Jun-27 (49) Jul-18 (47)	Jul 7 Jul-25	Priaxor	Jul-25 Aug-8	Sep-16 (all)
OL-22	Wheat	Snowbird	6-30-0-0	Apr-29 May-16	Jun-3 (all)	not recorded	Jun-30 Jul-7	Priaxor	Jul-15 Jul-23	Aug-25
PA-22	Oat	Snowbird	13-60-0-0	May-11 May-30	Jun-9 Jun-24	Jul-7 (57) Jul-20 (51)	Jul-15 Jul-27	Priaxor	Jul-26 Aug-9	Sep-27 (all)
SW-21	Barley	CDC Snowdrop	12-56-0-0	May-4 May-28	Jun-7 Jun-14	Jun-25 (52) Jul-9 (42)	Jul-5 Jul-19	Dyax	Jul-23 Aug-4	Sep-1 (all)
SW-22	Wheat	CDC Snowdrop	12-56-0-0	May-3 May-23	May-31 Jun-10	Jun-28 (56) Jul-10 (48)	Jul-6 Jul-18	Dyax	Jul-18 Aug-2	Aug-18 Aug-24
YK-21	Wheat	Snowbird	3-15-0-0	Apr-30 May-27	May-26 Jun-14	Jun-25 (56) Jul-6 (40)	Jul-5 Jul-16	Dyax	Jul-20 Jul-30	Sep-14 (all)
YK-22	Wheat	Snowbird	3-15-0-0	May-11 Jun-1	Jun-3 Jun-17	Jul-11 (61)[Z] Jul-25 (54)[Z]	Jul-7 Jul-20	Dyax	Jul-22 Aug-5	Sep-29 (all)

[Z] Days to first flower estimated to be after the fungicide applications at YK-22 – possibly set back by late June hail and potentially a confounding factor

Table 14. Overall tests of fixed effects for faba bean plant densities for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	0.602	0.026	0.098	0.218	0.467	0.433	0.210	0.910	0.013	0.033
Seeding Rate (R)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
D x R	0.807	0.785	0.211	0.928	0.516	0.064	0.317	0.001	0.068	0.224

Table 15. Overall tests of fixed effects for initial faba bean disease ratings (prior to fungicide) for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	0.002	0.034	0.006	0.084	0.070	0.002	0.058	0.043	0.042	0.027
Seeding Rate (R)	0.397	0.685	0.627	0.597	0.480	0.041	0.328	0.564	0.294	0.117
D x R	0.209	0.114	0.871	0.223	0.761	0.162	0.328	0.421	0.181	0.059

Table 16. Overall tests of fixed effects for final faba bean disease ratings (14+ days post-fungicide) for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	0.115	0.341	1.000	0.466	0.327	0.860	—	0.715	0.011	0.391
Seed Rate (R)	0.284	0.060	1.000	0.492	1.000	0.349	—	0.099	0.319	0.331
Fungicide (F)	0.933	0.012	0.174	0.001	0.001	0.349	—	0.361	0.319	0.331
D x R	0.124	0.104	1.000	0.492	0.335	0.850	—	0.361	0.736	0.331
D x F	0.560	0.962	0.174	0.024	0.335	0.850	—	0.512	0.319	0.331
R x F	0.363	0.597	0.174	0.492	0.468	0.349	—	0.035	0.319	0.331
D x R x F	0.676	0.473	0.174	1.000	0.100	0.850	—	0.099	0.319	0.331

Table 17. Overall tests of fixed effects for faba bean maturity for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	<0.001	<0.001	0.010	<0.001	—	0.007	0.007	—	0.005	—
Seed Rate (R)	<0.001	<0.001	0.367	0.089	—	0.475	0.470	—	0.041	—
Fungicide (F)	<0.001	<0.001	0.367	0.556	—	0.239	0.040	—	0.095	—
D x R	0.779	0.021	0.367	0.089	—	0.811	0.884	—	0.095	—
D x F	0.172	0.222	0.367	0.556	—	0.239	0.040	—	0.665	—
R x F	0.779	1.000	1.000	0.089	—	1.000	0.470	—	0.203	—
D x R x F	0.172	0.535	1.000	0.089	—	0.343	0.470	—	1.000	—

