2023 Final Report

for the

Saskatchewan Pulse Crop Development Board

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

(Project #AP-2320a)

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1. **Project Code** (as per contract): AP2320a

2. **Project Title:** Faba Bean Agronomy to Enhance Yield, Hasten Maturity, and Reduce Disease

3. **Introduction** (background and rationale for the 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 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 from 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 achieve higher faba bean yields, reduce disease, and harvest the crop 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 allow the crop to reach maturity in a timely manner. In a four-year study focused 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 could be 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% and even seeding dates of May 9 significantly reduced yields relative to the earliest date in 1 of 2 years (McVetty et al. 1986).

Focusing 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 marginal populations could sometimes lead to delayed maturity and weed issues. 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 an increase of only 139 kg/ha (7%) going from 25 to 65 seeds/m^2 rates. Under these conditions, increasing seeding rate from 25-65 seeds/m^2 accelerated maturity by 3 days when averaged across row spacing treatments.

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

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4. **Objective(s):**

The objectives of this project were to demonstrate and investigate:

1. The overall adaption and yield potential of faba beans throughout all of the major soil climatic zones of Saskatchewan, including regions where this crop has not traditionally been grown or recommended.
2. The ability of early seeding to both optimize yield and allow for earlier faba bean harvest.
3. The effects of higher seeding rates on disease development, maturity, and yield.
4. The capacity for foliar fungicide applications to reduce disease, enhance yield, and potentially delay maturity.

5. **Materials & Methods** (experimental design, methods used, details of growing season, materials used, sites and site design, statistical analysis used):

Over the 2021, 2022, and 2023 growing seasons, field trials with faba bean were successfully completed at 16 sites 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, while four locations were in the Black soil zone, which is generally best suited for faba bean production. These included one southern (Indian Head), one central (Yorkton), and two more northern (Melfort and Prince Albert) locations. Selected agronomic details and dates of operations for each of the 16 sites are provided in Table 8 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, seeding was sometimes initiated later than targeted due to delayed snow melt and/or 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.

Plot size 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. The protocols specified that the variety would be Snowbird at all locations since this is a popular and well-adapted variety in western Canada with good yield potential, reasonably early maturity, and a smaller seed size than many high tannin types. However, Swift Current grew CDC

Snowdrop in all three years which will need to be considered when interpreting results since CDC Snowdrop has a lower yield potential and smaller seed size than many of the other faba bean varieties, including Snowbird. 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 it made agronomic and logistic sense but, in some cases, all plots were harvested on the same date.

Various data were collected over 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 beginning 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 while the second was completed during pod filling, 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 were rather subjective, they were useful to confirm the presence of disease and the relative severity across treatments. The Julian date where each plot reached maturity was recorded and used to calculate the number of days from seeding to maturity. Maturity was defined as the stage where approximately 80% of the pods had 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.

Data from all 16 sites were combined and analyzed using the generalized linear mixed model (GLIMMIX) procedure of SAS Studio. For plant density and initial disease ratings, the effects of site (S), seeding date (D), seeding rate (R), and all possible interactions were included as fixed effects. For the remaining variables, site, seeding date, seeding rate, fungicide (F) and interactions were included as fixed effects. Replicate and D x Replicate interactions (nested within site) were included as random effects. While we attempted to test and allow for heterogeneous variance estimates within each site, model convergence could not be achieved with this model due to the large size and complexity of the data set. Based on preliminary, individual site analyses, we knew that there was a high probability that heterogeneity in variance components likely did exist amongst the sites for some variables. With that in mind, basic tests of the fixed effects and variance estimates from the individual site analyses were summarized and reported to compliment the combined analyses and aid in the interpretation of results in cases where the combined analyses may not have been as precise as we had hoped. The single site analyses were essentially identical to the combined analyses, but without the effects of site or any associated interactions included in the model. Tukey's multiple comparisons test was used to separate individual treatment means and treatment effects and differences between means were considered significant at $P \leq 0.05$.

6. **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 & Environment

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. Although the late-seeded faba beans were harvested in early October on some occasions, September harvests were much more common, and it is unlikely that September precipitation ever had much impact on either disease or yield potential. There were far more instances where harvest was completed in late August than cases where it was delayed until October and weather data are only reported for May through August. With 16 location-years, there was wide variation in the environmental conditions encountered; however, the project was conducted through a relatively hot, dry period which was neither ideal for faba bean yield potential nor for the development of the most important diseases affecting this crop.

Table 1. Mean monthly temperatures along with long-term (LT; 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	Avg.
		---------- Mean Temperature (°C) ----------				
Indian Head	2021	9.0	17.7	20.3	17.1	16.0 (+0.4)
	2022	10.9	16.1	18.1	18.3	15.9 (+0.3)
	2023	14.0	19.4	16.7	17.7	17.0 (+1.4)
	LT	10.8	15.8	18.2	17.4	15.6
Melfort	2021	9.6	18.2	20.1	16.9	16.2 (+1.0)
	2022	9.8	15.2	18.2	18.7	15.5 (+0.3)
	2023	14.1	19.2	16.9	17.3	16.9 (+1.7)
	LT	10.7	15.9	17.5	16.8	15.2
Outlook	2022	11.8	16.3	19.7	20.5	17.1 (+1.0)
	2023	15.2	19.5	18.5	18.7	18.0 (+1.9)
	LT	11.5	16.1	18.9	18.0	16.1
Prince Albert	2022	10.2	15.1	17.9	18.0	15.3 (+0.2)
	2023	14.4	18.8	16.6	17.1	16.7 (+1.6)
	LT	10.4	15.3	18.0	16.7	15.1
Swift Current	2021	9.5	18.3	21.6	17.9	16.8 (+1.0)
	2022	10.8	15.7	19.7	20.9	16.8 (+1.0)
	2023	14.8	17.7	18.4	18.8	17.4 (+1.6)
	LT	10.9	15.7	18.4	17.9	15.8
Yorkton	2021	8.9	19.1	21.0	17.3	16.6 (+1.4)
	2022	10.6	15.7	18.6	18.9	16.0 (+0.8)
	2023	13.8	19.7	16.7	17.8	17.0 (+1.8)
	LT	10.4	15.5	17.9	17.1	15.2

Mean growing season temperatures were considered above average (> 0.5 °C of the long-term average) at 75% of the sites and approximately average (within 0.5 °C of the long-term average) at the remainder of the sites. There were no cases where the mean growing season temperatures fell below the long-term (1981-2010) average. Growing season precipitation amounts were much more variable, ranging from as low as 42% of average (ME-23) to as high as 121% of average (IH-21). However, this information can be misleading as initial soil moisture reserves varied widely and both the timing of precipitation and corresponding temperatures could have major implications regarding both total water availability and the water use-efficiency of the crop. For example, Indian Head 2021 (IH-21) and IH-22 received similar amounts of total precipitation; however, 2021 started out

extremely dry and a large percentage of the precipitation came in August, too late to be of much benefit to the crop. In contrast, 2022 started wet, and most of the precipitation came in May and July. As such, 2022 was a much wetter growing season overall with considerably higher yield potential, despite the four-month precipitation amounts being much like the previous season. Despite the wetter overall conditions at IH-22, June was dry and disease pressure during this critical, early flowering period, was negligible. In hindsight, it would have been beneficial to measure initial spring soil moisture to a minimum depth of 60 cm at the start of each growing season. Notably, the plots at Yorkton 2022 (YK-22) and Swift Current 2023 (SW-23) were damaged by hail. This should be kept in mind when considering the overall yield potential at these locations and it is also possible that the early seeded faba beans were affected to a greater degree than the late seeded plots. At Swift Current, yield loss was estimated at 40%; however, no distinction was made between the early and late seeded crops. At Yorkton, pea leaf weevil was a persistent problem, particularly in 2022 and 2023. In addition to the hail, this likely contributed to the low yields and extremely high variability at this location.

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	Avg.
		---------- Precipitation (mm) ----------				
Indian Head	2021	81.6	62.9	51.2	99.4	295 (121%)
	2022	97.7	27.5	114.5	45.9	286 (117%)
	2023	12.9	49.6	15.9	40.8	119 (49%)
	LT	51.7	77.4	63.8	51.2	244
Melfort	2021	31.4	37.6	0.2	69.3	139 (52%)
	2022	90.8	78.1	34.9	37.5	241 (91%)
	2023	17.9	26.4	16.4	50.0	111 (42%)
	LT	42.9	54.3	76.7	52.4	226
Outlook	2022[Z]	35.7	75.2	53.2	7.0	171 (83%)
	2023[Y]	17.2	15.3	15.5	46.6	95 (46%)
	LT	42.6	63.9	56.1	42.8	205
Prince Albert	2022	22.4	63.4	45.7	42.2	174 (60%)
	2023	22.8	52.8	40.8	51.2	168 (57%)
	LT	44.7	68.6	76.6	61.6	252
Swift Current	2021	30.0	26.8	36.6	53.5	147 (78%)
	2022	43.2	31.2	83.5	6.7	165 (88%)
	2023 [X]	41.0	32.9	63.3*	42.1	116 (62%)
	LT	42.1	66.1	44.0	35.4	188
Yorkton	2021	24.6	18.1	35.2	69.7	148 (54%)
	2022 [X]	137.9	57.9	38.4	90.8	325(119%)
	2023	16.8	67.9	18.0	33.3	136 (50%)
	LT	51.3	80.1	78.2	62.2	272

[Z] OL-22 site also received 155 mm of irrigation water between June-1 and August 31, 2022
[Y] OL-23 site also received 279 mm of irrigation water between June-1 and August 31, 2022
[X] Plots were damaged by hail at Swift Current 2023 (Jul-22) and Yorkton 2022 (Jun-23)

Overall Tests of Fixed Effects

The overall tests of fixed effects from the combined analyses are presented in Table 3 below. The effect of site was highly significant for all variables, and the overall site means provide information on the broader performance and adaptation of faba beans throughout Saskatchewan, in the years for which this project was conducted. Bear in mind that the variability in the disease ratings and maturity dates was, at times, negligible for individual sites and this had implications for the statistical analyses. Consequently, differences that were too small to be of much agronomic importance were occasionally still significant. For some of the other variables, particularly seed yield and seed weight, convergence could not be achieved when the model allowed for heterogenous variance estimates for individual sites and, as such, treatment differences that were detected in the individual site analyses were not significant in the combined analyses. In other cases, particularly for sites where the data was more variable, treatment effects that could not be detected in the individual site analyses became significant in the combined analyses. Consequently, results from the overall tests of fixed effects from the individual site analyses were also summarized and reported (Tables 9-11) along with measures of variability for each effect/site combination. While we will mainly focus on the combined analyses, this additional layer of information may be useful to help interpret results in cases where the combined analyses did not work as well as we would have liked. Specific results of the tests of fixed effects will be referred to as required throughout the discussion of results.

Table 3. Overall tests of fixed effects for selected response variables in faba bean seeding date by seeding rate by fungicide trials conducted 2021-23. Data were combined across 16 sites for analyses and analyzed using the generalized linear mixed model procedure of SAS® Studio.

Source	Plant Density	Initial Disease	Final Disease	Days to Maturity	Seed Yield	Seed Weight
	p-values					
Site (S)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Seed Date (D)	<0.001	<0.001	0.238	<0.001	<0.001	0.009
S × D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Seeding Rate (R)	<0.001	0.865	0.234	0.015	<0.001	<0.001
S × R	<0.001	0.228	0.868	<0.001	<0.001	0.008
D × R	0.517	0.217	0.167	0.130	0.474	0.880
S × D × R	0.005	0.186	0.577	0.926	0.916	0.029
Fungicide (F)	–	–	0.009	0.003	0.002	0.293
S × F	–	–	0.399	0.025	0.207	0.010
D × F	–	–	0.026	0.130	0.156	0.231
S × D × F	–	–	0.040	0.204	0.538	0.141
R x F	–	–	0.431	0.743	0.389	0.170
S × R × F	–	–	0.742	0.999	0.887	0.947
D × R × F	–	–	0.610	0.838	0.879	0.579
S × D × R × F	–	–	0.919	0.996	0.981	0.703

Overall Adaptation and Performance Across Locations

We recognized that, of the dryland locations, faba beans were likely to be most well adapted to the more northern, Black soil zone locations; however, production challenges with more conventional options (i.e., pea and lentil) in the Brown and Dark Brown soil zones incentivized us to conduct this project outside of the traditional faba bean growing areas. Overall mean plant densities, disease

levels, maturities, seed yields, and thousand seed weights are presented for each site in Table 3.

