SASKATCHEWAN pulse Growers

**SPG Applied Research & Demonstration Report Format**

2021 Interim Report
for the
Saskatchewan Pulse Crop Development Board

**Project Title:** Agronomic and Economic Response of Lentil to Seed Rate and Fungicides
(Project #AP-2104a)


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1. **Project Code (as is in contract):** AP2104a

2. **Project Title:** Agronomic and Economic Response of Lentil to Seed Rate and Fungicides

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

This project was initiated as a follow-up to a recently concluded ADF/SPG/ WGRF research project led by Jessica Enns (Weber) in collaborations with multiple Agri-ARM sites and the University of Saskatchewan (Weber et al. 2019). That study evaluated multiple combinations of seeding rates, fungicide application strategies, and herbicide layering for improved weed control. Amongst other variables, data collection included relatively intensive weed measurements and disease ratings. Several key messages were derived from that work.

A pre-seed residual herbicide reduced early season annual weed populations by 66% compared to the traditional pre-seed burn-off strategy. Weed issues were most severe at the commonly recommended seeding rate of 130 seeds/m$^2$ compared to higher rates. A seeding rate of 190 seeds/m$^2$ resulted in the highest yield and net returns compared to seeding rates of 130 and 260 seeds/m$^2$. Prior to this, under organic management and subsequently heavy weed pressure, Baird et al. (2009) achieved the highest yields and economic returns with a seeding 235 seeds/m$^2$ and subsequent plant densities of approximately 150-160 plants/m$^2$; however, the closest seeding rate below this was only 94 seeds/m$^2$. As such, it is unclear whether intermediate seeding rates would have been sufficient to optimize yield and profits under these weedy conditions.

In the Weber et al. (2019) study, disease severity tended to increase with seeding rate (260 seeds/m$^2$ > 190 seeds/m$^2$ > 130 seeds/ m$^2$). The work showed that a single fungicide application was more likely to be required when higher seeding rates were used and dual fungicide applications may be required under higher disease pressure; however, under the conditions encountered for that project, the cost of a fungicide typically reduced net returns compared to the unsprayed treatments. These specific field trials were generally conducted under drought conditions with low disease pressure; thus, may not have shown the economic benefits that were likely to have occurred under wetter conditions. For example, at Saskatoon in 2016, Kasper (2019) maximized red lentil yields with a combination of higher seeding rates (targeting 240 plants/m$^2$) and two fungicide applications (Headline® and Bravo®).

The Saskatchewan Pulse Growers specifically identified a need to expand on this recent work with a follow-up project to demonstrate the key findings, build upon the existing knowledge base (for a broader range of conditions) and to create opportunities to extend the information to farmers throughout the province. For this project, we chose to focus on the seeding rate and fungicide aspects in order to simplify field trial management and data collection activities while also reducing the number of treatments. Demonstrating the benefits of herbicide layering is challenging because results depend on the specific weed species and biotypes (i.e. herbicide resistance) along with environmental factors and timing of operations. Furthermore, natural weed populations are often patchy which exacerbates these challenges in small plot trials. When considered along with relevant preceding research, this project was intended to provide producers with information and extension material on the benefits of higher seeding rates to enhance lentil yields and their ability to compete with weeds while illustrating potential implications for disease pressure and crop response to varying intensities of fungicide management.

Literature Cited

**Baird, J. M., Shirtliffe, S. J., and Walley, F. L. 2009.** Optimal seeding rate for organic production of lentil in the Northern Great Plains. Can. J. Plant Sci. **89:** 1089-1097.

**Kasper, K. M. 2018.** The effect of seeding rate and fungicide applications on lentil cultivars. University of Saskatchewan. MSc dissertation. Online [Available]: https://harvest.usask.ca/bitstream/handle/10388/11909/KASPER-THESIS-2019.pdf?sequence=1&isAllowed=y (December 8, 2021).

**Weber, J. Holzapfel, C., Hall, M., Nybo, B, Hnatowich, G., Johnson, E., and Shirtliffe, S. 2019.** Lentil Input Study: Final Report for the Saskatchewan Ministry of Agriculture (ADF Program), Saskatchewan Pulse Growers, and Western Grains Research Foundation. Online [Available]: https://applications.saskatchewan.ca/apps/AGR_Apps/adf/ADFAdminReport/20160010.pdf (December 6, 2021).

**6. Objective(s) or purpose of the project**

The objectives of the proposed project are to:

1. Demonstrate the effects of lentil seeding rates and subsequent plant densities on competition with weeds, disease, yield, grain quality, and agronomic response to foliar fungicide applications
2. Demonstrate the most profitable combinations of seeding rates and foliar fungicide application strategies for lentils under a range of Saskatchewan growing conditions.

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

Field trials with small red lentils were initiated at three locations for the 2021 growing season; Swift Current (Brown Soil Zone), Scott (Dark Brown Soil Zone), and Indian Head (thin Black Soil Zone). The treatments were a factorial combination of three seed rates (130, 190, and 250 seeds/m$^2$) and three fungicide management treatments (no fungicide applied, single application at early flowering, single application at early flowering and a second application approximately 14 days after the first) for a total of 9 individual treatments. The fungicide products and rates were 395 ml/ha Dyax (250 g/l fluxapyroxad and 250 g/l pyraclostrobin) for the first application and 420 g/ha Lance WDG (70% boscalid) for the second. The treatments were replicated four times in an RCBD and are listed in Table 1.

**Table 1. Proposed lentil seeding rate and fungicide treatments.**

| # | Seeding Rate | T1 Fungicide (early bloom) | T2 Fungicide (≈14 days after T1) |
|---|---|---|---|
| 1 | 130 seeds/m$^2$ | None applied | None applied |
| 2 | 130 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 3 | 130 seeds/m$^2$ | 395 ml Dyax/ha | 420 g Lance WDG/ha |
| 4 | 190 seeds/m$^2$ | None applied | None applied |
| 5 | 190 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 6 | 190 seeds/m$^2$ | 395 ml Dyax/ha | 420 g Lance WDG/ha |
| 7 | 250 seeds/m$^2$ | None applied | None applied |
| 8 | 250 seeds/m$^2$ | 395 ml Dyax/ha | None applied |
| 9 | 250 seeds/m$^2$ | 395 ml Dyax/ha | 420 g Lance WDG/ha |
| T1 - 100 g fluxapyroxad/ha + 100 g pyraclostrobin/ha applied 3-7 days after 1$^{st}$ flowers have appeared<br>T2 – 294 g boscalid/ha applied approximately 14 days after the first fungicide application | | | |

Selected agronomic information and dates of operations/data collection activities are provided in Table 4 of the Appendices. The lentils were direct seeded into cereal stubble and seeding equipment varied across locations. Fertilizer and granular inoculant were applied with fertility intended to be non-limiting across treatments. Seed treatment was used at all locations and the variety was either CDC Impulse CL (Swift Current and Scott) or CDC Proclaim CL (Indian Head). Weeds were controlled with registered pre-emergent and in-crop herbicide applications, as required. Because we were interested in assessing the relative ability of the crop to compete with weeds at each seed rate, no hand-weeding was permitted. Foliar fungicides were applied to individual plots as per protocol using hand booms or similar. Upon maturity, the plots were desiccated using glyphosate and/or diquat, depending on the location. The plots were straight-combined when it was fit do so and outside rows were excluded wherever it was possible to do so.

Several data were collected during the growing season and from the harvest samples. Spring plant densities were estimated by counted 4 x 1 m sections of crop row and converting the observed values to plants/m$^2$. Detailed disease ratings were completed for all plots at two distinct times: prior to the first fungicide application and approximately 7 days after the 2$^{nd}$ fungicide application. At each time, five sections within each plot were rated on a scale of 0-100 (percent plant and stem area affected) and values were averaged for each plot. Prior to senescence, the lentils were either inspected by SPG staff (Swift Current) or plant samples were submitted to the Saskatchewan Crop Protection Laboratory (Indian Head and Scott) for disease identification. At maturity, each plot was rated on a scale of 1-10 for the lentils ability to compete with weeds. A rating of 1 indicated that less than 10% of the plot area was affected by weeds while a rating of 10 indicated that >90% of the plot area was affected by weeds. Seed yields were determined from the harvested grain samples and are corrected for dockage and to 13% seed moisture content. Test weights were determined from the cleaned sub-samples using standard Canadian Grain Commission methods and are expressed as g/0.5 l. Seed weight was determined by counting and weighing approximately 250-1000 seeds per plot and converting the values to g/1000 seeds. Growing season temperatures and precipitation were compiled from the nearest Environment and Climate Change Canada weather stations, which were located within 3 km of the plots for all locations.