Table 18. Overall tests of fixed effects for faba bean seed yield for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	0.536	0.402	0.867	<0.001	0.026	0.051	<0.001	0.013	0.847	0.723
Seed Rate (R)	0.295	0.018	0.660	0.749	0.023	<0.001	0.382	0.959	0.778	0.485
Fungicide (F)	0.110	0.383	0.516	0.025	0.633	0.185	0.013	0.624	0.005	0.021
D x R	0.237	0.957	0.468	0.191	0.283	0.871	0.722	0.964	0.907	0.980
D x F	0.458	0.070	0.549	0.041	0.182	0.653	0.317	0.692	0.360	0.784
R x F	0.565	0.171	0.802	0.674	0.162	0.256	0.277	0.101	0.342	0.265
D x R x F	0.777	0.416	0.978	0.338	0.804	0.378	0.389	0.566	0.466	0.980

Table 19. Overall tests of fixed effects for faba bean seed weight for all sites (2021-22).

Source	IH21	IH22	ME21	ME22	OL22	PA22	SW21	SW22	YK21	YK22
	p-values									
Seeding Date (D)	0.003	0.109	0.004	<0.001	0.001	0.001	0.076	<0.001	0.206	0.399
Seed Rate (R)	<0.001	<0.001	0.945	0.136	0.081	0.429	0.064	0.317	0.379	0.053
Fungicide (F)	0.575	0.661	0.550	0.002	0.985	0.089	0.217	0.611	0.017	0.352
D x R	<0.001	0.020	0.103	0.205	0.883	0.014	0.384	0.612	0.640	0.231
D x F	0.075	<0.001	0.794	0.400	0.479	0.868	0.945	0.222	0.639	0.781
R x F	0.004	0.536	0.964	0.301	0.746	0.756	0.661	0.282	0.652	0.354
D x R x F	0.673	0.043	0.544	0.698	0.633	0.161	0.221	0.141	0.465	0.292

Table 20. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Indian Head 2021.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	42.4 b	1.9 a	1.8 a	104.1 a	1774 a	415.3 b
Early - 65	63.2 a	1.7 a	2.6 a	102.3 b	1861 a	413.3 b
Delayed - 45	41.7 b	0.5 b	1.0 a	99.0 c	1896 a	469.8 a
Delayed - 65	61.6 a	0.6 b	0.9 a	97.3 d	1891 a	429.1 b
S.E.M.	1.84	0.17	0.46	0.22	92.8	3.97
Pr > F (p-value)	0.807	0.209	0.124	0.779	0.237	<0.001
Date x Fung						
Early - Control	—	—	2.1 a	102.9 a	1800 a	409.6 b
Early - Treated	—	—	2.3 a	103.5 a	1835 a	419.1 b
Delayed - Control	—	—	1.0 a	97.5 c	1848 a	452.0 a
Delayed - Treated	—	—	0.9 a	98.8 b	1939 a	446.9 a
S.E.M.	—	—	0.46	0.22	92.8	3.97
Pr > F (p-value)	—	—	0.56	0.172	0.458	0.075
Rate x Fung						
45 - Control	—	—	1.3 a	101.1 ab	1793 a	447.7 a
45 - Treated	—	—	1.6 a	102.0 a	1878 a	437.4 ab
65 - Control	—	—	1.9 a	99.3 c	1855 a	413.8 c
65 - Treated	—	—	1.6 a	100.3 b	1896 a	428.6 bc
S.E.M.	—	—	0.39	0.22	77.6	3.91
Pr > F (p-value)	—	—	0.363	0.779	0.565	0.004

Table 21. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Indian Head 2021.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	1.5 a	104.0 ab	1741 a	416.0 bc
Early - 45 - Treated	2.1 a	104.3 a	1808 a	414.6 bc
Early - 65 - Control	2.7 a	101.8 c	1860 a	403.1 c
Early - 65 - Treated	2.5 a	102.8 bc	1862 a	423.5 bc
Delay - 45 - Control	1.0 a	98.3 e	1845 a	479.5 a
Delay - 45 - Treated	1.0 a	99.8 d	1947 a	460.2 a
Delay - 65 - Control	1.0 a	96.8 f	1850 a	424.5 bc
Delay - 65 - Treated	0.7 a	97.8 ef	1931 a	433.7 b
S.E.M.	0.55	0.31	100.1	5.53
Pr > F (p-value)	0.676	0.172	0.777	0.673