Focusing on emergence, the target seeding rates averaged 55 viable seeds/m^2 for all sites. Actual plant populations ranged from 39-65 plants/m^2. While plant densities exceeding 55 seeds/m^2 were technically not possible, they can potentially be explained by differences in the target versus actual seeding rates, variation in seed distribution from row to row and within the plot, discrepancies in the assumed versus actual TKW/germination info, and sampling error. In any case, populations of ≥50 plants/m^2 for 63% of the sites indicated that seedling mortality was less 10% in many cases. There were only 2/16 (13%) sites where the estimated mortality approached 30% (SW-23 and OL-23) and, in the case of OL-23, the month of May was extremely dry, and irrigation did not begin until June. To be safe, growers might consider assuming approximately 10-25% seedling mortality along with their target plant populations when calculating faba beans seeding rates, with the higher values only being likely under poor seeding conditions. This is valuable information for farmers since, due to the large seed size, seeding can be expensive and logistically challenging for this crop.

As alluded to in the previous section, disease pressure was generally quite low in 2021-23, regardless of location. The plots were rated on a scale of 0-9 at two distinct stages, first at early bloom (prior to any fungicide applications) and again during pod fill but prior to senescence. Although the ratings were quite subjective, 75% of the sites had mean overall ratings of less than 0.5 at the early flowering stage, indicating that <5% of the plant area was affected, generally just the lowest leaves which may have also been affected by other environmental stressors. For the final ratings, the values were generally not much higher and, in some cases, were even lower, despite half of the plots not receiving any foliar fungicide. While disease was frequently confirmed by the Saskatchewan Crop Protection Laboratory (not shown), the observed ratings suggested that, for the most part, disease was not much of a limiting factor under the environmental conditions encountered. Where samples were submitted for positive identification, Chocolate spot (*Botrytis sp*) was, by far, the dominant disease while Alternaria Leaf spot (*Alternaria sp*) was confirmed in a few cases (likely saprophytic) and Alternaria/Stemphylium leaf spot complex was identified in one case.

The number of days from seeding to maturity ranged from 88-109 days, on average, with the crop generally developing more slowly at sites where moisture was less limiting and/or temperatures were cooler. For example, the driest to wettest seasons at Indian Head were 2023, 2021, and 2022 while the corresponding values for days to maturity were 93, 101, and 104 days from seeding. While longer periods from seeding to maturity often appeared to correlate to higher yields, this was not always the case. Maturity was consistently achieved in a relatively short period of time at Swift Current. While we cannot rule out the role of genetics, Snowbird and CDC Snowdrop have similar maturities; therefore, we expect that the earlier maturity at this location was primarily due to environment.

Yield potentials ranged widely across environments. Indian Head had intermediate yields but substantial variation from year to year. 2021 and 2023 were the drier years and yields averaged 1855-2235 kg/ha in these years compared to 3352 kg/ha under the wetter conditions in 2022. The same was true at Melfort where yields ranged from 2235 in 2021 to 4223 kg/ha in 2022. Yields were also reasonably high in 2023 at Melfort, despite the dry and hot weather. The difference between 2021 and 2023 at this location was partly attributed to higher soil moisture reserves going into 2023. At 4575-5782 kg/ha, yields under irrigation at Outlook were consistently quite high, despite the coarser soil texture and high temperatures at this location. While they will need to compete with other high value crops, this suggests that faba beans are quite well adapted to irrigated production in the Brown soil zone, unlike some other cool season pulse crops (i.e., peas and lentils) which generally do better under dry conditions and are not necessarily the best candidates for irrigated

production. Yields at Prince Albert were highly variable, the highest of all sites in 2022 (6654 kg/ha) but amongst the lowest in 2023 (1754 kg/ha). This extreme variability could not easily be attributed to weather, as total growing season precipitation was similar for both years. Weed control issues and residual herbicide damage were noted as possible yield limiting factors in 2023 and this was also the site with the highest overall disease ratings and the sole site where *Stemphylium* complex was confirmed. Swift Current consistently had the lowest yields, especially in 2021 and 2023 where mean yields were less than 1 Mt/ha; however, the low yields in 2023 were partly attributed to hail damage which was estimated to have resulted in a yield loss of approximately 40%. Again, Swift Current also grew a lower yielding variety; however, we know that this site is likely a poor candidate for faba bean production relative to the cooler, wetter regions of the province. Field peas, lentils, and chickpeas are likely to be better overall pulse crop options for the dry Brown soil zone, but these crops have been met with challenges of their own in the region; hence the interest in alternatives such as faba bean. Yorkton would normally be considered a location that should be quite well suited for faba beans; however, this site has been challenged by drought, hail, and pea leaf weevil over the three years of this project. As such, yields at Yorkton have been poorer than expected and were amongst the lowest of all sites in 2021 which was particularly dry. Yields in 2022 and 2023 were more intermediate (2300-2367 kg/ha); however, the potential was higher in 2022 but substantially reduced by the hail damage that occurred.

Table 4. Overall site effects on selected faba bean response variables. Trials were conducted in 2021 (21), 2022 (22), and 2023 (23) and, in alphabet order, the locations were Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK). Means within a column followed by the same letter do not significantly differ (Tukey's, $P \leq 0.05$).

Site	Plant Density	Initial Disease	Final Disease	Days to Maturity	Seed Yield	Seed Weight
	- plants/m^2 -	------ 0-9 ------	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
IH-21	52.2 FE	1.2 B	1.6 AB	100.7 E	1855 GH	432 B
IH-22	64.1 AB	0.7 C	1.1 CD	104.1 D	3352 E	382 F
IH-23	64.8 A	0.5 CDE	0.7 D	93.0 H	2235 FG	390 EF
ME-21	41.1 HI	0.4 EF	0.1 E	92.3 BC	2235 FG	400 DE
ME-22	53.7 E	0.4 DE	0.9 CD	105.2 BC	4223 CD	408 CD
ME-23	51.2 EF	0.4 DE	0.2 E	108.8 A	3967 D	481 A
OL-22	53.7 E	0.5 CDE	0.7 D	103.5 D	4575 C	401 DE
OL-23	38.6 I	0.0 H	0.2 E	106.0 B	5782 B	432 B
PA-22	60.2 BC	0.6 CD	0.2 E	105.1 C	6654 A	487 A
PA-23	58.7 CD	0.2 GH	1.9 A	103.6 D	1754 H	494 A
SW-21	44.9 GH	0.0 GH	0.0 E	91.2 I	749 J	223 H
SW-22	46.7 G	0.5 CDE	1.2 BC	95.0 G	1476 HI	228 H
SW-23	39.5 I	0.0 H	0.0 E	88.3 J	833 J	245 G
YK-21	55.1 DE	0.2 FG	0.1 E	98.5 F	1087 IJ	415 CD
YK-22	60.8 BC	1.5 A	0.1 E	–	2300 F	421 BC
YK-23	48.9 FG	0.2 F	0.0 E	94.6 G	2367 F	422 BC
S.E.M.	1.41	0.06	0.14	0.30	144.3	5.4

Thousand seed weights varied substantially with environment. First, Swift Current needs to be considered separately as CDC Snowdrop has a much smaller seed than Snowbird (325 versus 448 g/1000 seeds according to the 2023 Saskatchewan Seed Guide). Even then, the actual seed sizes at Swift Current were much smaller than expected, ranging from only 223-245 g/1000 seeds. These low

seed weights were attributed to the poor overall adaptation of faba beans to this environment with its coarse textured, low organic matter soil, low precipitation, and high temperatures, particularly in 2021-23 when this project was conducted. For the sites that grew Snowbird, seed weights ranged from 382-494 g/1000 seeds. Notably, seed size did not appear to be well correlated to the overall yield potential. For example, at Indian Head, we saw the largest seeds in the lowest yielding year, 2021. Prince Albert consistently saw the largest overall seeds (487-494 g/1000 seeds); however, yields in 2022 were nearly 4x as high as they were in 2023 at this location. While seed size is undeniably a yield component, this data suggests that it is not likely to be a primary driver of the overall faba bean yield potential with pods per plant or seeds per pod, neither of which were measured, likely being much more important.

Multi-site Averages for Main Effects and Interactions

The multi-site averages for all effects and all response variables are summarized in Tables 5-7 below. These are solely intended to provide a high-level summary of the results; however, it needs to be appreciated that interactions with site occurred in most cases. As such, the overall across site averages are not representative of the actual results that were observed on an individual site basis. These means will be referred to where appropriate throughout the report as we look more closely at the individual factors that were evaluated. While we will touch on interactions where meaningful conclusions can be drawn, much of the focus will be on main effects as the higher-level interactions can be obscure and difficult to explain given the project's large size and complexity.

Table 5. Overall main effect means of seeding date, seeding rate, and fungicide treatment for selected faba bean response variables. The values presented are overall 16 site averages and, importantly, the individual site results often varied. Main effect means within a column followed by the same letter do not significantly differ (Tukey's; $P \leq 0.05$).

Main Effect	Plant Density	Initial Disease	Final Disease	Days to Maturity [z]	Seed Yield	Seed Weight
Seeding Date	- plants/m^2 -	----- 0-9 ----	----- 0-9 ----	---- days ----	--- kg/ha ---	g/1000 seeds
Early	50.8 B	0.60 A	0.52 A	101.3 A	3060 A	394.5 A
Delayed	53.4 A	0.29 B	0.60 A	97.4 B	2621 B	388.2 B
S.E.M.	0.48	0.021	0.048	0.11	48.6	1.78
Pr > F (p-value)	<0.001	<0.001	0.238	<0.001	<0.001	0.009
Seeding Rate						
45 seeds/m^2	44.7 B	0.44 A	0.54 A	99.4 A	2793 B	394.6 A
65 seeds/m^2	59.5 A	0.45 A	0.58 A	99.2 B	2887 A	388.1 B
S.E.M.	0.47	0.018	0.039	0.09	37.9	1.54
Pr > F (p-value)	<0.001	0.865	0.234	0.015	<0.001	<0.001
Fungicide						
Control	—	—	0.61 A	99.5 A	2803 B	390.6 A
Treated	—	—	0.51 B	99.2 B	2878 B	392.1 A
S.E.M.	—	—	0.039	0.09	37.9	1.54
Pr > F (p-value)	–	–	0.009	0.003	0.002	0.293

[z] Days to maturity was not reported at YK-22

Table 6. Overall average means for two-way interactions between seeding date, seeding rate, and fungicide treatment for selected faba bean response variables. The values presented are overall 16 site averages and, importantly, the individual site results often varied. Main effect means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