Data from the first year of this project were analyzed separately for each location using the generalized linear mixed model (GLIMMIX ) in SAS® Studio. Since we did not expect these variables to be affected by fungicide treatment only the effects of seed rate (SR) were considered fixed for plant density, initial disease ratings, and weediness ratings. For the remaining variables, effects of SR, fungicide (FUNG), and their interaction (SR x FUNG) were considered fixed. Replicate effects were always considered random. Main effect and individual treatment means were separated using the Tukey-Kramer test and orthogonal contrasts were used to confirm whether any responses to seeding rate were linear, quadratic, or not significant. All treatment effects and differences between means were considered significant at $P \leq 0.05$; however, responses at $P \leq 0.100$ were also generally highlighted if they made agronomic sense and were considered important.

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

*Weather*

Mean monthly temperatures and precipitation amounts are presented relative to the long-term (1981-2010) averages for the 2021 growing seasons (May-August) in Tables 2 and 3, respectively. Over the four month period, temperatures were above average at all three locations. May was slightly cooler than average while June and July were well above average and August was closer to normal. Precipitation relative to the long-term average varied widely. At Indian Head, there were periods of drought throughout the season but, overall, 295 mm of precipitation fell between May 1 and August 31. That said, much of the precipitation came in a few storm events and nearly 100 mm came in August after the lentils were harvested. At Scott, there was a total of 149 mm during the four month period relative to a long-term average of 227 mm; however, similar to Indian Head, 48 mm (32%) of the precipitation reported for this period fell after the lentils were harvested in August. Swift Current received a total of 147 mm, 78% of average, but similar to the other two sites, 49 mm of this fell late in August after the lentils had been harvested. Although lentils can tolerate heat and drought reasonably well compared to many crops, the conditions encountered at all three locations in 2021 were not conducive to disease and, as such, limited our ability to achieve the stated project objectives to a certain extent.

**Table 2. Mean monthly temperatures along with long-term (1981-2010) averages for the 2021 growing seasons at Indian Head, Scott, and Swift Current, Saskatchewan.**

| Location | Year | May | June | July | August | Average |
|---|---|---|---|---|---|---|
| | | ---------------------------- Mean Temperature (°C) ---------------------------- | | | | |
| Indian Head | 2021 | 9.0 | 17.7 | 20.3 | 17.1 | 16.0 (103%) |
| | *Long-term* | *10.8* | *15.8* | *18.2* | *17.4* | *15.6* |
| Scott | 2021 | 8.9 | 17.3 | 19.6 | 17.2 | 15.8 (107%) |
| | *Long-term* | *10.8* | *14.8* | *17.3* | *16.3* | *14.8* |
| Swift Current | 2021 | 9.5 | 18.3 | 21.6 | 17.9 | 16.8 (106%) |
| | *Long-term* | *11.0* | *15.7* | *18.4* | *17.9* | *15.8* |

**Table 3. Mean monthly precipitation along with long-term (1981-2010) averages for the 2021 growing seasons at Indian Head, Scott, and Swift Current, Saskatchewan.**

| Location | Year | May | June | July | August | Total |
|---|---|---|---|---|---|---|
| | | ------------------------ Cumulative Precipitation (mm) ------------------------ | | | | |
| Indian Head | 2021 | 81.6 | 62.9 | 51.2 | 99.4 | 295 (121%) |
| | *Long-term* | *51.7* | *77.4* | *63.8* | *51.2* | *244* |
| Scott | 2021 | 43.9 | 43.8 | 10.4 | 51.3 | 149 (66%) |
| | *Long-term* | *38.9* | *69.7* | *69.4* | *48.7* | *227* |
| Swift Current | 2021 | 30.0 | 26.8 | 36.6 | 53.5 | 147 (78%) |
| | *Long-term* | *42.1* | *66.1* | *44.0* | *35.4* | *188* |

Detailed results tables are reserved for the Appendices (Section 14; Tables 5-14) with selected responses and basic observations illustrated graphically in the main body of the report.

Emergence was generally quite good at all locations and, as expected, plant populations were affected by seeding rate at all three locations ($P < 0.001$; Table 5). In the all cases the response was linear ($P < 0.001$) while, at Scott, the quadratic response was also marginally significant ($P = 0.066$). While this was most pronounced at Scott, seedling mortality tended to increase with seed rate in all cases. The percentage of live seeds that established plants was 81-83% at 130 seeds/$m^2$, 72-75% at 190 seeds/$m^2$, and 60-71% at 250 seeds/$m^2$. This is not uncommon as seeding rates are increased to high levels and is attributable to increased competition for space and resources amongst seedlings. The basic plant density response to seed rate is illustrated in Fig. 1 below.


**Figure 1. Seed rate effects on lentil plant densities at Indian Head, Scott, and Swift Current, Saskatchewan (2021).**

Based on the more in-depth project this demonstration was based on along with past experience with lentils and other crops, we expected increased seed rates to improve the crop's ability to compete with weeds. While we utilized a pre-seed burn-down and registered in-crop herbicides, no pre-emergent residual herbicides were applied and hand-weeding was not permitted. While detailed weed counts or biomass measurements were beyond the scope of this project, the visual weediness rates did show a subtle decline in weeds with increasing seed rate at both Indian Head and Scott ($P$ < 0.001-0.007) but not at Swift Current ($P$ = 0.249; Table 6). At both Indian Head and Scott, the linear response was significant ($P$ < 0.001-0.002) while at Indian Head, the quadratic response was also marginally significant ($P$ = 0.067). The quadratic response at Indian Head was indicative of less impact going from 190-250 seeds/$m^2$ than from 130-190 seeds/$m^2$. Although not quite significant at the desired probability due to higher variability (SR linear: $P$ = 0.104), the trend was similar at Swift Current. These results are presented graphically in Fig. 2 below.

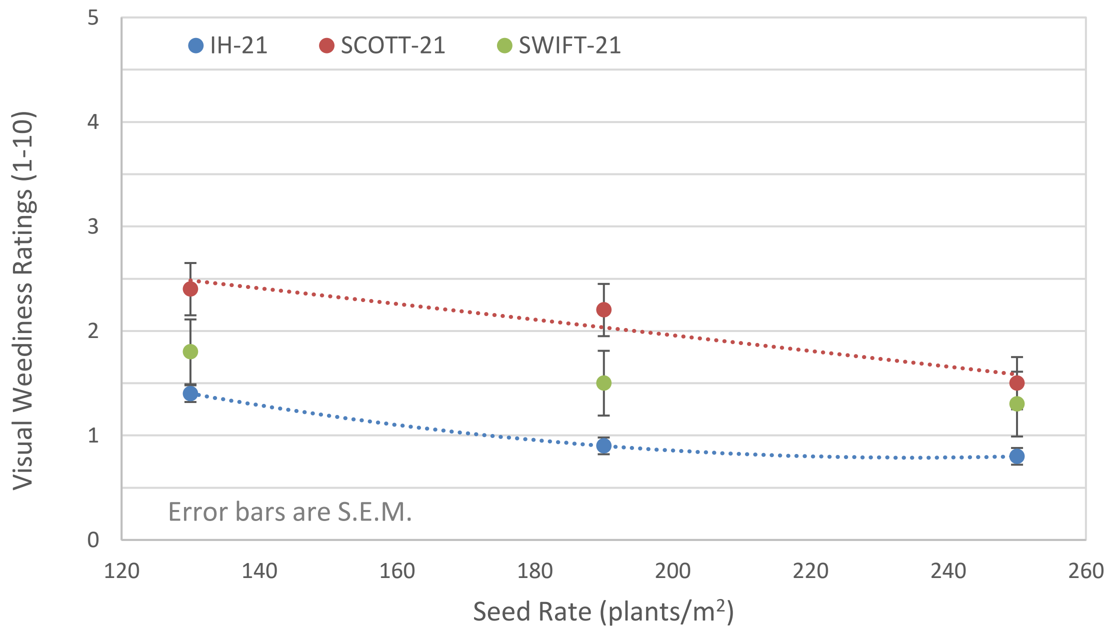


**Figure 2. Seed rate effects on visual weediness ratings in lentil plots at Indian Head, Scott, and Swift Current, Saskatchewan (2021). Higher values are indicative of increased weed pressure.**

The initial disease ratings were completed at the start of flowering, immediately prior to the first fungicide treatment applications, to provide information on the disease pressure at the time when producers would have to decide whether or not to invest in a foliar fungicide application. Because no fungicides had been applied at this time, we only considered the effects of seed rate. The crop was rated on a scale of 0-100 (based on the percentage of stem and leaf area affected) in order to better allow us to document trace levels of disease relative to coarser rating scales. Disease pressure was negligible at all three locations at this time, not significantly affected by seed rate ($P$ =0.413-0.985) and no trends were observed (Table 7). Averaged across treatments, the absolute rating values were 0.5% at Indian Head, 0.5% at Scott, and 0.1% at Swift Current. Due to the low numbers and lack of treatment effects, no figures were generated for these data.