Table 22. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Indian Head 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	48.8 c	0.5 b	0.9 a	111.0 a	3207 a	386.6 a
Early - 65	68.3 b	0.6 ab	1.4 a	109.4 b	3323 a	362.5 b
Delayed - 45	59.4 b	0.8 a	1.0 a	98.4 c	3384 a	392.4 a
Delayed - 65	80.0 a	0.7 a	1.0 a	97.8 c	3495 a	385.0 a
S.E.M.	2.42	0.07	0.17	0.41	134.2	5.00
Pr > F (p-value)	0.785	0.114	0.104	0.021	0.957	0.02
Date x Fung						
Early - Control	—	—	1.4 a	109.6 b	3204 a	366.7 c
Early - Treated	—	—	1.0 a	110.8 a	3327 a	382.4 ab
Delayed - Control	—	—	1.2 a	97.3 d	3462 a	398.0 a
Delayed - Treated	—	—	0.8 a	98.9 c	3417 a	379.4 ab
S.E.M.	—	—	0.17	0.41	134.2	5.00
Pr > F (p-value)	—	—	0.962	0.222	0.070	<0.001
Rate x Fung						
45 - Control	—	—	1.1 ab	104.0 b	3307 ab	391.2 a
45 - Treated	—	—	0.8 b	105.4 a	3284 b	387.8 a
65 - Control	—	—	1.4 a	102.9 c	3359 ab	373.4 b
65 - Treated	—	—	1.0 ab	104.3 b	3460 a	374.0 b
S.E.M.	—	—	0.16	0.40	102.3	4.20
Pr > F (p-value)	—	—	0.597	1.000	0.171	0.536

Table 23. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Indian Head 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	1.1 a	110.5 ab	3195 a	383.3 ab
Early - 45 - Treated	0.8 a	111.5 a	3220 a	389.9 ab
Early - 65 - Control	1.6 a	108.8 c	3212 a	350.1 c
Early - 65 - Treated	1.3 a	110.0 bc	3435 a	374.9 ab
Delay - 45 - Control	1.1 a	97.5 ef	3420 a	399.2 a
Delay - 45 - Treated	0.9 a	99.3 d	3348 a	385.7 ab
Delay - 65 - Control	1.3 a	97.0 f	3505 a	396.8 a
Delay - 65 - Treated	0.8 a	98.5 de	3486 a	373.2 bc
S.E.M.	0.21	0.45	141.1	5.96
Pr > F (p-value)	0.473	0.535	0.416	0.043

Table 24. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Melfort 2021.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	35.1 b	0.7 a	0.0 a	95.0 a	2284 a	383.6 b
Early - 65	42.5 ab	0.7 a	0.1 a	95.0 a	2170 a	375.1 b
Delayed - 45	37.2 b	0.0 b	0.1 a	88.6 b	2230 a	417.0 a
Delayed - 65	49.7 a	0.1 b	0.0 a	90.4 b	2258 a	426.2 a
S.E.M.	1.99	0.09	0.04	0.95	95.9	6.15
Pr > F (p-value)	0.211	0.871	1.000	0.367	0.468	0.103
Date x Fung						
Early - Control	—	—	0.1 a	95.0 a	2229 a	377.1 b
Early - Treated	—	—	0.0 a	95.0 a	2224 a	381.6 b
Delayed - Control	—	—	0.1 a	90.4 b	2305 a	420.7 a
Delayed - Treated	—	—	0.0 a	88.6 b	2183 a	422.5 a
S.E.M.	—	—	0.04	0.95	95.9	6.15
Pr > F (p-value)	—	—	0.174	0.367	0.549	0.794
Rate x Fung						
45 - Control	—	—	0.1 a	92.3 a	2301 a	398.6 a
45 - Treated	—	—	0.1 a	91.4 a	2213 a	402.0 a
65 - Control	—	—	0.1 a	93.1 a	2233 a	399.2 a
65 - Treated	—	—	0.0 a	92.3 a	2194 a	402.1 a
S.E.M.	—	—	0.04	0.95	95.9	6.15
Pr > F (p-value)	—	—	0.174	1.000	0.802	0.964