2-Way Interaction	Plant Density	Initial Disease	Final Disease	Days to Maturity [z]	Seed Yield	Seed Weight
Date × Rate	plants/m^2	----- 0-9 -----	----- 0-9 -----	---- days ----	--- kg/ha ---	g/1000 seeds
Early – 45	43.2 D	0.59 A	0.47 A	101.5 A	3021 B	397.6 A
Early – 65	58.5 B	0.61 A	0.57 A	101.1 B	3098 A	391.3 B
Delay – 45	46.1 C	0.30 B	0.60 A	97.4 C	2566 D	391.6 B
Delay – 65	60.6 A	0.28 B	0.60 A	97.3 C	2677 C	384.8 C
S.E.M.	0.65	0.025	0.055	0.13	51.3	2.06
Pr > F (p-value)	0.517	0.217	0.167	0.130	0.474	0.880
Date × Fung						
Early – Untr	—	—	0.53 B	101.2 A	3006 B	392.8 AB
Early – Fung	—	—	0.51 B	101.3 A	3114 A	396.1 A
Delay – Untr	—	—	0.69 A	97.1 C	2601 C	388.3 B
Delay – Fung	—	—	0.51 B	97.6 B	2642 C	388.1 B
S.E.M.	—	—	0.055	0.13	51.3	2.05
Pr > F (p-value)	–	–	0.026	0.130	0.156	0.231
Rate × Fung						
45 – Untr	—	—	0.57 AB	99.3 A	2766 C	394.8 A
45 – Fung	—	—	0.50 B	99.6 A	2821 BC	394.4 A
65 – Untr	—	—	0.65 A	99.0 B	2840 B	386.3 B
65 – Fung	—	—	0.52 B	99.4 A	2935 B	389.8 B
S.E.M.	—	—	0.047	0.12	41.4	1.85
Pr > F (p-value)	–	–	0.431	0.743	0.389	0.170

[z] Days to maturity was not reported at YK-22

Table 7. Individual seeding date by seeding rate by fungicide treatments for selected faba bean response variables. The values presented are the overall 16 site averages and, importantly, the individual site results often varied. Main effect means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Individual Treatment	Final Disease	Days to Maturity [z]	Seed Yield	Seed Weight
D × R × F	----- 0-9 -----	---- days ----	--- kg/ha ---	g/1000 seeds
Early – 45 – Untr	0.48 C	101.4 A	2979 B	397.4 AB
Early – 45 – Fung	0.47 C	101.5 A	3063 B	397.8 A
Early – 65 – Untr	0.58 ABC	100.9 B	3032 B	388.3 CDE
Early – 65 – Fung	0.55 ABC	101.2 AB	3164 A	394.3 AB
Delay – 45 – Untr	0.67 AB	97.2 DE	2554 E	392.3 ABC
Delay – 45 – Fung	0.54 BC	97.7 C	2578 DE	390.9 BCD
Delay – 65 – Untr	0.71 A	97.1 E	2648 CD	384.3 E
Delay – 65 – Fung	0.48 C	97.6 CD	2706 C	385.3 DE
S.E.M.	0.066	0.16	56.5	2.51
Pr > F (p-value)	0.610	0.838	0.879	0.579

[z] Days to maturity was not reported at YK-22

Faba Bean Establishment

Again, only site, seeding date and seeding rate were considered when we looked at faba bean establishment and, as previously discussed, seedling mortality was quite low overall. When averaged across all sites, seeding rate, and fungicide treatments, we saw slightly better establishment with delayed (53.4 plants/m^2) versus early (50.8 plants/m^2) seeding (Table 5). This could be reasonably attributed to warmer soils and better seeding conditions as the fields had time to dry out; however, the effect was small and, based on the S × D interaction ($P < 0.001$), inconsistent. Inspection of individual site means (Table 12) revealed that the seeding date effect was only significant at five individual sites, four of which favoured delayed seeding (IH-22, IH-23, YK-21, and YK-23) and one of which favoured early seeding (YK-22). For 11/16 sites (69%), seeding date did not significantly affect establishment regardless of whether the data was analyzed for each site individually or combined across sites. As such, growers are not necessarily advised to adjust their seeding rates based on seeding date; however, they should pay attention to the specific soil conditions and drill settings at the time of seeding. The S × D treatments where we did see higher mortality appeared to be heavier soils under relatively wet conditions, likely resulting in poorer overall seed bed conditions. While beyond the scope of this project, seeding into cold wet soils may increase the potential benefits of seed treatments. Notably, faba beans can be seeded quite deep so it is important to try to place to the seed into good moisture; however, seeding too deep in wet clay soils can result in poorer seed placement and furrow closure and subsequently delayed emergence or higher seedling mortality.

Seeding rate effects on faba bean establishment were always as expected with higher populations achieved at the heavier seeding rate. The actual values were 45 plants/m^2 and 60 plants/m^2 at the 45 and 65 seeds/m^2 seeding rates, respectively, when averaged across all 16 sites (Table 5). These numbers suggest that seedling mortality increased slightly at the higher seeding rates. An S × R interaction for plant density ($P < 0.001$) was likely due to cases where seedling mortality was much worse at the higher seeding rate, most notably OL-23 and SW-23. At these sites, there was only a 6 plants/m^2 difference in plant populations despite a 20 plants/m^2 difference in seeding rate while, for the remaining sites, the spread was in the range of 10-20 plants/m^2 (Table 12).

While there was no D x R interaction ($P = 0.517$) for plant density according to the combined analyses, the S × D × R interaction was significant ($P = 0.005$). Although such interactions can be challenging to decipher and explain, the individual site analyses showed at least marginally significant interactions at three sites, IH-23, PA-22, and SW-22, with SW-22 being most prominent. For example, at SW-22 we saw much higher seedling mortality at the lower seeding rate compared to the higher seeding rate while the opposite occurred with delayed seeding. This response is difficult to explain and may have largely been due to random variability.

Faba Bean Disease Severity

Like plant density, the initial disease ratings were completed prior to any fungicide applications; therefore, fungicide treatment was not included in the statistical model. At this time, there were differences between sites ($P < 0.001$) and seeding date ($P < 0.001$); however, the seeding date effects varied with site ($P < 0.001$; Table 3). Although initial disease severity was low in all cases, we saw higher ratings with early seeding at 9/16 sites, higher ratings with delayed seeding at 2/16 sites, and no difference between dates at 5/16 sites (Table 14). These differences were generally too small to be of much practical importance. Neither seeding rate nor any interactions associated with it were significant for the initial disease ratings ($P = 0.186$-0.865).

Although the values for the final disease ratings were, again, all quite low in practical terms, we detected significant site and S × D effects ($P < 0.001$) but no overall date effect ($P = 0.238$). We also

detected overall fungicide (P =0.009), D × F (P = 0.026), and S × D × F (P = 0.040) interactions for the final disease ratings. The S × D interaction was such that the vast majority (14/16) of sites saw no differences in final disease levels between seeding dates, but IH-21 reported higher severity with early seeding while PA-23 observed the opposite, higher disease severity with delayed seeding (Table 16). Averaged across sites, the mean ratings were similarly low (0.5-0.6/9) for both seeding dates (Table 5). The overall fungicide effect, while significant, was small with just slightly lower ratings with a fungicide and the overall D × F interaction suggested that the difference was only evident with delayed seeding, when averaged across sites. Again, these responses should not be given too much weight since the disease pressure was extremely low in all cases and the S × D × F interaction indicates that the responses varied with environment (Table 18). The D x F interactions for individual sites were too subtle to be identified using the Tukey's means separations, but were likely due to many sites showing no treatment effects whatsoever, some showing a trend for a benefit to fungicide at one date but not the other (i.e., ME-22), and some showing a trend for opposite fungicide effects depending on the date (i.e., PA-23). Again, disease levels were low in all cases with site and, to a lesser extent, seeding date generally being more important than fungicide treatments.

Faba Bean Maturity

Overall tests of fixed effects and differences between means for maturity should be interpreted cautiously as some sites did not report any variation whatsoever between treatments within a seeding date. The data were still analyzed to help guide the discussion and identify the most important factors; however, some specific results may be misleading. While the overall main effects of site, seeding date, and fungicide on maturity were significant (P < 0.001-0.015), interactions with site were detected for all three factors P < 0.001-0.025), indicating that the effects of these treatments all varied with environment. When averaged across sites, only the seeding date effect was large enough to be of much importance. Early seeded faba beans took an extra four days, from seeding, to reach maturity. That said, there was a 14-27 day spread in the seeding dates for individual sites; therefore, the early seeded crop always reached physiological maturity well before the late seeded crop in terms of the actual calendar date. Focussing on the S × D interactions (Table 21), we see that the slower crop development with early seeding was observed at 11/16 sites while there was no effect at one site (IH-23) and the opposite effect (slower development with delayed seeding) at 3/16 sites (ME-23, PA-23, and YK-21). At IH-23, ME-23, and PA-23, where the unusual seeding date responses occurred, it was attributed to extreme heat in May and June followed by cooler temperatures and, perhaps, a slight improvement in moisture conditions during the latter half of the season. A similar weather pattern occurred at YK-21; however, it was likely driven more by moisture than temperature in this case. Seeding rate effects on maturity were much less frequent and, when they did occur, smaller than seeding date effects. In one case (ME-21), maturity was slightly delayed at the higher seeding rate, but this effect was unexpected and difficult to explain. In any case, our results indicate that higher seeding rates would not be a cost-effective way to hasten maturity to any meaningful degree. Past research has shown the maturity can be delayed at very sparse faba bean populations; however, the ranges evaluated in this project did not have much impact. Similarly, while fungicides have potential to delay maturity in crops, any effects on maturity in this project were also infrequent, occurring at only 25% of the sites. The actual maturity dates with and without fungicide were always within 1.5 days when differences did occur. Here too, the results at ME-21 were the opposite of what was expected with a slight hastening of maturity observed with fungicide. In many cases, even when the difference was not significant, there was a tendency for slightly later maturity with fungicide; however, the effect was never large enough to be of any agronomic concern.

Faba Bean Seed Yield

In addition to the previously discussed differences between sites, faba bean seed yields were affected by seeding date, seeding rate, and fungicide ($P < 0.001$-0.002) with significant S × D and S × R interactions also detected ($P < 0.001$). The overall, 16 site average seeding date effect was as expected, with early seeded faba beans yielding 17% higher than with delayed seeding, or 3060 kg/ha versus 2621 kg/ha (Table 5). The combined analyses (Table 26) revealed this seeding date effect to be significant at 44% of the sites (7/16) while the individual site analyses picked up an effect at 56% (9/16) of the sites (Table 10). The only site where higher yields were achieved with delayed seeding was YK-23; however, data from this site were extremely variable and, despite being quite large, this effect was not significant ($P = 0.191$) when data from YK-23 was analyzed on its own. The seeding rate effect on yield was smaller and less consistent with, averaged across all 16 sites and seeding date / fungicide treatments, a mean yield of 2793 kg/ha at 45 seeds/m^2 and 2887 kg/ha at 65 seeds/m^2. The S × R effect revealed that positive responses to higher seeding rates only occurred 19% of the time (3/16 sites). The responsive sites were OL-22, OL-23, and PA-22 along with a marginally significant ($P = 0.057$) seeding rate effect detected at ME-22. The statistical significance of these responses was consistent for both the combined and individual site analyses and, while there were never any yield losses associated with higher seeding rates, most sites saw no difference between these two treatments. The overall fungicide effect, although significant, was also small with only a 75 kg/ha gain when averaged across all 16 sites. Depending on the cost of the fungicide product, application cost, and price of faba beans, the overall average response was unlikely to be sufficient to cover the cost of this input. Although the S × F interaction was not significant ($P = 0.207$), inspection of the individual site means and tests of fixed effects (Table 26) revealed that the response was strongest at ME-22, YK-21, and YK-22 ($P = 0.008$-0.014). The lack of an S × F interaction was attributed to the fact that most sites showed a numerical yield advantage to fungicide, even when it was not statistically significant or likely to be large enough to cover the cost of application. The individual site analyses (Table 10) also showed a fungicide benefit at SW-21 ($P = 0.013$) and a D × F interaction at ME-22 ($P = 0.041$) whereby the fungicide response was only observed with delayed seeding (Table 28). The lack of any R × F interactions, regardless of how the data was analysed or interpreted, suggested that higher seeding rates did not have a measurable effect on disease pressure or the potential benefits of a fungicide.