For the final disease ratings, completed approximately 7 days after the second fungicide treatments were applied, disease pressure was still extremely low with no meaningful treatment effects (Table 8). At Swift Current, all values were zero at this time and, therefore, no statistical analyses were completed for the final disease ratings at this location. At Indian Head, the overall average rating was 1.8% and marginally affected by seed rate ($P$ = 0.061) but not fungicide treatment ($P$ = 0.360) and there was no interaction between these factors ($P$ = 0.693). While the quadratic response to seeding rate was, in fact, significant, the response was difficult to explain agronomically and the values were too low to be of any practical importance (Fig. 3). In addition to the lack of statistical significance, no trends with regard to fungicide were observed in the final disease ratings (Fig. 4). Similar to Indian Head, the final disease ratings at Scott were extremely low and not affected by seed rate ($P$ = 0.613), fungicide treatment ($P$ = 0.157), or their interaction ($P$ = 0.736). Individual treatment means for the final disease ratings are presented in Table 9 of the Appendices. Plant samples from both Indian Head and Scott were submitted to the Saskatchewan Ministry of Agriculture Crop Protection Laboratory. At Indian Head, there was no disease identified in the sample while, at Scott, the laboratory reported the presence of root rot complex but no diseases which would be controlled by the foliar fungicide treatments. At Swift Current, the plots were inspected by a Saskatchewan Pulse Growers agronomist who confirmed their observation that no disease was present. The full, original reports from the Crop Protection Laboratory are provided in Figs. 11 and 12 of the Appendices.

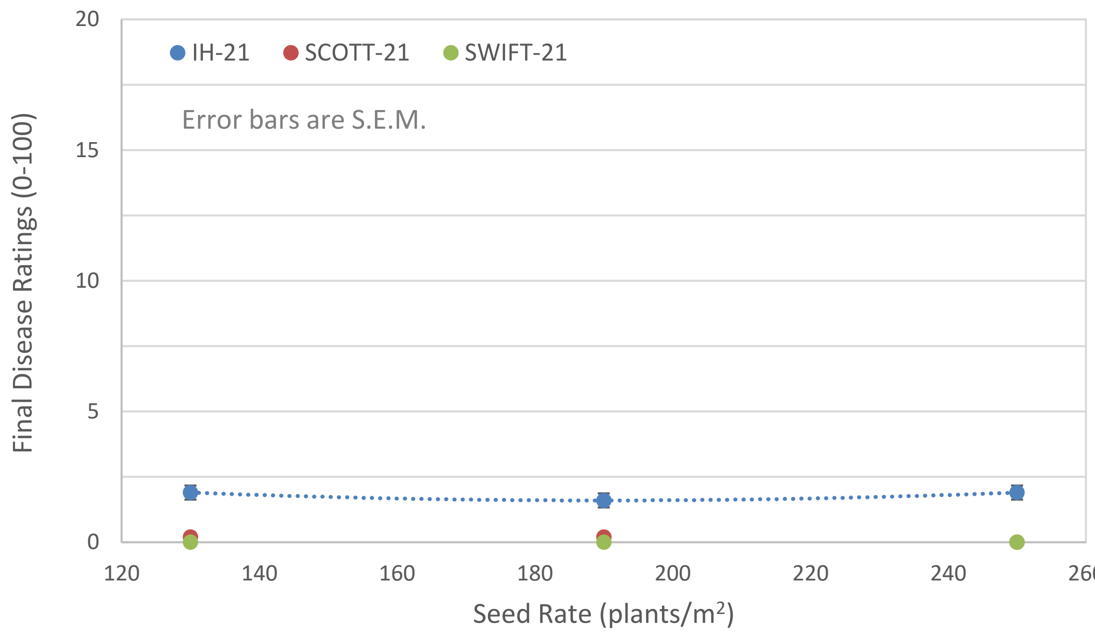


**Figure 3. Seed rate effects on final disease ratings in lentil plots at Indian Head, Scott, and Swift Current, Saskatchewan (2021). The values are percent stem and leaf area affected by disease. All values from Swift Current were zero.**

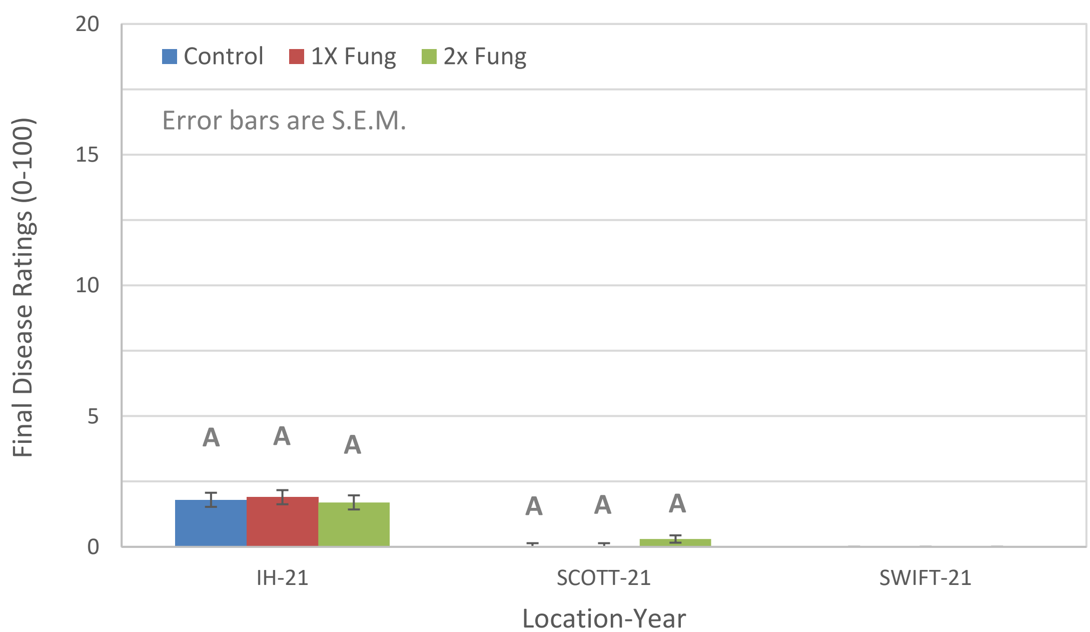


**Figure 4. Fungicide treatment effects on final disease ratings in lentil plots at Indian Head, Scott, and Swift Current, Saskatchewan (2021). The fungicide treatments were 1) an untreated control, 2) fungicide application at early flowering,**

**and 3) fungicide application at early flowering and a second ~14 day later. The values are percent stem and leaf area affected by disease. All values from Swift Current were zero.**

Detailed results tables for lentil seed yield are presented in Tables 10 and 11 of the Appendices with basic summary graphs provided below in Figs. 5 and 6. At Indian Head, yields were affected by seed rate ($P < 0.001$) but not fungicide ($P = 0.404$) and there was no SR x FUNG interaction detected ($P = 0.940$). The lack of an interaction tells that the effects of fungicide (or lack thereof) were consistent regardless of seed rate. Although the greatest yield increase occurred when the seed rate was increased from 130 seeds/$m^2$ to 190 seeds/$m^2$, the significant linear orthogonal contrast ($P < 0.001$) and non-significant quadratic contrast ($P = 0.316$) indicated that yields continued to climb with seeding rates beyond 190 seeds/$m^2$. At Scott, the response was generally similar; however, due to much higher overall variability, none of the overall F-tests were significant ($P = 0.137$-$0.822$) and the orthogonal linear contrast was only marginally significant ($P = 0.072$). Similarly, none of the overall F-tests were significant at Swift Current ($P = 0.152$-$0.840$) and the linear response was marginally significant ($P = 0.078$); however, at this location, the response was negative showing a trend for slight yield reductions as the seeding rate was increased. The observed responses observed at Indian Head and Scott are largely consistent with previous work. At Swift Current, under drier conditions, it is possible that higher plant populations led to accelerated senescence and increased drought stress during flowering and pod fill.