Table 25. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Melfort 2021.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0.0 a	95.0 a	2300 a	382.8 bc
Early - 45 - Treated	0.1 a	95.0 a	2268 a	384.4 bc
Early - 65 - Control	0.2 a	95.0 a	2159 a	371.4 c
Early - 65 - Treated	0.0 a	95.0 a	2181 a	378.8 c
Delay - 45 - Control	0.1 a	89.5 ab	2302 a	414.4 ab
Delay - 45 - Treated	0.1 a	87.8 b	2158 a	419.6 a
Delay - 65 - Control	0.1 a	91.3 ab	2308 a	427.0 a
Delay - 65 - Treated	0.0 a	89.5 ab	2208 a	425.4 a
S.E.M.	0.1 a	1.34	135.6	8.02
Pr > F (p-value)	0.174	1.000	0.978	0.544

Table 26. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Melfort 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	45.6 b	0.5 ab	0.8 a	112.1 a	5017 a	475.0 a
Early - 65	63.9 a	0.6 a	0.9 a	112.5 a	4912 a	461.8 a
Delayed - 45	42.3 b	0.3 ab	1.0 a	98.0 b	3396 b	347.8 b
Delayed - 65	60.9 a	0.2 b	1.0 a	98.0 b	3568 b	346.7 b
S.E.M.	2.19	0.09	0.08	0.11	106.8	4.81
Pr > F (p-value)	0.928	0.223	0.492	0.089	0.191	0.205
Date x Fung						
Early - Control	—	—	0.9 ab	112.3 a	4952 a	461.8 a
Early - Treated	—	—	0.8 ab	112.4 a	4977 a	475.0 a
Delayed - Control	—	—	1.2 a	98.0 b	3244 c	336.7 c
Delayed - Treated	—	—	0.7 b	98.0 b	3720 b	357.8 b
S.E.M.	—	—	0.08	0.11	106.8	4.81
Pr > F (p-value)	—	—	0.024	0.556	0.041	0.400
Rate x Fung						
45 - Control	—	—	1.1 a	105.1 a	4103 a	405.2 ab
45 - Treated	—	—	0.7 b	105.0 a	4310 a	417.5 a
65 - Control	—	—	1.1 a	105.1 a	4093 a	393.2 b
65 - Treated	—	—	0.8 ab	105.4 a	4387 a	415.2 a
S.E.M.	—	—	0.08	0.11	106.8	4.81
Pr > F (p-value)	—	—	0.492	0.089	0.674	0.301

Table 27. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Melfort 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0.9 ab	112.3 ab	4976 a	471.7 a
Early - 45 - Treated	0.8 ab	112.0 b	5058 a	478.2 a
Early - 65 - Control	1.0 ab	112.3 ab	4928 a	451.8 a
Early - 65 - Treated	0.9 ab	112.8 a	4895 a	471.7 a
Delay - 45 - Control	1.2 a	98.0 c	3230 b	338.8 b
Delay - 45 - Treated	0.7 b	98.0 c	3562 b	356.8 b
Delay - 65 - Control	1.2 ab	98.0 c	3258 b	334.6 b
Delay - 65 - Treated	0.8 ab	98.0 c	3879 b	358.8 b
S.E.M.	0.11	0.15	147.9	6.65
Pr > F (p-value)	1.000	0.089	0.338	0.698

Table 28. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Outlook 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	43.8 b	0.7 a	0.9 a	110	4829 ab	439.7 a
Early - 65	61.3 a	0.6 a	0.8 a	110	4965 a	453.2 a
Delayed - 45	48.1 b	0.4 a	0.6 a	97	4077 b	349.8 b
Delayed - 65	61.8 a	0.3 a	0.7 a	97	4430 ab	361.3 b
S.E.M.	2.93	0.12	0.10	—	178.6	6.75
Pr > F (p-value)	0.516	0.761	0.335	—	0.283	0.883
Date x Fung						
Early - Control	—	—	1.0 a	110	4805 ab	444.1 a
Early - Treated	—	—	0.7 ab	110	4989 a	448.9 a
Delayed - Control	—	—	0.9 a	97	4298 bc	358.1 b
Delayed - Treated	—	—	0.4 b	97	4209 c	353.1 b
S.E.M.	—	—	0.10	—	178.6	6.75
Pr > F (p-value)	—	—	0.335	—	0.182	0.479
Rate x Fung						
45 - Control	—	—	0.9 ab	103.5	4501 a	396.0 a
45 - Treated	—	—	0.6 ab	103.5	4405 a	393.6 a
65 - Control	—	—	1.0 a	103.5	4602 a	406.2 a
65 - Treated	—	—	0.5 b	103.5	4793 a	408.3 a
S.E.M.	—	—	0.10	—	168.1	6.75
Pr > F (p-value)	—	—	0.468	—	0.162	0.746