Faba Bean Seed Weight

In addition to site ($P < 0.001$), thousand seed weights were affected by seeding date ($P = 0.009$) and seeding rate ($P < 0.001$) with significant S × D, S × R, and S × D × R interactions ($P < 0.001$-0.0290. Across all 16 sites, seed weights were slightly higher with early (395 g/1000 seeds) versus delayed (388 g /1000 seeds) and at the 45 seeds/m^2 (395 g/1000 seeds) versus 65 seeds/m^2 (388 g/1000 seeds) seeding rates. The S × D interaction revealed that seeding date effects on seed weight occurred at 69% (11/16) but were not consistent in that the advantage went to early seeding at five sites and to delayed seeding at six sites (Table 31). The sites were nearly evenly split between larger seeds with early seeding, larger seeds with delayed seeding, and no effect of seeding date whatsoever. Seeding rate effects on seed weight were also inconsistent across sites and generally less important than seeding date. At 3/16 sites, significantly larger seeds were observed at the low seeding rate while the opposite occurred at 2/16 sites and there was no effect at 11/16 (69%) of the sites. The S × D × R interaction was attributed to D × R interactions at IH-21, IH-22, and, to a lesser extent, PA-22 where the seeding rate effects on seed weight differed, depending on the seeding date. Although the overall fungicide effect on seed weight was not significant ($P = 0.293$), we did detect an S × F interaction ($P = 0.010$). This interaction was due to positive responses to fungicide

occurring at two sites (ME-22 and ME-23), a negative response at one (YK-21), and no effect at 81% (13/16) of the sites. Even though the nature of the responses differed, 2/3 of the sites that observed a fungicide effect on seed weight also observed some of the strongest yield increases with fungicide. As previously noted, seed weight is a key yield component; however, the lack of a consistent correlation with yield indicates that pods per plant and/or seeds per pod are likely more important determinants of faba bean yield.

7. **Economic & Practical Implications for Growers:**

Although results have been variable and environmental conditions have not always been ideal for faba bean production or conducive to disease, this project has allowed us to identify several broad and practical implications for producers. Due to the potentially high variation in grain prices, seed costs, and fungicide costs, a detailed economic analysis was beyond the scope of this project.

Seeding faba beans as early as possible was, for most cases, advantageous in several ways. Despite developing more slowly and taking longer (from seeding) to reach maturity, early seeded faba beans were always ready to desiccate and harvest earlier than with delayed seeding. There were cases where establishment was better overall with delayed seeding, but faba beans are relatively tolerant to cool spring conditions and any establishment benefits that were observed were either small or did not translate to a yield advantage. In addition to being ready to harvest earlier, seeding faba beans as early in spring as possible led to similar or higher yields than with delayed seeding 94% of the time. Averaged over 16 sites, there was a 17% yield advantage to early seeding, and, in some cases, the benefit was considerably larger. The sole instance where delayed seeding was advantageous was attributed to unusual environmental conditions (extremely hot dry spring followed by cooler summer conditions) that would have been difficult to predict. Early seeding can be even more critical in the more northern locations, as crops generally develop more slowly in these environments and the growing seasons / frost free periods are generally shorter; however, it was also important at the more southern locations which can be prone to heat and drought stress later in the season. While the faba beans consistently reached maturity with delayed seeding in this project, temperatures were generally warmer than average, and we aimed to keep the delayed seeding date in the third or fourth weeks of May as opposed to into June where we would expect more dramatic yield losses and by which time most growers would likely have changed their cropping decisions.

Due to the large seed size, high faba bean seeding rates can be both expensive and logistically challenging. Drills can be prone to plugging when seeding this crop, especially at high rates, and there are also implications for productivity with respect to travel speed and how many acres can be seeded between drill fills. In the current project, the overall average yield benefit that was observed with the higher seeding rate was likely insufficient to cover the higher seeding costs that would be incurred. Significant benefits were observed less than 20% of the time but, notably, were generally most prominent under the relatively high yielding conditions at Outlook (irrigated) and Prince Albert (2022). Higher seeding rates did not have any meaningful impact on days to maturity, which was one of the specific production issues identified which we had hoped to potentially address with this treatment. Overall, target seeding rates of 45 seeds/m^2 are likely to be sufficient and most economical under most circumstances if growers pay attention to seed quality and placement to keep seedling mortality as low as possible.

While benefits to foliar fungicide applications were observed, they were small in most cases and, if applied preventatively across the broad, relatively low yielding environments encountered during this project, would not have been likely to increase profits. That said, overall disease pressure was

consistently low in this project and results may have differed under environmental conditions that were more favourable for disease. Chocolate spot (*Botrytis spp*) was the most frequently identified disease when plant samples were submitted to the Saskatchewan Crop Protection Laboratory; therefore, it is recommended to use products that are known to be effective for this specific disease. Unfortunately, Dyax® is not specifically registered for *Botrytis* and this may have affected our results to a certain extent. At the time when this project was conceived, registered options for controlling *Botrytis* were limited and our first product choice, Priaxor®, was discontinued and not available to all collaborators. Dyax® and Priaxor® have the same active ingredients and the latter is registered for suppression of *Botrytis*; therefore, we expected that Dyax® may also have some activity against this disease. Growers should refer to the SPG website for a full list of fungicide options for faba beans, in addition to the specific diseases for which they are registered to control (https://saskpulse.com/resources/faba-bean-fungicide-options/). Additionally, frequent scouting for disease and monitoring environmental conditions will help farmers make better informed decisions and, hopefully, improve the potential for increased economic returns to be realized with fungicide applications on this crop. In general, the risk of *Botrytis* infection, or chocolate spot, is higher under cool, wet conditions and this disease often sets in relatively late in the season. This, along with the fact that faba beans generally have a reasonably open canopy and are not prone to lodging affords a reasonable amount of flexibility in application timing and the optimum timing will likely vary, depending on when the disease becomes established.

8. **Conclusions & Recommendations** (how do results relate to original objectives or research that the project is based on? Is there a need to refine current recommendations based on the results from this project?):

   Overall, our results are largely in agreement with past research and supportive of current recommendations. Faba beans should be seeded as early as possible and target seeding rates of approximately 45 seeds/m^2 are likely to be sufficient in most cases if seedling mortality is not excessive. Higher seeding rates may potentially be justified under high yielding conditions such as with irrigation or in cooler environments when moisture or other factors are non-limiting. Higher seeding rates can also help with weed competition; however, there is likely little to gain in this regard by going beyond 40-50 plants/m^2 if establishment is uniform, and herbicides are used appropriately and applied in a timely manner. As opposed to waiting for the soil to warm up, utilizing high quality seed, potentially using a seed treatment, and paying attention to seeding depth and placement will be the best ways to minimize seedling mortality. Faba beans can be seeded relatively deep and require substantial moisture to germinate so should not be seeded too shallow; however, seeding too deep into wet, heavy clay soils can have the unwanted effects of delaying emergence and increasing mortality. Seeding in the third week of May can still produce a viable crop; however, yield losses are possible and will become increasingly likely and severe as seeding is delayed into late May or June. Anecdotally, at Indian Head we also observed noticeably more lygus bug damage on the harvested seed with delayed seeding; however, this was not specifically measured, and no other sites reported similar observations. Regarding disease management, our results would not necessarily support the widespread, preventative application of a foliar fungicide. In most cases, the yield increases realized with a fungicide were likely too small to cover the combined costs of the product and its application. Any impacts of fungicide applications on disease symptoms were also low. This is not, by any means, to say that fungicides will never be required or advantageous. The project was conducted during a period of relatively low disease pressure, and it is unclear whether the product we used at most sites had much activity on the dominant disease, Chocolate spot (*Botrytis*). In this regard, we recommend basing decisions regarding whether or

when to apply a fungicide in faba beans on the actual disease pressure encountered and choosing products that are specifically registered for *Botrytis* to maximize the likelihood of the applications being warranted and profitable.

9. **Future Research** (did the project identify a need for future research?):

   It continues to be quite clear that early seeding is preferred for this crop and this project will provide good information on the frequency at which yield losses might be expected when seeding is delayed until the latter part of May. 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 previous interim reports, 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.

10. **Technology Transfer Activities** (detail any presentations delivered, extension material developed, field days, and articles published):

    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 discussed during indoor presentations by Chris Holzapfel and Sara Anderson, with approximately 120 participants. The site was also visited by numerous farmers and industry representatives during informal site tours at Indian Head 2022 and again in 2023; however, could not be shown during the 2023 Indian Head Crop Management Field Day, again for logistic reasons. 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). The trial was also signed and acknowledged during the 2023 Melfort field day on July 26, attended by 70 people. The project results for the Melfort site were also shared at the NE Ag Update in Melfort on March 14th, 2024 to approximately 100 people. 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). Zoe Galbraith also presented results to 50 participants at the Crop Talk extension meeting heled at Prince Albert on March 13, 2024. At Swift Current in both 2021 and 2022, 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. While it was not a formal stop during the 2023 field day at Swift Current, it was signed and available for viewing for part of the season. 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, and, with a discussion provided by Meagan Reed (SPG), also during the 2023 ECRF Field Day on July 20 (80 attendees). All interim technical reports have been available for viewing on the IHARF website (www.iharf.ca) and the current, final report will be made available in the coming months. Results will continue to be incorporated into presentations and farm media articles as appropriate opportunities arise and may also be utilized by SPG staff in the future for their own extension materials.

11. **Funding Contributions** (acknowledge any 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.

12. **Appendices** (include any additional, detailed data tables, maps, photos, etc):

Table 8. 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), 2022 (22), and 2023 (23).

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	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)
IH-23	Wheat	Snowbird	10-45-0-0	May 5 May-29	Jun-5 Jun-14	Jun-20 (42) Jul-10 (46)	Jun-29 Jul-20	Dyax®	Jul-26 Aug-11	Aug-21 Sep-19
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)
ME-23	Wheat	Snowbird	27-56-0-17	May-9 May-30	Jun-6 Jun-21	Jun-23 (45) Jul-17 (48)	Jun-28 Jul-28	Dyax®	Jul-13 Aug-14	Sep-11 Oct-10
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
OL-23	Wheat	Snowbird	5-25-0-0	May-1 May-16	Jun-12 Jun-14	Jun-14 Jun-27	Jun-22 Jul-5	Priaxor®	Jul-10 Jul-24	Sep-6 (all)
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)
PA-23	Oat	Snowbird	12-55-0-0	May-10 May-31	Jun-19 (all)	Jun-23 (44) Jul-10 (40)	Jun-30 Jul-19	Dyax®	Jul-14 Aug-2	Sep-8 Sp-28
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
SW-23	Wheat	CDC Snowdrop	12-56-0-0	May-4 May-23	Jun-6 Jun-12	Jun-20 (47) Jun-30 (38)	Jun-27 Jul-10	Dyax®	Jul-10 Jul-26	Aug-15 Aug-31
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)
YK-23	Wheat	Snowbird	7-34-0-0	May-11 May-25	May-29 Jun-8	Jun-27 (47) Jul-5 (41)	Jul-7 Jul-11	Dyax®	Jul-25 Aug-2	Sep-12 Sep-22

Table 9. Overall tests of fixed effects and relative variability from the individual site analyses for faba bean plant populations (plants/m^2) in seeding date (D) by seeding rate (R) by fungicide (F) trials conducted at 16 sites. Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). The values in parentheses are the standard error values for each effect, expressed as a percentage of the overall mean.