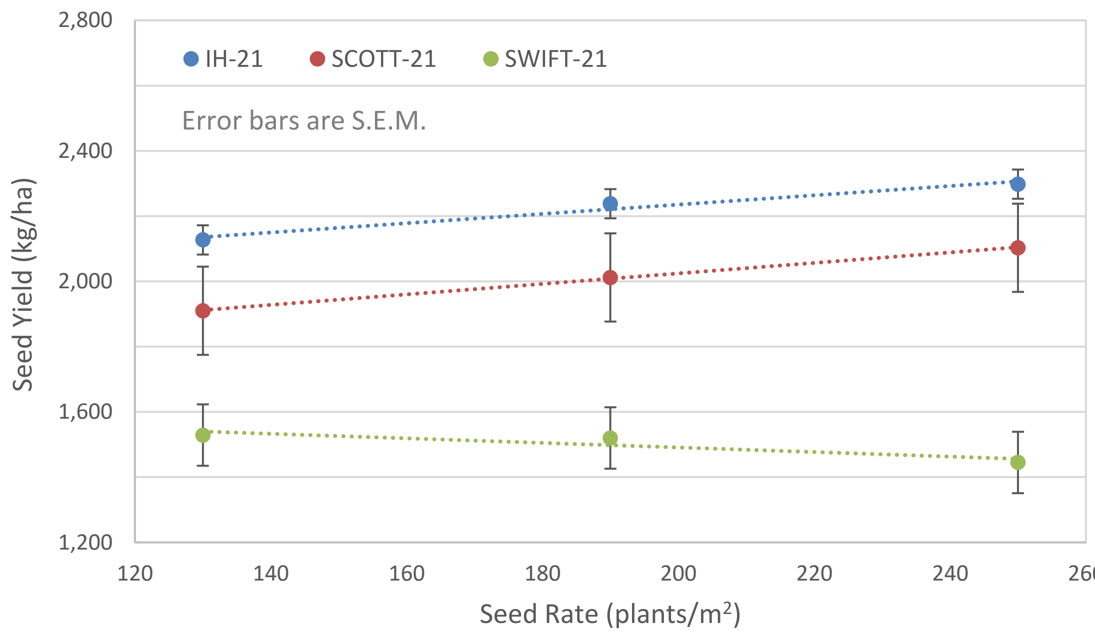


**Figure 5. Seed rate effects on lentil seed yield at Indian Head, Scott, and Swift Current, Saskatchewan (2021).**

The main effect means for fungicide effects on lentil yield are illustrated in Fig. 6 below. As previously alluded to, there was no statistical evidence of the fungicide applications affecting lentil yield and no trends were observed at any of the three locations. This response was not unexpected given the dry conditions and lack of disease observed in the plots.

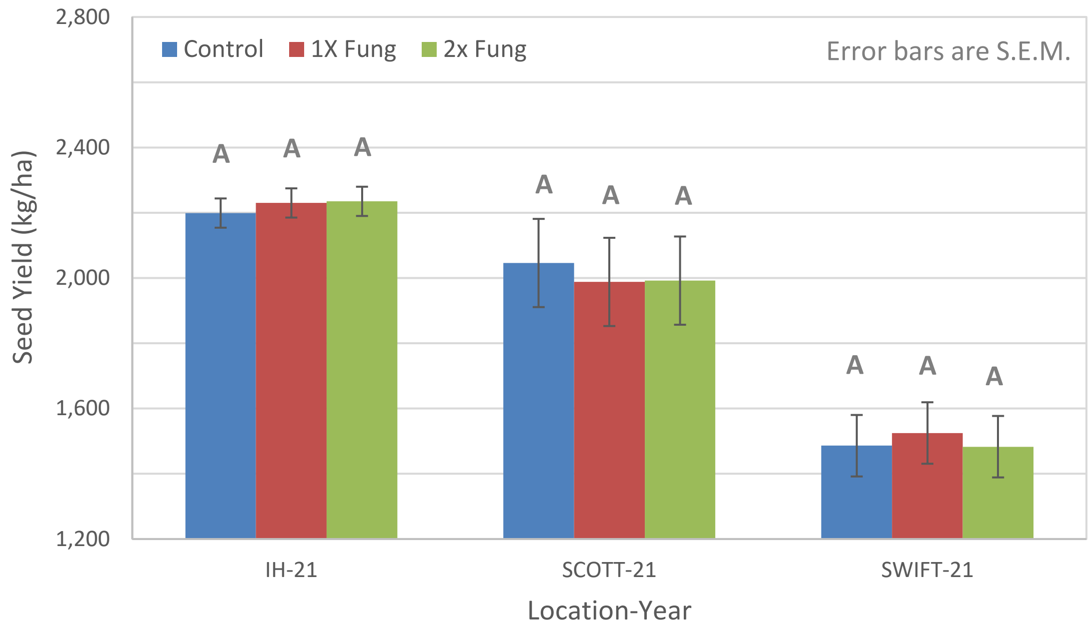


**Figure 6. Fungicide treatment effects lentil seed yield at Indian Head, Scott, and Swift Current, Saskatchewan (2021). The fungicide treatments were 1) an untreated control, 2) fungicide application at early flowering, and 3) fungicide application at early flowering and a second ~14 day later.**

Detailed results tables for the treatment effects on lentil test weight are provided in Tables 12 and 13 of the Appendices while the main effects are presented below in Figures 7 and 8. At Indian Head, test weight was affect by seed rate (*P* = 0.001) but not fungicide (*P* = 0.560) and an SR x FUNG interaction was detected (*P* = 0.047). The seeding rate response was due to a small but significant linear (*P* < 0.001) increase in test weight with seed rate. The interaction appear to be due to the response being more prominent in the control and with a single fungicide application than with the dual application of fungicide (Table 13). While significant, this response was of little practical importance and was likely due more to random or spatial variability than actual, repeatable treatment effects. At Scott, neither seed rate (*P* = 0.796), fungicide (*P* = 0.532), or the interaction (*P* = 0.394) was significant for test weight and no trends were observed. At Swift Current, the overall F-test for seed rate was marginally significant (*P* = 0.093) but fungicide had no effect (*P* = 0.764) and there was no interaction between the two factors (*P* = 0.587). Similar to Indian Head, lentil test weight at Swift Current increased linearly (*P* = 0.033) with seed rate.