Table 29. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Outlook 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	1.1 a	110	4821 ab	440.1 a
Early - 45 - Treated	0.7 ab	110	4837 ab	439.4 a
Early - 65 - Control	0.9 ab	110	4789 ab	448.1 a
Early - 65 - Treated	0.7 ab	110	5141 a	458.4 a
Delay - 45 - Control	0.8 ab	97	4181 bc	351.8 b
Delay - 45 - Treated	0.5 ab	97	3973 c	347.9 b
Delay - 65 - Control	1.1 ab	97	4415 abc	364.4 b
Delay - 65 - Treated	0.4 b	97	4445 abc	358.3 b
S.E.M.	0.15	—	203.9	9.55
Pr > F (p-value)	0.100	—	0.804	0.633

Table 30. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Prince Albert 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	48.5 b	0.9 a	0.2 a	110.8 a	7014 b	525.6 a
Early - 65	69.5 a	0.9 a	0.3 a	110.3 a	7515 a	542.4 a
Delayed - 45	56.0 b	0.1 b	0.2 a	99.9 b	5778 c	444.7 b
Delayed - 65	66.8 a	0.4 b	0.3 a	99.6 b	6309 b	435.6 b
S.E.M.	2.63	0.08	0.06	1.22	419.1	6.22
Pr > F (p-value)	0.064	0.162	0.850	0.811	0.871	0.014
Date x Fung						
Early - Control	—	—	0.3 a	110.5 a	7179 ab	529.3 a
Early - Treated	—	—	0.2 a	110.5 a	7350 a	538.7 a
Delayed - Control	—	—	0.3 a	99.1 b	6001 c	436.3 b
Delayed - Treated	—	—	0.2 a	100.4 b	6086 bc	444.0 b
S.E.M.	—	—	0.06	1.22	419.1	6.22
Pr > F (p-value)	—	—	0.850	0.239	0.653	0.868
Rate x Fung	—					
45 - Control	—	—	0.3 a	105.0 a	6389 b	480.1 a
45 - Treated	—	—	0.1 a	105.6 a	6405 b	490.2 a
65 - Control	—	—	0.3 a	104.6 a	6793 a	485.5 a
65 - Treated	—	—	0.3 a	105.3 a	7030 a	492.5 a
S.E.M.	—	—	0.06	0.93	374.4	5.53
Pr > F (p-value)	—	—	0.349	1.000	0.256	0.756

Table 31. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Prince Albert 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0.3 a	110.5 a	7025 bcd	516.7 a
Early - 45 - Treated	0.2 a	111.0 a	7003 bcd	534.5 a
Early - 65 - Control	0.3 a	110.5 a	7333 abc	541.9 a
Early - 65 - Treated	0.3 a	110.0 a	7696 a	542.8 a
Delay - 45 - Control	0.3 a	99.5 b	5748 d	443.5 b
Delay - 45 - Treated	0.1 a	100.3 b	5808 d	445.8 b
Delay - 65 - Control	0.3 a	98.8 b	6253 cd	429.0 b
Delay - 65 - Treated	0.3 a	100.5 b	6364 abcd	442.2 b
S.E.M.	0.09	1.32	429.3	7.83
Pr > F (p-value)	0.850	0.343	0.378	0.161

Table 32. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Swift Current 2021.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	39.7 B	0.1 ab	0	93.3 a	1093 a	229.2 a
Early - 65	53.8 A	0.1 a	0	93.5 a	1051 a	225.8 ab
Delayed - 45	33.8 B	0.0 b	0	88.8 b	435 b	223.7 ab
Delayed - 65	52.2 A	0.0 b	0	89.1 b	418 b	214.8 b
S.E.M.	2.21	0.03	—	0.57	40.1	3.14
Pr > F (p-value)	0.317	0.328	—	0.884	0.722	0.384
Date x Fung						
Early - Control	—	—	0	93.4 a	1009 a	225.4 a
Early - Treated	—	—	0	93.4 a	1136 a	229.6 a
Delayed - Control	—	—	0	88.0 c	398 b	217.4 a
Delayed - Treated	—	—	0	89.9 b	455 b	221.1 a
S.E.M.	—	—	—	0.57	40.1	3.14
Pr > F (p-value)	—	—	—	0.040	0.317	0.945
Rate x Fung						
45 - Control	—	—	0	90.4 a	699 a	223.8 a
45 - Treated	—	—	0	91.6 a	829 a	229.1 a
65 - Control	—	—	0	91.0 a	707 a	219.0 a
65 - Treated	—	—	0	91.6 a	762 a	221.6 a
S.E.M.	—	—	—	0.5	36.9	3.14
Pr > F (p-value)	—	—	—	0.470	0.277	0.661