Site	Date (D)	Rate (R)	D × R
IH-21	0.602 (2.5)	<0.001 (2.5)	0.807 (3.5)
IH-22	0.026 (3.0)	<0.001 (2.7)	0.785 (3.8)
IH-23	0.004 (2.2)	<0.001 (2.2)	0.082 (3.2)
ME-21	0.098 (3.4)	<0.001 (3.4)	0.211 (4.8)
ME-22	0.218 (1.7)	<0.001 (1.7)	0.928 (4.1)
ME-23	0.472 (5.9)	0.004 (5.5)	0.232 (7.8)
OL-22	0.467 (3.9)	<0.001 (3.9)	0.516 (5.5)
OL-23	0.973 (9.3)	0.035 (7.7)	0.580 (10.2)
PA-22	0.433 (3.1)	<0.001 (3.1)	0.064 (4.4)
PA-23	0.973 (6.1)	<0.001 (5.9)	0.906 (7.2)
SW-21	0.210 (3.7)	<0.001 (3.5)	0.317 (4.9)
SW-22	0.910 (3.7)	<0.001 (3.7)	0.001 (5.2)
SW-23	0.274 (4.3)	0.029 (4.3)	0.237 (6.1)
YK-21	0.013 (3.3)	<0.001 (3.3)	0.068 (4.0)
YK-22	0.033 (3.3)	<0.001 (3.0)	0.224 (4.2)
YK-23	0.028 (4.0)	<0.001 (4.0)	0.139 (5.3)

Table 10. Overall tests of fixed effects and relative variability from the individual site analyses for faba bean seed yields (kg/ha) in seeding date (D) by seeding rate (R) by fungicide (F) trials conducted at 16 sites. Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). The values in parentheses are the standard error values for each effect, expressed as a percentage of the overall mean.

Site	D	R	F	D × R	D × F	R × F	D × R × F
IH-21	0.536 (4.8)	0.295 (3.9)	0.110 (3.9)	0.237 (5.0)	0.458 (5.0)	0.565 4.2)	0.777 (5.4)
IH-22	0.402 (3.9)	0.018 (2.9)	0.383 (2.9)	0.957 4.0)	0.070 (4.0)	0.171 (3.1)	0.416 (4.2)
IH-23	0.032 (4.2)	0.792 (3.8)	0.545 (3.8)	0.879 (4.3)	0.525 (4.3)	0.873 (3.9)	0.966 (4.6)
ME-21	0.867 (3.0)	0.660 (3.0)	0.516 (3.0)	0.468 (4.3)	0.549 (4.3)	0.802 (4.3)	0.978 (6.1)
ME-22	<0.001 (1.9)	0.749 (1.9)	0.025 (1.9)	0.191 (2.5)	0.041 (2.5)	0.674 (2.5)	0.338 (3.5)
ME-23	0.312 (3.9)	0.200 (3.9)	0.459 (3.9)	0.298 (4.6)	0.844 (4.6)	0.512 (4.6)	0.920 (5.7)
OL-22	0.026 (3.6)	0.023 (3.3)	0.633 (3.3)	0.283 (3.9)	0.182 (3.9)	0.162 (3.7)	0.804 (4.5)
OL-23	0.006 (2.7)	0.188 (2.7)	0.428 (2.7)	0.340 (3.2)	0.674 (3.2)	0.120 (3.2)	0.247 (4.1)
PA-22	0.051 (6.2)	<0.001 (5.5)	0.185 (5.5)	0.871 (6.3)	0.653 (6.3)	0.256 (5.6)	0.378 (6.5)
PA-23	0.004 (13.5)	0.157 (12.9)	0.158 (12.9)	0.353 (14.0)	0.306 (14.0)	0.478 (13.5)	0.921 (15.0)
SW-21	<0.001 (4.3)	0.382 (3.8)	0.013 (3.8)	0.722 (5.4)	0.317 (5.4)	0.277 (4.9)	0.389 (7.0)
SW-22	0.013 (5.9)	0.959 (5.6)	0.624 (5.6)	0.964 (6.3)	0.692 (6.3)	0.101 (6.0)	0.566 (6.9)
SW-23	0.003 (4.3)	0.475 (3.9)	0.274 (3.9)	0.884 (5.5)	0.267 (5.5)	0.884 (5.2)	0.267 (7.3)
YK-21	0.847 (6.5)	0.778 (5.7)	0.005 (5.7)	0.907 (8.0)	0.360 (8.0)	0.342 (7.4)	0.466 (10.4)
YK-22	0.723 (10.7)	0.485 (7.8)	0.021 (7.8)	0.980 (11.1)	0.784 (11.1)	0.265 (8.3)	0.980 (11.8)
YK-23	0.137 (11.5)	0.699 (8.4)	0.707 (8.4)	0.912 (11.9)	0.380 (11.9)	0.634 (8.9)	0.191 (12.6)

Table 11. Overall tests of fixed effects and relative variability from the individual site analyses for faba bean seed weights (g/1000 seeds) in seeding date (D) by seeding rate (R) by fungicide (F) trials conducted at 16 sites. Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). The values in parentheses are the standard error values for each effect, expressed as a percentage of the overall mean.

Site	D	R	F	D × R	D × F	R × F	D × R × F
IH-21	0.003 (0.7)	<0.001 (0.7)	0.575 (0.7)	<0.001 (0.9)	0.075 (0.9)	0.004 (0.9)	0.673 (1.3)
IH-22	0.109 (1.2)	<0.001 (0.9)	0.661 (0.9)	0.020 (1.3)	<0.001 (1.3)	0.536 (1.1)	0.043 (1.6)
IH-23	0.876 (1.1)	0.109 (1.1)	0.283 (1.1)	0.271 (1.3)	0.180 (1.3)	0.475 (1.2)	0.292 (1.5)
ME-21	0.004 (1.2)	0.945 (1.2)	0.550 (1.2)	0.103 (1.5)	0.794 (1.5)	0.964 (1.5)	0.544 (2.0)
ME-22	<0.001 (0.9)	0.136 (0.9)	0.002 (0.9)	0.205 (1.2)	0.400 (1.2)	0.301 (1.2)	0.698 (1.6)
ME-23	0.002 (1.1)	0.068 (0.9)	<0.001 (0.9)	0.367 (1.2)	0.094 (1.2)	0.430 (1.0)	0.623 (1.4)
OL-22	<0.001 (1.2)	0.081 (1.2)	0.985 (1.2)	0.883 (1.7)	0.479 (1.7)	0.746 (1.7)	0.633 (2.4)
OL-23	0.218 (1.6)	0.514 (1.6)	0.676 (1.6)	0.567 (2.2)	0.542 (2.2)	0.099 (2.2)	0.966 (3.1)
PA-22	0.001 (1.1)	0.429 (0.9)	0.089 (0.9)	0.014 (1.3)	0.868 (1.3)	0.756 (1.1)	0.161 (1.6)
PA-23	0.019 (2.6)	0.965 (2.2)	0.511 (2.2)	0.117 (2.7)	0.048 (2.7)	0.516 (2.3)	0.920 (2.9)
SW-21	0.076 (1.0)	0.064 (1.0)	0.217 (1.0)	0.384 (1.4)	0.945 (1.4)	0.661 (1.4)	0.221 (2.0)
SW-22	<0.001 (1.7)	0.317 (1.7)	0.611 (1.7)	0.612 (2.4)	0.222 (2.4)	0.282 (2.4)	0.141 (3.4)
SW-23	0.161 (2.3)	0.046 (2.2)	0.458 (2.2)	0.806 (2.7)	0.822 (2.7)	0.685 (2.6)	0.077 (3.3)
YK-21	0.206 (2.6)	0.379 (2.1)	0.017 (2.1)	0.640 (2.8)	0.639 (2.8)	0.642 (2.3)	0.465 (3.2)
YK-22	0.399 (1.0)	0.053 (1.0)	0.352 (1.0)	0.231 (1.5)	0.781 (1.5)	0.354 (1.5)	0.292 (2.1)
YK-23	0.025 (4.0)	0.007 (3.1)	0.324 (3.1)	0.515 (4.2)	0.202 (4.2)	0.836 3.2)	0.606 (4.4)

Table 12. Individual site main effect (seeding date and seeding rate) means for faba bean emergence. Data were combined across sites prior to analyses and both the S × D and S × R interactions were significant (*P* < 0.001). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Main effect means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	Emergence (plants/m²)															
Early	52.8 a	58.5 b	56.3 b	38.8 a	54.8 a	49.5 a	52.5 a	37.3 a	59.0 a	58.8 a	46.8 a	46.8 a	41.1 a	50.3 b	66.0 a	44.1 b
Delay	51.7 a	69.7 a	73.3 a	43.5 a	51.6 a	53.0 a	54.9 a	39.9 a	61.4 a	58.7 a	43.0 a	46.5 a	37.9 a	59.8 a	55.5 b	53.7 a
S.E.M.	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93
Pr > F	0.687	<0.001	<0.001	0.080	0.235	0.192	0.360	0.320	0.372	0.961	0.164	0.910	0.231	<0.001	<0.001	<0.001
Rate																
45/m²	42.0 b	54.1 b	56.7 b	36.1 b	43.9 b	45.2 b	45.9 b	35.7 b	52.3 b	49.5 b	36.8 b	37.6 b	36.7 b	46.1 b	53.8 b	42.1 b
65/m²	62.4 a	74.1 a	72.9 a	46.1 a	62.4 a	57.3 a	61.5 a	41.5 a	68.1 a	68.0 a	53.0 a	55.8 a	42.3 a	64.1 a	67.7 a	55.7 a
S.E.M.	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
Pr > F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.019	<0.001	<0.001	<0.001	<0.001	0.026	<0.001	<0.001	<0.001

Table 13. Individual site seeding date (D) by seeding rate (R) means for faba bean emergence. Data were combined across sites prior to analyses and the S × D × R interaction was significant (*P* = 0.005). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	Emergence (plants/m²)															
E-45	42.4 b	48.8 c	50.0 c	35.1 b	45.6 b	41.1 b	43.8 b	36.2 ab	48.5 b	49.7 b	39.7 b	33.3 b	36.8 a	43.1 c	57.7 bc	39.2 c
E-65	63.2 a	68.3 b	62.5 b	42.5 ab	63.9 a	57.8 a	61.3 a	38.4 ab	69.5 a	67.9 a	53.8 a	60.4 a	45.3 a	57.6 b	74.3 a	49.0 b
D-45	41.7 b	59.4 b	63.3 b	37.2 b	42.3 b	49.2 ab	48.1 b	35.2 b	56.0 b	49.2 b	33.8 b	41.9 b	36.5 a	49.1 bc	49.9 c	45.1 bc
D-65	61.6 a	80.0 a	83.2 a	49.7 a	60.9 a	56.7 a	61.8 a	44.7 a	66.8 a	68.2 a	52.2 a	51.2 a	39.2 a	70.5 a	61.0 b	62.3 a
S.E.M.	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62
Pr > F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.036	<0.001	<0.001	<0.001	<0.001	0.051	<0.001	<0.001	<0.001

Table 14. Individual site main effect (seeding date and seeding rate) means for initial faba bean disease ratings. Data were combined across sites prior to analyses. The S × D interaction was significant (*P* < 0.001) but the S × R interaction was not (*P* = 0.228). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Main effect means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	---------- Initial Disease (0-9) ----------															
Early	1.8 a	0.5 a	0.8 a	0.7 a	0.5 a	0.3 b	0.7 a	0.0 a	0.9 a	0.0 b	0.1 a	0.7 a	0.0 a	0.4 a	2.0 a	0.3 a
Delay	0.5 b	0.8 a	0.1 b	0.0 b	0.3 b	0.6 a	0.3 b	0.0 a	0.2 b	0.3 a	0.0 a	0.3 b	0.0 a	0.0 b	1.0 b	0.1 a
S.E.M.	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Pr > F	<0.001	0.054	<0.001	<0.001	0.015	0.009	0.005	1.000	<0.001	0.015	0.514	0.003	1.000	0.003	<0.001	0.132
Rate																
45/m²	1.2 a	0.6 a	0.5 a	0.3 a	0.4 a	0.5 a	0.5 a	0.0 a	0.5 b	0.2 a	0.0 a	0.5 a	0.0 a	0.2 a	1.4 a	0.2 a
65/m²	1.1 a	0.7 a	0.5 a	0.4 a	0.4 a	0.3 a	0.4 a	0.0 a	0.6 a	0.1 a	0.1 a	0.6 a	0.0 a	0.2 a	1.6 a	0.2 a
S.E.M.	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Pr > F	0.173	0.733	0.306	0.609	0.609	0.061	0.233	1.000	0.041	0.233	0.733	0.394	1.000	0.233	0.125	0.733