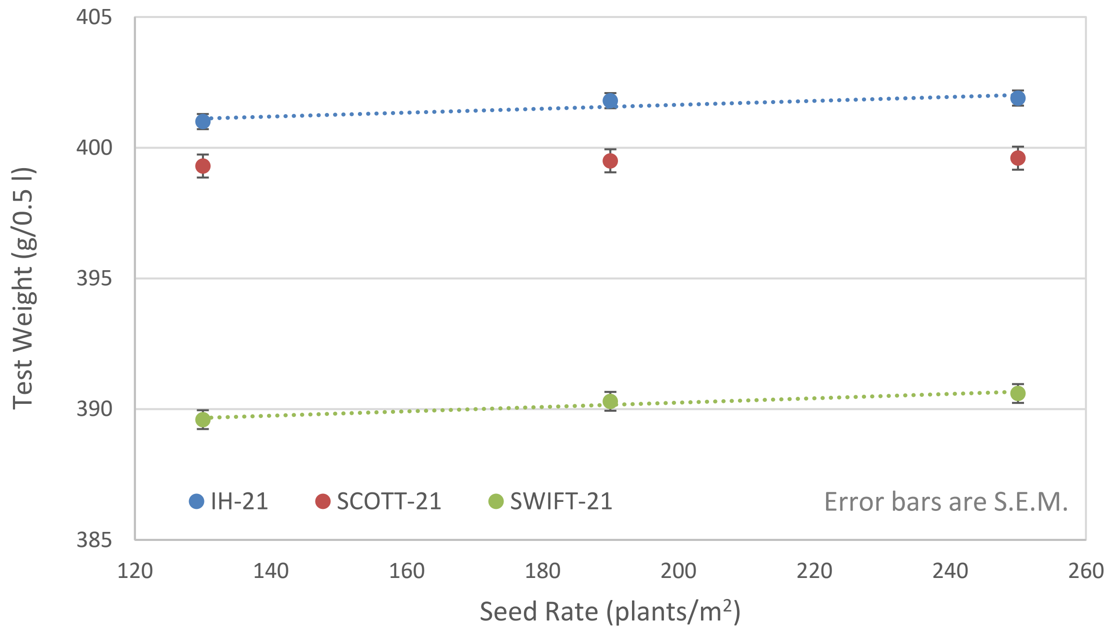


**Figure 7. Seed rate effects on lentil test weight at Indian Head, Scott, and Swift Current, Saskatchewan (2021).**

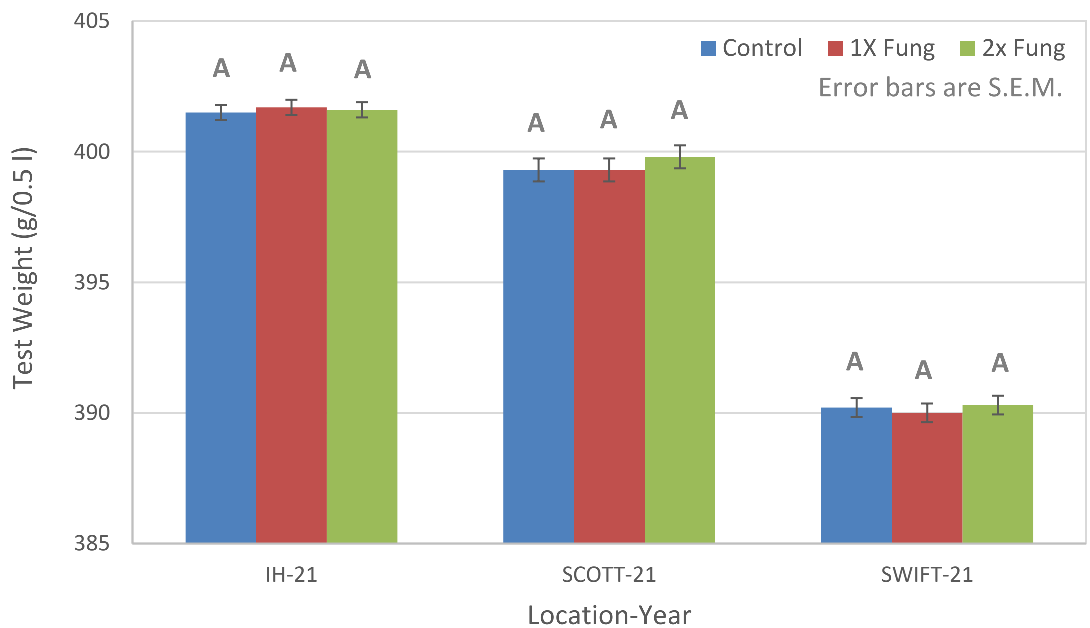


**Figure 8. Fungicide treatment effects lentil test weight at Indian Head, Scott, and Swift Current, Saskatchewan (2021). The fungicide treatments were 1) an untreated control, 2) fungicide application at early flowering, and 3) fungicide application at early flowering and a second ~14 day later.**

For lentil seed weight, or thousand kernel weight, detailed results are provided in Tables 15 and 16 while simplified main effect results are provided in Figs. 9 and 10 below. At Indian Head, seed weight was affected by seed rate ($P$ = 0.001) but not fungicide ($P$ = 0.128) and no SR x FUNG interaction was detected ($P$ = 0.910). The seed rate response was such that seed weight declined linearly ($P$ < 0.001) with increasing seed rate. At Scott, the response was similar whereby seed weight declined linearly ($P$ = 0.016) as the seed rate increased. The fungicide response was marginally significant ($P$ = 0.061) but inconsistent and there was no SR x FUNG interaction ($P$ = 0.621). At Swift Current, neither seed rate ($P$ = 0.280), fungicide ($P$ = 0.146), nor their interaction ($P$ = 0.849) were significant and their were no noteworthy trends observed.