Table 33. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Swift Current 2021.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0	93.3 ab	996 a	224.5 ab
Early - 45 - Treated	0	93.3 ab	1190 a	234.0 a
Early - 65 - Control	0	93.5 a	1021 a	226.4 ab
Early - 65 - Treated	0	93.5 a	1081 a	225.3 ab
Delay - 45 - Control	0	87.5 c	403 b	223.1 ab
Delay - 45 - Treated	0	90.0 bc	468 b	224.3 ab
Delay - 65 - Control	0	88.5 c	393 b	211.7 b
Delay - 65 - Treated	0	89.8 c	443 b	218.0 ab
S.E.M.	—	0.71	52.2	4.41
Pr > F (p-value)	—	0.470	0.389	0.221

Table 34. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Swift Current 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	33.3 c	0.6 ab	1.3 a	100	1668 a	273.7 a
Early - 65	60.4 a	0.8 a	1.1 a	100	1664 a	265.3 a
Delayed - 45	41.9 bc	0.4 b	1.3 a	90	1286 b	188.0 b
Delayed - 65	51.2 ab	0.3 b	1.2 a	90	1286 b	185.2 b
S.E.M.	2.43	0.12	0.14	—	91.7	5.45
Pr > F (p-value)	0.001	0.421	0.361	—	0.964	0.612
Date x Fung						
Early - Control	—	—	1.3 a	100	1647 a	264.7 a
Early - Treated	—	—	1.1 a	100	1685 a	274.4 a
Delayed - Control	—	—	1.2 a	90	1284 b	188.7 b
Delayed - Treated	—	—	1.2 a	90	1288 b	184.6 b
S.E.M.	—	—	0.14	—	91.7	5.45
Pr > F (p-value)	—	—	0.512	—	0.692	0.222
Rate x Fung						
45 - Control	—	—	1.4 a	95	1430 a	232.5 a
45 - Treated	—	—	1.1 ab	95	1524 a	229.3 a
65 - Control	—	—	1.1 b	95	1501 a	220.8 a
65 - Treated	—	—	1.2 ab	95	1449 a	229.7 a
S.E.M.	—	—	0.14	—	87.3	5.45
Pr > F (p-value)	—	—	0.035	—	0.101	0.282

Table 35. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Swift Current 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	1.4 a	100	1624 ab	276.1 a
Early - 45 - Treated	1.2 a	100	1711 a	271.4 a
Early - 65 - Control	1.1 a	100	1669 ab	253.2 a
Early - 65 - Treated	1.0 a	100	1659 ab	277.4 a
Delay - 45 - Control	1.5 a	90	1235 c	188.9 b
Delay - 45 - Treated	1.1 a	90	1337 bc	187.2 b
Delay - 65 - Control	1.0 a	90	1333 bc	188.5 b
Delay - 65 - Treated	1.4 a	90	1238 c	182.0 b
S.E.M.	0.17	—	101.1	7.71
Pr > F (p-value)	0.099	—	0.566	0.141

Table 36. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Yorkton 2021.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	43.1 c	0.5 a	0.3 a	96.5 b	1091 a	427.1 a
Early - 65	57.6 b	0.3 ab	0.2 a	96.6 b	1062 a	424.4 a
Delayed - 45	49.1 c	0.0 b	0.1 b	99.9 a	1104 a	407.4 a
Delayed - 65	70.5 a	0.0 b	0.0 b	101.0 a	1092 a	398.9 a
S.E.M.	2.21	0.094	0.05	0.66	87.5	11.58 a
Pr > F (p-value)	0.068	0.181	0.736	0.095	0.907	0.64
Date x Fung						
Early - Control	—	—	0.3 a	96.4 b	994 ab	432.4 a
Early - Treated	—	—	0.2 a	96.8 b	1159 ab	419.1 a
Delayed - Control	—	—	0.0 b	100.1 a	948 b	412.7 a
Delayed - Treated	—	—	0.0 b	100.8 a	1248 a	393.6 a
S.E.M.	—	—	0.05	0.66	87.5	11.58
Pr > F (p-value)	—	—	0.319	0.665	0.360	0.639
Rate x Fung						
45 - Control	—	—	0.2 a	98.1 a	1017 ab	426.7 a
45 - Treated	—	—	0.2 a	98.3 a	1179 ab	407.7 a
65 - Control	—	—	0.2 a	98.4 a	925 b	418.4 a
65 - Treated	—	—	0.1 a	99.3 a	1229 a	405.0 a
S.E.M.	—	—	0.05	0.62	80.3	9.71
Pr > F (p-value)	—	—	0.319	0.203	0.342	0.652