Table 15. Individual site seeding date (D) by seeding rate (R) means for initial faba bean disease ratings. Data were combined across sites prior to analyses and the S × D × R interaction was not significant (*P* = 0.186). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	---------- Initial Disease (0-9) ----------															
E-45	1.9 a	0.5 a	0.8 a	0.7 a	0.5 ab	0.3 b	0.7 a	0.0 a	0.9 a	0.0 b	0.1 a	0.6 ab	0.0 a	0.5 a	1.9 a	0.3 a
E-65	1.7 a	0.6 a	0.9 a	0.7 a	0.6 a	0.2 b	0.6 a	0.0 a	0.9 a	0.1 b	0.1 a	0.8 a	0.0 a	0.3 ab	2.1 a	0.3 a
D-45	0.5 b	0.8 a	0.1 b	0.0 b	0.3 ab	0.7 a	0.4 ab	0.0 a	0.1 b	0.4 a	0.0 a	0.4 b	0.0 a	0.0 b	1.0 b	0.1 a
D-65	0.6 b	0.7 a	0.2 b	0.1 b	0.2 b	0.5 ab	0.3 b	0.0 a	0.4 b	0.2 ab	0.0 a	0.3 b	0.0 a	0.0 b	1.0 b	0.1 a
S.E.M.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Pr > F	<0.001	0.120	<0.001	<0.001	0.047	0.011	0.016	1.000	<0.001	0.011	0.881	0.007	1.000	0.004	<0.001	0.403

Table 16. Individual site main effect (seeding date, seeding rate, and foliar fungicide) means for final faba bean disease ratings. Data were combined across sites prior to analyses. The S × D interaction was significant (*P* < 0.001) but the S × R and S × F interactions were not (*P* = 0.399-0.868). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Main effect means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	Final Disease (0-9)															
Early	2.2 a	1.2 a	0.7 a	0.1 a	0.9 a	0.2 a	0.8 a	0.2 a	0.2 a	0.4 b	0.0 a	1.2 a	0.0 a	0.2 a	0.1 a	0.0 a
Delay	0.9 b	1.0 a	0.7 a	0.1 a	1.0 a	0.2 a	0.7 a	0.2 a	0.2 a	3.5 a	0.0 a	1.2 a	0.0 a	0.0 a	0.0 a	0.0 a
S.E.M.	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Pr > F	<0.001	0.508	0.801	1.000	0.784	0.964	0.648	0.855	0.964	<0.001	1.000	0.891	1.000	0.438	0.648	1.000
Rate																
45/m²	1.4 a	1.0 a	0.7 a	0.1 a	0.9 a	0.2 a	0.7 a	0.2 a	0.2 a	1.9 a	0.0 a	1.3 a	0.0 a	0.2 a	0.0 a	0.0 a
65/m²	1.7 a	1.2 a	0.7 a	0.1 a	0.9 a	0.2 a	0.7 a	0.2 a	0.3 a	1.9 a	0.0 a	1.1 a	0.0 a	0.1 a	0.1 a	0.1 a
S.E.M.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Pr > F	0.028	0.082	0.702	1.000	0.734	0.932	1.000	0.865	0.671	0.799	1.000	0.269	1.000	0.799	0.395	0.865
Fung																
Untr	1.6 a	1.3 a	0.7 a	0.1 a	1.1 a	0.2 a	0.9 a	0.3 a	0.3 a	2.0 a	0.0 a	1.2 a	0.0 a	0.2 a	0.0 a	0.0 a
Fung	1.6 a	0.9 b	0.7 a	0.0 a	0.8 a	0.2 a	0.5 b	0.1 a	0.2 a	1.8 a	0.0 a	1.2 a	0.0 a	0.1 a	0.1 a	0.0 a
S.E.M.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Pr > F	0.865	0.016	0.966	0.734	0.062	0.932	0.007	0.174	0.671	0.107	1.000	0.552	1.000	0.799	0.395	1.000

Table 17. Individual site seeding date (D) by seeding rate (R) means for final faba bean disease ratings. Data were combined across sites prior to analyses and the S × D × R interaction was not significant (*P* = 0.577). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	Final Disease (0-9)															
E-45	1.8 b	0.9 a	0.6 a	0.0 a	0.8 a	0.2 a	0.9 a	0.2 a	0.2 a	0.3 b	0.0 a	1.3 a	0.0 a	0.3 a	0.0 a	0.1 a
E-65	2.6 a	1.4 a	0.7 a	0.1 a	0.9 a	0.2 a	0.8 a	0.2 a	0.3 a	0.4 b	0.0 a	1.1 a	0.0 a	0.2 a	0.3 a	0.0 a
D-45	1.0 c	1.0 a	0.7 a	0.1 a	1.0 a	0.2 a	0.6 a	0.2 a	0.2 a	3.5 a	0.0 a	1.3 a	0.0 a	0.1 a	0.0 a	0.0 a
D-65	0.9 c	1.0 a	0.8 a	0.0 a	1.0 a	0.2 a	0.7 a	0.2 a	0.3 a	3.4 a	0.0 a	1.2 a	0.0 a	0.0 a	0.0 a	0.1 a
S.E.M.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Pr > F	<0.001	0.129	0.968	0.990	0.958	0.999	0.879	0.996	0.979	<0.001	1.000	0.660	1.000	0.877	0.646	0.986

Table 18. Individual site seeding date (D) by fungicide (F) means for final faba bean disease ratings. Data were combined across sites prior to analyses and the S × D × F interaction was significant (*P* = 0.040). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × F	Final Disease (0-9)															
E-Untr	2.1 a	1.4 a	0.7 a	0.1 a	0.9 a	0.2 a	1.0 a	0.3 a	0.3 a	0.1 b	0.0 a	1.3 a	0.0 a	0.3 a	0.0 a	0.0 a
E-Fung	2.3 a	1.0 a	0.7 a	0.0 a	0.8 a	0.2 a	0.7 a	0.1 a	0.2 a	0.6 b	0.0 a	1.1 a	0.0 a	0.2 a	0.3 a	0.1 a
D-Untr	1.0 b	1.2 a	0.8 a	0.1 a	1.2 a	0.2 a	0.9 a	0.3 a	0.3 a	4.0 a	0.0 a	1.2 a	0.0 a	0.0 a	0.0 a	0.1 a
D-Fung	0.9 b	0.8 a	0.7 a	0.0 a	0.7 a	0.2 a	0.4 a	0.1 a	0.2 a	3.0 a	0.0 a	1.2 a	0.0 a	0.0 a	0.0 a	0.0 a
S.E.M.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Pr > F	<0.001	0.099	0.994	0.990	0.174	0.995	0.046	0.590	0.979	<0.001	1.000	0.906	1.000	0.863	0.646	0.999

Table 19. Individual site seeding rate (R) by fungicide (F) means for final faba bean disease ratings. Data were combined across sites prior to analyses and the S × R × F interaction was not significant (*P* = 0.742). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
R × F	Final Disease (0-9)															
45-Untr	1.3 b	1.1 ab	0.7 a	0.1 a	1.1 a	0.2 a	0.9 a	0.2 a	0.3 a	1.9 a	0.0 a	1.4 a	0.0 a	0.2 a	0.0 a	0.0 a
45-Fung	1.6 ab	0.8 b	0.7 a	0.1 a	0.7 a	0.2 a	0.6 a	0.1 a	0.1 a	2.0 a	0.0 a	1.1 a	0.0 a	0.2 a	0.0 a	0.1 a
65-Untr	1.9 a	1.4 a	0.7 a	0.1 a	1.1 a	0.2 a	1.0 a	0.4 a	0.3 a	2.2 a	0.0 a	1.1 a	0.0 a	0.2 a	0.0 a	0.1 a
65-Fung	1.6 ab	1.0 ab	0.7 a	0.0 a	0.8 a	0.2 a	0.5 a	0.1 a	0.3 a	1.6 a	0.0 a	1.2 a	0.0 a	0.1 a	0.3 a	0.0 a
S.E.M.	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19 a	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Pr > F	0.040	0.029	0.983	0.972	0.293	0.999	0.055	0.504	0.909	0.091	1.000	0.300	1.000	0.978	0.537	0.986

Table 20. Individual site seeding date (D) by seeding rate (R) by fungicide (F) means for final faba bean disease ratings. Data were combined across sites prior to analyses and the S × D × R × F interaction was not significant (*P* = 0.919). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R × F	Final Disease (0-9)															
E-45-Unt	1.5 bc	1.1 a	0.6 a	0.0 a	0.9 a	0.2 a	1.1 a	0.3 a	0.3 a	0.1 c	0.0 a	1.4 a	0.0 a	0.3 a	0.0 a	0.0 a
E-45-Fun	2.1 ab	0.8 a	0.6 a	0.1 a	0.8 a	0.2 a	0.7 a	0.2 a	0.2 a	0.6 c	0.0 a	1.2 a	0.0 a	0.3 a	0.0 a	0.1 a
E-65-Unt	2.7 a	1.6 a	0.7 a	0.2 a	1.0 a	0.1 a	0.9 a	0.4 a	0.3 a	0.2 c	0.0 a	1.1 a	0.0 a	0.3 a	0.0 a	0.1 a
E-65-Fun	2.5 a	1.3 a	0.7 a	0.0 a	0.9 a	0.3 a	0.7 a	0.1 a	0.3 a	0.7 c	0.0 a	1.0 a	0.0 a	0.2 a	0.5 a	0.0 a
D-45-Unt	1.0 bc	1.1 a	0.8 a	0.1 a	1.2 a	0.2 a	0.8 a	0.2 a	0.3 a	3.8 a	0.0 a	1.5 a	0.0 a	0.1 a	0.0 a	0.0 a
D-45-Fun	1.0 bc	0.9 a	0.7 a	0.1 a	0.7 a	0.2 a	0.5 a	0.1 a	0.1 a	3.3 ab	0.0 a	1.1 a	0.0 a	0.1 a	0.0 a	0.0 a
D-65-Unt	1.0 bc	1.3 a	0.8 a	0.1 a	1.2 a	0.3 a	1.1 a	0.3 a	0.3 a	4.2 a	0.0 a	1.0 a	0.0 a	0.0 a	0.0 a	0.1 a
D-65-Fun	0.7 c	0.8 a	0.8 a	0.0 a	0.8 a	0.2 a	0.4 a	0.1 a	0.3 a	2.6 b	0.0 a	1.4 a	0.0 a	0.0 a	0.0 a	0.1 a
S.E.M.	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Pr > F	<0.001	0.098	1.000	1.000	0.617	1.000	0.180	0.931	0.999	<0.001	1.000	0.604	1.000	0.996	0.713	1.000

Table 21. Individual site main effect (seeding date, seeding rate, and foliar fungicide) means for days to faba bean maturity. Data were combined across sites prior to analyses. The S × D, S × R, and S × F interactions were all significant (*P* < 0.001-0.025). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	---------- Maturity (Days from Seeding) ----------															
Early	103.2 a	110.2 a	92.8 a	95.0 a	112.3 a	100.2 b	110.0 a	108.0 a	110.5 a	99.8 b	93.4 a	100.0 a	91.0 a	96.6 b	–	95.8 a
Delay	98.1 b	98.1 b	93.1 a	89.5 b	98.0 b	117.4 a	97.0 b	104.0 b	99.8 b	107.5 a	88.9 b	90.0 b	85.5 b	100.4 a	–	93.3 b
S.E.M.	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	–	0.42
Pr > F	<0.001	<0.001	0.669	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	–	<0.001
Rate																
45/m²	101.6 a	104.7 a	93.5 a	91.8 b	105.1 a	108.9 a	103.5 a	106.0 a	105.3 a	103.8 a	91.0 a	95.0 a	88.3 a	98.2 a	–	95.0 a
65/m²	99.8 b	103.6 b	92.4 a	92.7 a	105.3 a	108.7 a	103.5 a	106.0 a	104.9 a	103.5 a	91.3 a	95.0 a	88.3 a	98.8 a	–	94.1 a
S.E.M.	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	–	0.36
Pr > F	<0.001	0.005	0.007	0.027	0.634	0.526	1.000	1.000	0.341	0.526	0.428	1.000	1.000	0.113	–	0.027
Fung																
Untr	100.2 b	103.4 b	93.0 a	92.7 a	105.1 a	108.5 a	103.5 a	106.0 a	104.8 a	103.5 a	90.7 b	95.0 a	88.3 a	98.3 a	–	94.4 a
Fung	101.1 a	104.8 a	92.9 a	91.8 b	105.2 a	109.1 a	103.5 a	106.0 a	105.4 a	103.8 a	91.6 a	95.0 a	88.3 a	98.8 a	–	94.7 a
S.E.M.	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	–	0.36
Pr > F	0.018	0.001	0.874	0.027	0.874	0.113	1.000	1.000	0.113	0.526	0.018	1.000	1.000	0.205	–	0.526