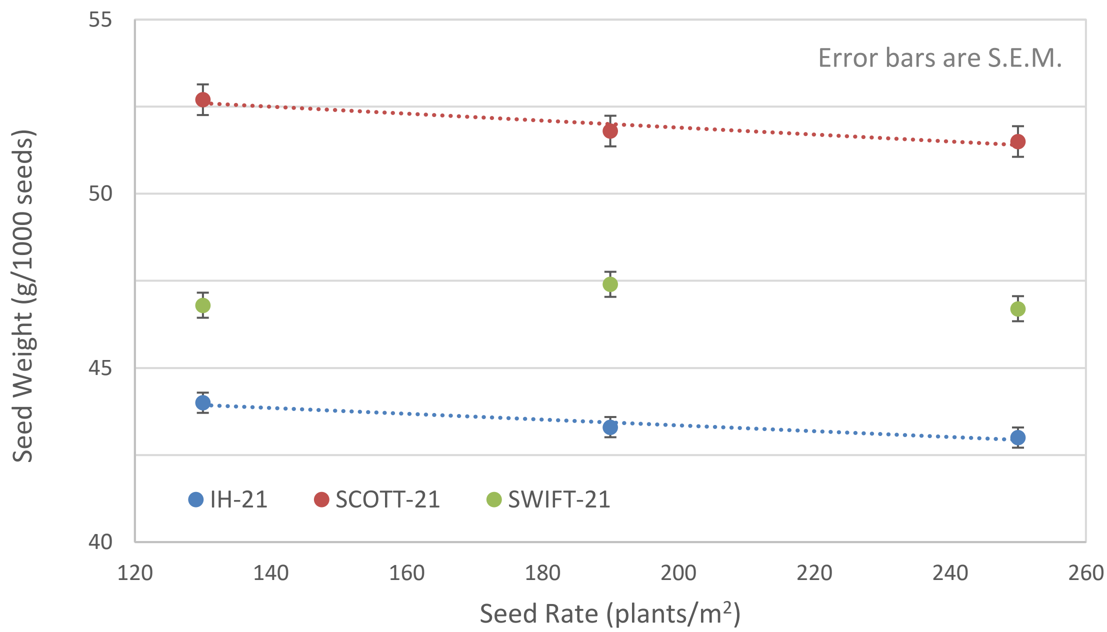


**Figure 9. Seed rate effects on lentil seed weight at Indian Head, Scott, and Swift Current, Saskatchewan (2021).**

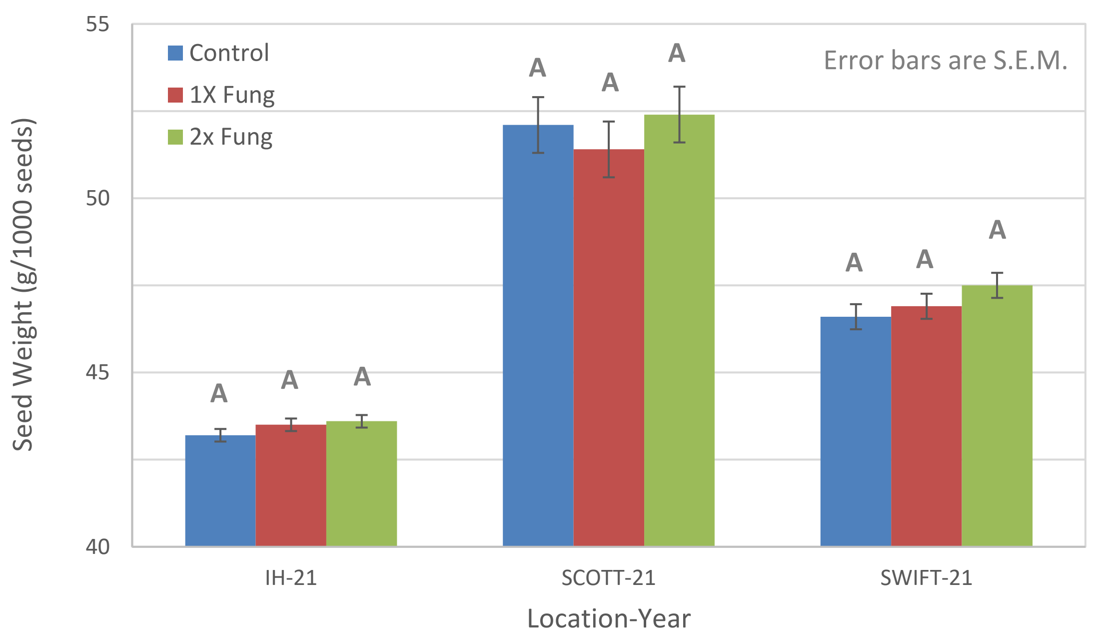


**Figure 10. Fungicide treatment effects lentil seed weight at Indian Head, Scott, and Swift Current, Saskatchewan (2021). The fungicide treatments were 1) an untreated control, 2) fungicide application at early flowering, and 3) fungicide application at early flowering and a second ~14 day later.**

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

As is the case with most agronomic decisions, the actual economic returns associated with the treatments we evaluated will vary widely with the specific environmental conditions encountered along with commodity and input prices. Further to that, absolute profits can also vary dramatically, regardless of responses, depending on factors such as land cost, equipment, labour, and interest rates. With that in mind, using some basic assumptions, we calculated marginal economic returns associated with each of the main factors evaluated in this project. Since there were no interactions between seeding rate and response to fungicide for yield, we did not calculate profits for individual treatments at this time. The assumptions we used follow. A small red lentil price of $0.53/kg was derived from the 2021 base price provided by SCIC (https://www.scic.ca/ci/prices/#commercialcrop). A seed price of $0.50/kg was based on the actual cost of seed IHARF purchased in the spring of 2021. Seed treatment products varied across locations but were accounted for and roughly estimated at $11/ha, $16/ha, and $21.23/ha at the 130 seeds/m$^2$, 190 seeds/m$^2$, and 250 seeds/m$^2$ seed rates. Fungicide prices are based on suggested retail prices provided by Nutrien ($140.57/l for Dyax and $140.34/kg for Lance WDG). A fungicide application cost of $14.44 was derived from Page 18 of the 2020-21 Farm Machinery Custom and Rental Rate Guide (https://publications.saskatchewan.ca/api/v1/products/76527/formats/85808/download). Summaries of these basic economic analyses are provided in Tables 16 and 17 of the Appendices.

The most profitable seed rate varied with location. At Indian Head and Scott, where yields increased linearly with seed rate (albeit not significantly at Scott), the 250 seeds/m$^2$ was most profitable despite the relatively modest responses. At Swift Current, however, yields were not significantly affected by seed rate and, numerically, declined slightly as the seed rate was increased and the lower rates were more profitable. Due to the small number of sites and specific environmental conditions the work was conducted under, we cannot draw broad economic conclusions with regard to seeding rate at this stage. That said, the observed seed rate responses and basic economic analyses show that higher seeding rates (i.e. ≥ 190 seeds/m$^2$) can increase economic returns, particularly under less severely moisture limiting environments where approximately average to above average yields are possible. However, these higher rates appear to be less likely to be beneficial in extremely dry and lower yielding environments such as Swift Current in 2021 and, under such circumstances, more traditional rates (i.e. 130-190 seeds/m$^2$) may still be appropriate.

Focussing on the foliar fungicide treatments, due to the lack of significant yield responses and relatively high costs of this input, the untreated control treatments were the most profitable at all three locations. While we know that lentils can be quite susceptible to disease and severely impacted if it is not managed, these results clearly illustrate the need to base fungicide applications on actual disease pressure and probability of response in order to maximize profits. While it can sometimes be difficult to predict the impact of disease and response to fungicide at the optimal application time, if symptoms are negligible and conditions during the early reproductive stages are dry, the likelihood of an economic benefit to the application is low and it would be extremely difficult to justify two fungicide applications.

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

Overall, the results from this project in 2021 were reasonably consistent with those observed in the previous ADF study it was initiated to expand upon and other regionally relevant work that preceded it, particularly with respect to seeding rate. We saw benefits in terms of the crop's ability to compete with weeds and yields were maximized with plant stands of 140 plants/m$^2$ or even higher (i.e. seed rates of ≥ 190 seeds/m$^2$). Aside from higher input costs, the greatest concern with increasing seed rates are in relation to higher disease pressure attributable to a denser canopy and, potentially, smaller and weaker individual plants. Due to the dry conditions, this did not occur in the current project; however, we expect that our results would have differed under wetter conditions and elevated disease pressure. At this stage, we would not revise any recommendations other than to say that, under dry conditions and in the absence of any visible disease, it is unlikely that there will be any benefit to even a single fungicide application and dual applications should not be considered. Deciding not to spray a crop like lentils for disease comes with a certain amount of risk and can be difficult for producers, however, and should be coupled with frequent scouting and monitoring of conditions. If conditions change (i.e. wetter weather commences, disease symptoms appear) it may be necessary to apply a foliar fungicide even if the crop is well into flowering/early pod fill in order to protect against yield loss.

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

Due to the unusually dry weather and relatively small number of locations, it is recommended to repeat this project in 2022. To build upon the seeding rate findings with respect to both competition with weeds and implications for disease, updated research on row spacing and how row spacing interacts with seeding rate recommendations and/or response to fungicide applications could have considerable merit. While 22-30 cm is most common, commercial drills are available with row spacing approaching 40 cm. Wider row spacing could be beneficial from a disease management perspective; however, this comes with other drawbacks including a lessened ability to compete with weeds and subsequently increased pressure on herbicides and potential for the development of resistant weeds. Furthermore, the ability of plants to compensate for wider rows through increased branching or extended flowering is limited and varies with crop type.

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

While we did host a small field day on July 20, 2021 at Indian Head these plots could not be shown for logistic reasons; however, the plots were shown to an assortment of industry representatives and producers during smaller, informal tours throughout the season. At Swift Current, the plots were shown during multiple tours throughout the season and also highlighted during a CKSW radio program entitled 'Walk the Plots' which is broadcast weekly throughout the growing season.

This annual report will be available online through the IHARF website and interim results will be highlighted in other presentations and extension activities where appropriate opportunities arise.

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

Financial support for this project was provided exclusively by the Saskatchewan Pulse Crop Development Board. We would also like to acknowledge the Board of Directors from each of the participating organizations in addition to the many technical and professional staff without whom this project could not have been completed. IHARF, WARC, and WCA also have strong working relationships and memorandums of understanding with Agriculture and Agri-Food Canada which should be acknowledged and help make work like this possible.