Table 37. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Yorkton 2021.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0.3 ab	96.5 b	1017 a	432.8 a
Early - 45 - Treated	0.3 ab	96.5 b	1166 a	421.3 a
Early - 65 - Control	0.3 a	96.3 b	971 a	431.9 a
Early - 65 - Treated	0.2 ab	97.0 b	1153 a	416.9 a
Delay - 45 - Control	0.1 ab	99.8 a	1016 a	420.7 a
Delay - 45 - Treated	0.1 ab	100.0 a	1192 a	394.2 a
Delay - 65 - Control	0.0 b	100.5 a	879 a	404.8 a
Delay - 65 - Treated	0.0 b	101.5 a	1305 a	393.1 a
S.E.M.	0.06	0.72	113.5	13.12
Pr > F (p-value)	0.319	1.000	0.466	0.465

Table 38. Two-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Yorkton 2022.

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Maturity	Seed Yield	Seed Weight
Date x Rate	- plants/m^2 -	------ 0-9 -----	------ 0-9 -----	---- days ----	---- kg/ha ----	g/1000 seeds
Early - 45	57.7 bc	1.9 a	0.0 a	—	2400 a	434.7 a
Early - 65	74.3 a	2.1 a	0.3 a	—	2336 a	414.0 a
Delayed - 45	49.9 c	1.0 b	0.0 a	—	2267 a	420.8 a
Delayed - 65	61.0 b	1.0 b	0.0 a	—	2198 a	415.6 a
S.E.M.	2.54	0.17	0.13	—	255.1	6.23
Pr > F (p-value)	0.224	0.059	0.331	—	0.98	0.231
Date x Fung						
Early - Control	—	—	0.0 a	—	2237 a	426.4 a
Early - Treated	—	—	0.3 a	—	2499 a	422.2 a
Delayed - Control	—	—	0.0 a	—	2128 a	422.1 a
Delayed - Treated	—	—	0.0 a	—	2337 a	414.4 a
S.E.M.	—	—	0.13	—	255.1	6.23
Pr > F (p-value)	—	—	0.331	—	0.784	0.781
Rate x Fung						
45 - Control	—	—	0.0 a	—	2269 a	433.7 a
45 - Treated	—	—	0.0 a	—	2398 a	421.8 a
65 - Control	—	—	0.0 a	—	2096 a	414.8 a
65 - Treated	—	—	0.3 a	—	2438 a	414.8 a
S.E.M.	—	—	0.13	—	192.1	6.23
Pr > F (p-value)	—	—	0.331	—	0.265	0.354

Table 39. Three-way interaction treatment means and tests of fixed effects for faba bean seeding date, seed rate, and foliar fungicide effects on selected response variables at Yorkton 2022.

3-Way Interaction	Final Disease	Maturity	Yield	Seed Weight
Date x Rate x Fung	---------- 0-9 ---------	--------- days ---------	-------- kg/ha --------	--- g/1000 seeds ---
Early - 45 - Control	0.0 a	—	2324 a	443.1 a
Early - 45 - Treated	0.0 a	—	2476 a	426.2 a
Early - 65 - Control	0.0 a	—	2151 a	409.8 a
Early - 65 - Treated	0.5 a	—	2522 a	418.3 a
Delay - 45 - Control	0.0 a	—	2215 a	424.3 a
Delay - 45 - Treated	0.0 a	—	2319 a	417.4 a
Delay - 65 - Control	0.0 a	—	2041 a	419.9 a
Delay - 65 - Treated	0.0 a	—	2355 a	411.4 a
S.E.M.	0.18	—	271.6	8.81
Pr > F (p-value)	0.331	—	0.98	0.292

15. Reference papers or articles – as applicable

There are no reference papers or articles to report currently.