Table 22. Individual site seeding date (D) by seeding rate (R) means for days to faba bean maturity. Data were combined across sites prior to analyses and the S × D × R interaction was not significant (*P* = 0.926). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	Maturity (days from seeding)															
E-45	104.1 a	111.0 a	93.4 a	95.0 a	112.1 a	100.3 b	110.0 a	108.0 a	110.8 a	100.0 b	93.3 a	100.0 a	91.0 a	96.5 b	–	96.4 a
E-65	102.3 b	109.4 b	92.3 a	95.0 a	112.5 a	100.1 b	110.0 a	108.0 a	110.3 a	99.5 b	93.5 a	100.0 a	91.0 a	96.6 b	–	95.3 ab
D-45	99.0 c	98.4 c	93.6 a	88.6 c	98.0 b	117.6 a	97.0 b	104.0 b	99.9 b	107.5 a	88.8 b	90.0 b	85.5 b	99.9 a	–	93.6 bc
D-65	97.3 d	97.8 c	92.6 a	90.4 b	98.0 b	117.3 a	97.0 b	104.0 b	99.6 b	107.5 a	89.1 b	90.0 b	85.5 b	101.0 a	–	93.0 c
S.E.M.	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	–	0.50
Pr > F	<0.001	<0.001	0.060	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	–	<0.001

Table 23. Individual site seeding date (D) by fungicide (F) means for days to faba bean maturity. Data were combined across sites prior to analyses and the S × D × F interaction was not significant (*P* = 0.204). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × F	Maturity (days from seeding)															
E-Untr	102.9 a	109.6 a	92.9 a	95.0 a	112.3 a	100.1 b	110.0 a	108.0 a	110.5 a	100.0 b	93.4 a	100.0 a	91.0 a	96.4 b	–	95.5 a
E-Fung	103.5 a	110.8 a	92.8 a	95.0 a	112.4 a	100.3 b	110.0 a	108.0 a	110.5 a	99.5 b	93.4 a	100.0 a	91.0 a	96.8 b	–	96.1 a
D-Untr	97.5 b	97.3 c	93.1 a	90.4 b	98.0 b	116.9 a	97.0 b	104.0 b	99.1 b	107.0 a	88.0 c	90.0 b	85.5 b	100.1 a	–	93.4 b
D-Fung	98.8 b	98.9 b	93.1 a	88.6 c	98.0 b	118.0 a	97.0 b	104.0 b	100.4 b	108.0 a	89.9 b	90.0 b	85.5 b	100.8 a	–	93.3 b
S.E.M.	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	–	0.50
Pr > F	<0.001	<0.001	0.958	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	–	<0.001

Table 24. Individual site seeding rate (R) by fungicide (F) means for days to faba bean maturity. Data were combined across sites prior to analyses and the S × R × F interaction was not significant (*P* = 0.999). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
R × F	Maturity (days from seeding)															
45-Untr	101.1ab	104.0ab	93.5 a	92.3 ab	105.1 a	108.8 a	103.5 a	106.0 a	105.0 a	103.5 a	90.4 a	95.0 a	88.3 a	98.1 a	–	95.0 a
45-Fung	102.0 a	105.4 a	93.5 a	91.4 b	105.0 a	109.1 a	103.5 a	106.0 a	105.6 a	104.0 a	91.6 a	95.0 a	88.3 a	98.3 a	–	95.0 a
65-Untr	99.3 c	102.9 b	92.5 a	93.1 a	105.1 a	108.3 a	103.5 a	106.0 a	104.6 a	103.5 a	91.0 a	95.0 a	88.3 a	98.4 a	–	93.9 a
65-Fung	100.3bc	104.3ab	92.4 a	92.3 ab	105.4 a	109.1 a	103.5 a	106.0 a	105.3 a	103.5 a	91.6 a	95.0 a	88.3 a	99.3 a	–	94.4 a
S.E.M.	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	–	0.45 a
Pr > F	<0.001	<0.001	0.064	0.021	0.923	0.345	1.000	1.000	0.332	0.750	0.076	1.000	1.000	0.171	–	0.127

Table 25. Individual site seeding date (D) by seeding rate (R) by fungicide (F) means for days to faba bean maturity. Data were combined across sites prior to analyses and the S × D × R × F interaction was not significant (*P* = 0.996). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R × F	Maturity (days from seeding)															
E-45-Unt	104.0ab	110.5ab	93.5 a	95.0 a	112.3 a	100.3 b	110.0 a	108.0 a	110.5 a	100.0 b	93.3 a	100.0 a	91.0 a	96.5 b	–	96.3 ab
E-45-Fun	104.3 a	111.5 a	93.3 a	95.0 a	112.0 a	100.3 b	110.0 a	108.0 a	111.0 a	100.0 b	93.3 a	100.0 a	91.0 a	96.5 b	–	96.5 a
E-65-Unt	101.8bc	108.8 b	92.4 a	95.0 a	112.3 a	100.0 b	110.0 a	108.0 a	110.5 a	100.0 b	93.5 a	100.0 a	91.0 a	96.3 b	–	94.8 a-d
E-65-Fun	102.8ab	110.0ab	92.3 a	95.0 a	112.8 a	100.3 b	110.0 a	108.0 a	110.0 a	99.0 b	93.5 a	100.0 a	91.0 a	97.0 b	–	95.8 a-c
D-45-Unt	98.3 de	97.5 c	93.5 a	89.5 bc	98.0 b	117.3 a	97.0 b	104.0 b	99.5 b	107.0 a	87.5 c	90.0 b	85.5 b	99.8 a	–	93.8 b-d
D-45-Fun	99.8 cd	99.3 c	93.8 a	87.8 c	98.0 b	118.0 a	97.0 b	104.0 b	100.3 b	108.0 a	90.0 b	90.0 b	85.5 b	100.0 a	–	93.5 cd
D-65-Unt	96.8 e	97.0 c	92.6 a	91.3 b	98.0 b	116.5 a	97.0 b	104.0 b	98.8 b	107.0 a	88.5 bc	90.0 b	85.5 b	100.5 a	–	93.0 d
D-65-Fun	97.8 de	98.5 c	92.5 a	89.5 bc	98.0 b	118.0 a	97.0 b	104.0 b	100.5 b	108.0 a	89.8 bc	90.0 b	85.5 b	101.5 a	–	93.0 d
S.E.M.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	–	0.64
Pr > F	<0.001	<0.001	0.360	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	–	<0.001

Table 26. Individual site main effect (seeding date, seeding rate, and foliar fungicide) means for days to faba bean seed yield. Data were combined across sites prior to analyses. The S × D and S × R interactions were significant (*P* < 0.001) but the S × F interaction was not (*P* = 0.207). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	---------- Seed Yield (kg/ha) ----------															
Early	1818 a	3265 a	2418 a	2227 a	4964 a	4049 a	4897 a	6383 a	7264 a	2443 a	1072 a	1666 a	1065 a	1077 a	2368 a	1979 b
Delay	1893 a	3440 a	2051 a	2244 a	3482 b	3885 a	4254 b	5181 b	6043 b	1066 b	427 b	1286 a	602 a	1098 a	2232 a	2756 a
S.E.M.	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3	194.3
Pr > F	0.772	0.506	0.164	0.947	<0.001	0.532	0.017	<.0001	<.0001	<.0001	0.017	0.151	0.082	0.936	0.605	0.005
Rate																
45/m²	1835 a	3296 a	2239 a	2257 a	4207 a	3877 a	4453 b	5544 b	6396 b	1683 a	764 a	1477 a	848 a	1098 a	2334 a	2387 a
65/m²	1876 a	3409 a	2230 a	2214 a	4240 a	4057 a	4698 a	6019 a	6912 a	1825 a	734 a	1475 a	819 a	1077 a	2267 a	2347 a
S.E.M.	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8
Pr > F	0.667	0.227	0.921	0.648	0.724	0.057	0.010	<0.001	<0.001	0.132	0.751	0.981	0.755	0.826	0.480	0.675
Fung																
Untr	1824 a	3333 a	2224 a	2267 a	4098 b	3916 a	4552 a	5845 a	6590 a	1683 a	703 a	1465 a	811 a	971 b	2183 b	2386 a
Fung	1887 a	3372 a	2245 a	2204 a	4349 a	4018 a	4599 a	5719 a	6718 a	1825 a	795 a	1486 a	856 a	1204 a	2418 a	2348 a
S.E.M.	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8	151.8
Pr > F	0.503	0.678	0.819	0.500	0.008	0.278	0.612	0.182	0.174	0.133	0.327	0.822	0.629	0.014	0.013	0.684

Table 27. Individual site seeding date (D) by seeding rate (R) means for days to faba bean seed yield. Data were combined across sites prior to analyses and the S × D × R interaction was not significant (*P* = 0.916). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	Seed Yield (kg/ha)															
E-45	1774 a	3207 a	2420 a	2284 a	5017 a	4032 a	4829 a	6101 b	7014 b	2326 a	1093 a	1668 a	1076 a	1091 a	2400 a	2004 b
E-65	1861 a	3323 a	2417 a	2170 a	4912 a	4067 a	4965 a	6665 a	7515 a	2559 a	1051 a	1664 a	1053 a	1062 a	2336 a	1954 b
D-45	1896 a	3384 a	2058 a	2230 a	3396 b	3723 a	4077 b	4988 d	5778 c	1041 b	435 a	1286 a	620 a	1104 a	2267 a	2770 a
D-65	1891 a	3495 a	2043 a	2258 a	3568 b	4047 a	4430 a	5373 c	6309 b	1091 b	418 a	1286 a	584 a	1092 a	2198 a	2741 a
S.E.M.	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4
Pr > F	0.917	0.590	0.571	0.853	<0.001	0.095	0.003	<0.001	<0.001	<0.001	0.102	0.546	0.355	0.996	0.856	0.030

Table 28. Individual site seeding date (D) by fungicide (F) means for days to faba bean seed yield. Data were combined across sites prior to analyses and the S × D × F interaction was not significant (*P* = 0.538). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × F	Seed Yield (kg/ha)															
E-Untr	1800 a	3204 a	2396 a	2229 a	4952 a	3985 a	4805 ab	6360 a	7179 a	2321 a	1009 ab	1647 a	1019 a	994 a	2237 a	1953 c
E-Fung	1835 a	3327 a	2441 a	2224 a	4977 a	4114 a	4989 a	6405 a	7350 a	2564 a	1136 a	1685 a	1111 a	1159 a	2499 a	2005 bc
D-Untr	1848 a	3462 a	2051 a	2305 a	3244 c	3848 a	4298 ab	5329 b	6001 b	1046 b	398 b	1284 a	602 a	947 a	2128 a	2820 a
D-Fung	1939 a	3417 a	2050 a	2183 a	3720 b	3923 a	4209 b	5033 b	6086 b	1086 b	455 ab	1288 a	602 a	1248 a	2337 a	2691 ab
S.E.M.	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4	205.4
Pr > F	0.890	0.700	0.551	0.838	<0.001	0.647	0.039	<0.001	<0.001	<0.001	0.067	0.530	0.306	0.086	0.087	0.020