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

**Table 4. Selected agronomic information and dates of operations in 2021 for lentil trials at Indian Head, Scott, and Swift Current, Saskatchewan.**

| Activity | Indian Head | Scott | Swift Current |
|---|---|---|---|
| Previous Crop | Oat | Wheat | Barley |
| Pre-seed Herbicide | 890g glyphosate/ha (May 11) | 1334g glyphosate/ha + 21g carfentrazone-ethyl (May 9) | 890g glyphosate/ha + 21g carfentrazone-ethyl (May 3) |
| Seeding | May 4 | May 10 | May 17 |
| Row Spacing | 30 cm | 25 cm | 21 cm |
| Fertilizer Applied | 7-35-0-0 | 7-33-0-0 | 9-41-0-0 |
| Inoculant | 3.0 kg/ha Nodualator Duo SCG | 3.7 kg/ha Nodualator Duo SCG | 4.6 kg/ha Nodualator Duo SCG |
| Variety | CDC Proclaim CL | CDC Impulse CL | CDC Impulse CL |
| Seed Treatment | 300 ml Insure Pulse + 39 ml INTEGO Solo/100 kg seed | 100 ml Vibrance Maxx RFC/100 kg seed | 100 ml Vibrance Maxx RFC/100 kg seed |
| In-crop Herbicide | 20g imazamox/ha + 9g imazapyr/ha (June 13) | 20g imazamox/ha + 171g sethoxydim/ha (June 13) | 211g sethoxydim/ha (May 31) 20g imazamox/ha (June 16) 59g clethodim/ha (June 21) |
| Emergence Counts | June 18 | June 14 | June 9 |
| Foliar Fungicide | June 30 and July 13 (as per protocol) | July 5 and July 13 (as per protocol) | July 5 and July 19 (as per protocol) |
| Disease Ratings | June 29 and July 23 | July 5 and July 20 | July 5 and July 27 |
| Weediness Ratings | August 1 | August 3 | July 27 |
| Pre-harvest Herbicide / Desiccant | 890g glyphosate/ha (July 30) 410g diquat/ha (August 3) | 410g diquat/ha (August 4) | 410g diquat/ha (August 6) |
| Harvest | August 8 | August 12 | August 13 |

**Table 5. Lentil seeding rate effects, orthogonal contrast results, and treatment means for spring plant densities at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ------------------------------------------- Pr > F ------------------------------------------- | | |
| Seeding Rate (SR) | <0.001 | <0.001 | <0.001 |
| SR: linear | <0.001 | <0.001 | <0.001 |
| SR: quadratic | 0.626 | 0.066 | 0.212 |
| | ------------------------------- Plant Density (plants/m$^2$) -------------------------------- | | |
| SR: 130 seeds/m$^2$ | 105.9 C | 108.4 C | 106.8 C |
| SR: 190 seeds/m$^2$ | 138.7 B | 137.1 B | 142.9 B |
| SR: 250 seeds/m$^2$ | 176.9 A | 149.5 A | 167.5 A |
| S.E.M | 4.85 | 6.04 | 4.41 |

**Table 6. Lentil seeding rate effects, orthogonal contrast results, and treatment means for visual weediness ratings at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ------------------------------------------- Pr > F ------------------------------------------- | | |
| Seeding Rate (SR) | <0.001 | 0.007 | 0.249 |
| SR: linear | <0.001 | 0.002 | 0.104 |
| SR: quadratic | 0.067 | 0.387 | 0.749 |
| | ------------------------------- Weediness Ratings (1-10) -------------------------------- | | |
| SR: 130 seeds/m$^2$ | 1.4 A | 2.4 A | 1.8 A |
| SR: 190 seeds/m$^2$ | 0.9 B | 2.2 AB | 1.5 A |
| SR: 250 seeds/m$^2$ | 0.8 B | 1.5 B | 1.3 A |
| S.E.M | 0.08 | 0.25 | 0.31 |

**Table 7. Lentil seeding rate effects, orthogonal contrast results, and treatment means for initial disease ratings (prior to first fungicide application) at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ------------ Pr > F ------------ | | |
| Seeding Rate (SR) | 0.985 | 0.413 | 0.851 |
| SR: linear | 1.000 | 0.505 | 0.778 |
| SR: quadratic | 0.862 | 0.252 | 0.625 |
| Main Effect | ------------ T1 Disease Ratings (0-100) ------------ | | |
| SR: 130 seeds/m$^2$ | 0.5 A | 0.8 A | 0.1 A |
| SR: 190 seeds/m$^2$ | 0.5 A | 0.2 A | 0.2 A |
| SR: 250 seeds/m$^2$ | 0.5 A | 0.5 A | 0.1 A |
| S.E.M | 0.08 | 0.35 | 0.06 |

**Table 8. Lentil seeding rate and fungicide main effects, orthogonal contrast results, and treatment means for final disease ratings at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Main effect means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current [Z] |
|---|---|---|---|
| | ------------ Pr > F ------------ | | |
| Seeding Rate (SR) | 0.061 | 0.613 | – |
| Fungicide (FUNG) | 0.360 | 0.157 | – |
| SR x FUNG | 0.693 | 0.736 | – |
| SR: linear | 0.946 | 0.395 | – |
| SR: quadratic | 0.019 | 0.622 | – |
| | ------------ T2 Disease Ratings (0-100) ------------ | | |
| SR: 130 seeds/m$^2$ | 1.9 A | 0.2 A | 0.0 |
| SR: 190 seeds/m$^2$ | 1.6 B | 0.2 A | 0.0 |
| SR: 250 seeds/m$^2$ | 1.9 A | 0.0 A | 0.0 |
| S.E.M | 0.27 | 0.14 | – |
| | | | |
| FUNG: Control (0x) | 1.8 A | 0.0 A | 0.0 |
| FUNG: Single (1x) | 1.9 A | 0.0 A | 0.0 |
| FUNG: Dual (2x) | 1.7 A | 0.3 A | 0.0 |
| S.E.M | 0.27 | 0.14 | – |

[Z] Final disease rating values were all zero at Swift Current 2021

**Table 9. Individual lentil seeding rate by fungicide treatment means and orthogonal contrast results for final disease ratings at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current [z] |
|---|---|---|---|
| | ------------------------- T2 Disease Ratings (0-100) -------------------------- | | |
| 0X Fung – 130 seeds/m$^2$ | 1.8 ab | 0.0 a | 0 |
| 0x Fung – 190 seeds/m$^2$ | 1.7 ab | 0.0 a | 0 |
| 0x Fung – 250 seeds/m$^2$ | 2.0 ab | 0.0 a | 0 |
| SR: linear (0x fung) | 0.411 | 1.000 | – |
| SR: quadratic (0x fung) | 0.253 | 1.000 | – |
| | | | |
| 1x Fung – 130 seeds/m$^2$ | 2.0 ab | 0.0 a | 0 |
| 1x Fung – 190 seeds/m$^2$ | 1.6 ab | 0.0 a | 0 |
| 1x Fung – 250 seeds/m$^2$ | 2.0 a | 0.0 a | 0 |
| SR: linear (1x fung) | 0.813 | 1.000 | – |
| SR: quadratic (1x fung) | 0.050 | 1.000 | – |
| | | | |
| 2x Fung – 130 seeds/m$^2$ | 1.9 ab | 0.5 a | 0 |
| 2x Fung – 190 seeds/m$^2$ | 1.6 ab | 0.5 a | 0 |
| 2x Fung – 250 seeds/m$^2$ | 1.7 ab | 0.0 a | 0 |
| SR: linear (2x fung) | 0.349 | 0.147 | – |
| SR: quadratic (2x fung) | 0.281 | 0.395 | – |
| | | | |
| S.E.M | 0.29 | 0.24 | – |

[Z] Final disease rating values were all zero at Swift Current 2021

**Table 10. Lentil seeding rate and fungicide main effects, orthogonal contrast results, and treatment means for seed yield at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Main effect means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ---------- Pr > F ---------- | | |
| Seeding Rate (SR) | <0.001 | 0.192 | 0.152 |
| Fungicide (FUNG) | 0.404 | 0.822 | 0.585 |
| SR x FUNG | 0.940 | 0.137 | 0.840 |
| SR: linear | <0.001 | 0.072 | 0.078 |
| SR: quadratic | 0.316 | 0.948 | 0.417 |
| | ---------- Seed Yield (kg/ha) ---------- | | |
| SR: 130 seeds/$m^2$ | 2127 B | 1910 A | 1529 A |
| SR: 190 seeds/$m^2$ | 2238 A | 2012 A | 1520 A |
| SR: 250 seeds/$m^2$ | 2298 A | 2103 A | 1445 A |
| S.E.M | 44.8 | 135.2 | 94.1 |
| | | | |
| FUNG: Control (0x) | 2199 A | 2046 A | 1486 A |
| FUNG: Single (1x) | 2230 A | 1988 A | 1525 A |
| FUNG: Dual (2x) | 2235 A | 1992 A | 1483 A |
| S.E.M | 44.8 | 135.2 | 94.1 |