Table 29. Individual site seeding rate (R) by fungicide (F) means for days to faba bean maturity. Data were combined across sites prior to analyses and the S × R × F interaction was not significant (*P* = 0.887). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
R × F	Seed Yield (kg/ha)															
45-Untr	1793 a	3307 a	2226 a	2301 a	4103 a	3781 a	4501 ab	5625 b	6387 b	1648 a	699 a	1430 a	792 a	1016 a	2269 ab	2382 a
45-Fung	1878 a	3284 a	2253 a	2213 a	4310 a	3974 a	4405 b	5464 b	6405 b	1719 a	829 a	1524 a	904 a	1179 a	2398 ab	2392 a
65-Untr	1855 a	3359 a	2222 a	2233 a	4093 a	4051 a	4602 ab	6064 a	6793 a	1719 a	707 a	1501 a	829 a	925 a	2096 b	2391 a
65-Fung	1896 a	3460 a	2238 a	2194 a	4387 a	4063 a	4793 a	5974 a	7030 a	1932 a	762 a	1449 a	808 a	1229 a	2438 a	2304 a
S.E.M.	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7
Pr > F	0.875	0.557	0.996	0.865	0.061	0.127	0.027	<0.001	<0.001	0.165	0.748	0.882	0.844	0.083	0.046	0.894

Table 30. Individual site seeding date (D) by seeding rate (R) by fungicide (F) means for days to faba bean seed yield. Data were combined across sites prior to analyses and the S × D × R × F interaction was not significant (*P* = 0.981). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R × F	Seed Yield (kg/ha)															
E-45-Unt	1741 a	3195 a	2396 a	2300 a	4976 a	3915 a	4821 ab	6052 bc	7025 bc	2245 a	996 a	1624 a	1014 a	1017 a	2324 a	2022 ab
E-45-Fun	1808 a	3220 a	2445 a	2268 a	5058 a	4148 a	4837 ab	6150 ab	7003 bc	2407 a	1190 a	1711 a	1139 a	1166 a	2476 a	1986 ab
E-65-Unt	1860 a	3212 a	2397 a	2159 a	4928 a	4054 a	4789 ab	6669 a	7333 ab	2397 a	1021 a	1669 a	1024 a	971 a	2151 a	1884 b
E-65-Fun	1862 a	3435 a	2437 a	2181 a	4895 a	4079 a	5141 a	6660 a	7696 a	2722 a	1081 a	1659 a	1082 a	1153 a	2522 a	2023 ab
D-45-Unt	1845 a	3420 a	2055 a	2302 a	3230 c	3647 a	4181 b	5199 cd	5748 e	1052 b	403 a	1235 a	571 a	1016 a	2215 a	2741 ab
D-45-Fun	1947 a	3348 a	2061 a	2158 a	3562 bc	3799 a	3973 b	4778 d	5808 de	1030 b	468 a	1337 a	669 a	1192 a	2319 a	2798 ab
D-65-Unt	1850 a	3505 a	2047 a	2308 a	3258 c	4048 a	4415 ab	5459 bc	6253cde	1040 b	393 a	1333 a	634 a	879 a	2041 a	2898 a
D-65-Fun	1931 a	3486 a	2039 a	2208 a	3879 b	4047 a	4445 ab	5288bcd	6364 cd	1142 b	443 a	1238 a	535 a	1305 a	2355 a	2584 ab
S.E.M.	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9	225.9
Pr > F	0.993	0.836	0.952	0.974	<0.001	0.285	0.010	<0.001	<0.001	<0.001	0.370	0.894	0.738	0.370	0.300	0.088

Table 31. Individual site main effect (seeding date, seeding rate, and foliar fungicide) means for days to faba bean thousand seed weight. Data were combined across sites prior to analyses. The S × D, S × R, and S × F interactions were all significant (*P* < 0.001-0.010). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Main Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
Date	---------- Seed Weight (g/1000 seeds) ----------															
Early	414 b	375 b	390 a	379 b	468 a	445 b	446 a	425 a	534 a	463 b	228 a	270 a	250 a	426 a	424 a	374 b
Delay	449 a	389 a	390 a	422 a	347 b	517 a	356 b	439 a	440 b	526 a	219 a	187 b	239 a	403 b	418 a	471 a
S.E.M.	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.1	7.1	7.1	7.1	7.1	7.1
Pr > F	<0.001	0.129	0.943	<0.001	<0.001	<0.001	<0.001	0.126	<0.001	<0.001	0.373	<0.001	0.227	0.018	0.510	<0.001
Rate																
45/m²	443 a	389 a	392 a	400 a	411 a	484 a	395 b	436 a	485 a	494 a	226 a	231 a	250 a	417 a	428 a	432 a
65/m²	421 b	374 b	388 a	401 a	404 a	478 a	407 a	429 a	489 a	494 a	220 a	225 a	240 a	412 a	415 b	413 b
S.E.M.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.2	6.2	6.2	6.2	6.2	6.2
Pr > F	<0.001	0.007	0.389	0.950	0.215	0.286	0.031	0.258	0.505	0.991	0.289	0.331	0.087	0.337	0.026	0.001
Fung																
Untr	431 a	382 a	388 a	399 a	399 b	472 b	401 a	434 a	483 a	492 a	221 a	227 a	247 a	423 a	424 a	425 a
Fung	433 a	381 a	392 a	402 a	416 a	489 a	401 a	430 a	491 a	496 a	225 a	229 a	243 a	406 b	418 a	419 a
S.E.M.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.2	6.2	6.2	6.2	6.2	6.2
Pr > F	0.703	0.803	0.572	0.587	0.003	0.003	0.982	0.504	0.139	0.540	0.492	0.625	0.544	0.005	0.303	0.269

Table 32. Individual site seeding date (D) by seeding rate (R) means for days to faba bean thousand seed weight. Data were combined across sites prior to analyses and the S × D × R interaction was significant (*P* = 0.029). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R	Seed Weight (g/1000 seeds)															
E-45	415 b	387 a	394 a	384 b	475 a	449 b	440 a	428 a	526 a	459 b	229 a	274 a	256 a	427 a	435 a	385 b
E-65	413 b	363 b	386 a	375 b	462 a	440 b	453 a	423 a	542 a	467 b	226 a	265 a	245 a	424 ab	414 a	362 c
D-45	470 a	392 a	390 a	417 a	348 b	518 a	350 b	443 a	445 b	530 a	224 a	188 b	244 a	407 ab	421 a	478 a
D-65	429 b	385 ab	389 a	426 a	347 b	515 a	361 b	435 a	436 b	521 a	215 a	185 b	235 a	399 b	416 a	463 a
S.E.M.	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.2	8.2	8.2
Pr > F	<0.001	0.009	0.780	<0.001	<0.001	<0.001	<0.001	0.288	<0.001	<0.001	0.539	<0.001	0.216	0.068	0.066	<0.001

Table 33. Individual site seeding date (D) by fungicide (F) means for days to faba bean thousand seed weight. Data were combined across sites prior to analyses and the S × D × F interaction was not significant (*P* = 0.141). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × F	Seed Weight (g/1000 seeds)															
E-Untr	410 b	367 b	387 a	377 b	462 a	439 c	444 a	431 a	529 a	467 b	225 a	265 a	252 a	432 a	426 a	373 b
E-Fung	419 b	382 ab	394 a	382 b	475 a	451 c	449 a	419 a	539 a	459 b	230 a	274 a	249 a	419 ab	422 a	375 b
D-Untr	452 a	398 a	390 a	421 a	337 c	505 b	358 b	437 a	436 b	518 a	217 a	189 b	241 a	413 ab	422 a	478 a
D-Fung	447 a	379 ab	389 a	422 a	358 b	528 a	353 b	442 a	444 b	533 a	221 a	185 b	237 a	394 b	414 a	463 a
S.E.M.	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.2	8.2	8.2
Pr > F	0.001	0.011	0.841	<0.001	<0.001	<0.001	<0.001	0.167	<0.001	<0.001	0.733	<0.001	0.594	0.003	0.660	<0.001

Table 34. Individual site seeding rate (R) by fungicide (F) means for days to faba bean thousand seed weight. Data were combined across sites prior to analyses and the S × R × F interaction was not significant (*P* = 0.947). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
R × F	Seed Weight (g/1000 seeds)															
45-Untr	448 a	391 a	390 a	399 a	405 ab	477 ab	396 a	436 a	480 a	494 a	224 a	233 a	251 a	427 a	434 a	434 a
45-Fung	437 a	388 a	395 a	402 a	418 a	491 a	394 a	435 a	490 a	494 a	229 a	229 a	249 a	408 ab	422 a	429 ab
65-Untr	414 b	373 a	387 a	399 a	393 b	468 b	406 a	432 a	485 a	491 a	219 a	221 a	243 a	418 ab	415 a	416 ab
65-Fung	429 ab	374 a	388 a	402 a	415 a	488 ab	408 a	426 a	493 a	498 a	222 a	230 a	237 a	405 b	415 a	409 b
S.E.M.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.5	7.4	7.4	7.4	7.4	7.4	7.4
Pr > F	<0.001	0.056	0.752	0.960	0.012	0.019	0.186	0.604	0.440	0.869	0.646	0.516	0.333	0.031	0.070	0.007

Table 35. Individual site seeding date (D) by seeding rate (R) by fungicide (F) means for days to faba bean thousand seed weight. Data were combined across sites prior to analyses and the S × D × R × F interaction was not significant (*P* = 0.703). Trials were conducted at Indian Head (IH), Melfort (ME), Outlook (OL), Prince Albert (PA), Swift Current (SW), and Yorkton (YK), in 2021 (21), 2022 (22), and 2023 (23). Means within a column followed by the same letter do not significantly differ (Tukey's; *P* ≤ 0.05).

Effect	IH21	IH22	IH23	ME21	ME22	ME23	OL22	OL23	PA22	PA23	SW21	SW22	SW23	YK21	YK22	YK23
D × R × F	Seed Weight (g/1000 seeds)															
E-45-Unt	416 c	383 ab	388 a	383 cd	472 a	446 b	440 a	431 a	517 a	464 b	224 a	276 a	261 a	433 a	443 a	382 b
E-45-Fun	415 c	390 a	401 a	384 bcd	478 a	453 b	439 a	425 a	535 a	453 b	234 a	271 a	251 a	421 a	426 a	389 b
E-65-Unt	403 c	350 b	385 a	371 d	452 a	433 b	448 a	432 a	542 a	469 b	226 a	253 a	243 a	432 a	410 a	363 b
E-65-Fun	424 bc	375 ab	387 a	379 cd	472 a	448 b	458 a	413 a	543 a	465 b	225 a	277 a	247 a	417 a	418 a	361 b
D-45-Unt	479 a	399 a	391 a	414 abc	339 b	507 a	352 b	442 a	444 b	524 a	223 a	189 b	241 a	421 a	424 a	487 a
D-45-Fun	460 ab	386 ab	390 a	420 abc	357 b	529 a	348 b	444 a	446 b	536 a	224 a	187 b	247 a	394 a	417 a	470 a
D-65-Unt	425 bc	397 a	389 a	427 a	335 b	503 a	364 b	432 a	429 b	513 a	212 a	188 b	242 a	405 a	420 a	470 a
D-65-Fun	434 bc	373 ab	389 a	425 ab	359 b	527 a	358 b	439 a	442 b	530 a	218 a	182 b	227 a	393 a	411 a	457 a
S.E.M.	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.2	10.0	10.0	10.0	10.0	10.0	10.0
Pr > F	<0.001	0.003	0.936	0.002	<0.001	<0.001	<0.001	0.409	<0.001	<0.001	0.868	<0.001	0.407	0.026	0.150	<0.001