**Table 11. Individual lentil seeding rate by fungicide treatment means and orthogonal contrast results for seed yields at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current [z] |
|---|---|---|---|
| | ------------------------------ Seed Yield (kg/ha) -------------------------------- | | |
| 0X Fung – 130 seeds/m$^2$ | 2098 c | 1875 a | 1489 a |
| 0x Fung – 190 seeds/m$^2$ | 2208 abc | 2262 a | 1533 a |
| 0x Fung – 250 seeds/m$^2$ | 2291 ab | 2000 a | 1435 a |
| SR: linear (0x fung) | <0.001 | 0.491 | 0.500 |
| SR: quadratic (0x fung) | 0.757 | 0.046 | 0.304 |
| | | | |
| 1x Fung – 130 seeds/m$^2$ | 2149 abc | 1869 a | 1552 a |
| 1x Fung – 190 seeds/m$^2$ | 2240 abc | 1959 a | 1527 a |
| 1x Fung – 250 seeds/m$^2$ | 2300 ab | 2135 a | 1498 a |
| SR: linear (1x fung) | 0.005 | 0.148 | 0.500 |
| SR: quadratic (1x fung) | 0.726 | 0.785 | 0.980 |
| | | | |
| 2x Fung – 130 seeds/m$^2$ | 2135 bc | 1985 a | 1547 a |
| 2x Fung – 190 seeds/m$^2$ | 2266 ab | 1816 a | 1499 a |
| 2x Fung – 250 seeds/m$^2$ | 2303 a | 2175 a | 1403 a |
| SR: linear (2x fung) | 0.002 | 0.298 | 0.081 |
| SR: quadratic (2x fung) | 0.280 | 0.100 | 0.725 |
| | | | |
| S.E.M | 53.1 | 169.9 | 104.5 |

**Table 12. Lentil seeding rate and fungicide main effects, orthogonal contrast results, and treatment means for test weight at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Main effect means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ---------- Pr > F ---------- | | |
| Seeding Rate (SR) | 0.001 | 0.796 | 0.093 |
| Fungicide (FUNG) | 0.560 | 0.532 | 0.764 |
| SR x FUNG | 0.047 | 0.394 | 0.587 |
| SR: linear | <0.001 | 0.504 | 0.033 |
| SR: quadratic | 0.111 | 0.985 | 0.705 |
| | ---------- Test Weight (g/0.5 l) ---------- | | |
| SR: 130 seeds/m$^2$ | 401.0 B | 399.3 A | 389.6 A |
| SR: 190 seeds/m$^2$ | 401.8 A | 399.5 A | 390.3 A |
| SR: 250 seeds/m$^2$ | 401.9 A | 399.6 A | 390.6 A |
| S.E.M | 0.29 | 0.44 | 0.36 |
| | | | |
| FUNG: Control (0x) | 401.5 A | 399.3 A | 390.2 A |
| FUNG: Single (1x) | 401.7 A | 399.3 A | 390.0 A |
| FUNG: Dual (2x) | 401.6 A | 399.8 A | 390.3 A |
| S.E.M | 0.29 | 0.44 | 0.36 |

**Table 13. Individual lentil seeding rate by fungicide treatment means and orthogonal contrast results for test weight at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current [z] |
|---|---|---|---|
| | ---------------------------- Test Weight (g/0.5 l) ------------------------------ | | |
| 0X Fung – 130 seeds/m$^2$ | 400.9 b | 398.5 a | 389.7 a |
| 0x Fung – 190 seeds/m$^2$ | 401.3 ab | 399.8 a | 390.8 a |
| 0x Fung – 250 seeds/m$^2$ | 402.3 a | 399.7 a | 390.2 a |
| SR: linear (0x fung) | 0.002 | 0.180 | 0.581 |
| SR: quadratic (0x fung) | 0.412 | 0.377 | 0.229 |
| | | | |
| 1x Fung – 130 seeds/m$^2$ | 400.9 b | 399.1 a | 389.6 a |
| 1x Fung – 190 seeds/m$^2$ | 402.2 ab | 399.5 a | 389.8 a |
| 1x Fung – 250 seeds/m$^2$ | 402.1 ab | 399.4 a | 390.5 a |
| SR: linear (1x fung) | 0.006 | 0.684 | 0.248 |
| SR: quadratic (1x fung) | 0.046 | 0.763 | 0.707 |
| | | | |
| 2x Fung – 130 seeds/m$^2$ | 401.4 ab | 400.4 a | 389.5 a |
| 2x Fung – 190 seeds/m$^2$ | 402.0 ab | 399.2 a | 390.2 a |
| 2x Fung – 250 seeds/m$^2$ | 401.5 ab | 399.8 a | 391.2 a |
| SR: linear (2x fung) | 0.803 | 0.543 | 0.040 |
| SR: quadratic (2x fung) | 0.123 | 0.253 | 0.851 |
| | | | |
| S.E.M | 0.37 | 0.66 | 0.57 |

**Table 14. Lentil seeding rate and fungicide main effects, orthogonal contrast results, and treatment means for seed weight at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| Source/Treatment | Indian Head | Scott | Swift Current |
|---|---|---|---|
| | ---------- Pr > F ---------- | | |
| Seeding Rate (SR) | 0.001 | 0.034 | 0.280 |
| Fungicide (FUNG) | 0.128 | 0.061 | 0.146 |
| SR x FUNG | 0.910 | 0.621 | 0.849 |
| SR: linear | <0.001 | 0.016 | 0.745 |
| SR: quadratic | 0.465 | 0.392 | 0.122 |
| | ---------- Seed Weight (g/1000 seeds) ---------- | | |
| SR: 130 seeds/m$^2$ | 44.0 A | 52.7 A | 46.8 A |
| SR: 190 seeds/m$^2$ | 43.3 B | 51.8 AB | 47.4 A |
| SR: 250 seeds/m$^2$ | 43.0 B | 51.5 B | 46.7 A |
| S.E.M | 0.18 | 0.80 | 0.36 |
| | | | |
| FUNG: Control (0x) | 43.2 A | 52.1 A | 46.6 A |
| FUNG: Single (1x) | 43.5 A | 51.4 A | 46.9 A |
| FUNG: Dual (2x) | 43.6 A | 52.4 A | 47.5 A |
| S.E.M | 0.18 | 0.80 | 0.36 |

**Table 15. Individual lentil seeding rate by fungicide treatment means and orthogonal contrast results for seed weight at Indian Head, Scott, and Swift Current, Saskatchewan in 2021. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, *P* ≤ 0.05).**

| **Source/Treatment** | **Indian Head** | **Scott** | **Swift Current** [z] |
|---|---|---|---|
| | ------------------------ Seed Weight (g/1000 seeds) ------------------------ | | |
| 0X Fung – 130 seeds/$m^2$ | 43.8 ab | 52.9 a | 46.2 a |
| 0x Fung – 190 seeds/$m^2$ | 43.1 ab | 52.3 a | 47.3 a |
| 0x Fung – 250 seeds/$m^2$ | 42.7 b | 51.2 a | 46.3 a |
| SR: linear (0x fung) | 0.007 | 0.032 | 0.975 |
| SR: quadratic (0x fung) | 0.646 | 0.702 | 0.152 |
| | | | |
| 1x Fung – 130 seeds/$m^2$ | 44.0 a | 51.9 a | 47.1 a |
| 1x Fung – 190 seeds/$m^2$ | 43.4 ab | 50.9 a | 46.9 a |
| 1x Fung – 250 seeds/$m^2$ | 43.3 ab | 51.4 a | 46.6 a |
| SR: linear (1x fung) | 0.083 | 0.552 | 0.595 |
| SR: quadratic (1x fung) | 0.435 | 0.273 | 0.957 |
| | | | |
| 2x Fung – 130 seeds/$m^2$ | 44.1 a | 53.2 a | 47.2 a |
| 2x Fung – 190 seeds/$m^2$ | 43.6 ab | 52.1 a | 48.1 a |
| 2x Fung – 250 seeds/$m^2$ | 43.1 ab | 52.0 a | 47.2 a |
| SR: linear (2x fung) | 0.014 | 0.121 | 0.950 |
| SR: quadratic (2x fung) | 0.978 | 0.447 | 0.226 |
| | | | |
| S.E.M | 0.28 | 0.91 | 0.58 |

**Table 16. Basic economic analyses including estimated gross revenues and expenses associated with the seed rate treatments. The basic assumptions included a grain price of $0.53/kg red lentils and seed costs (seed plus seed treatment) of $33, $49, and $64/ha at 130, 190, and 250 seeds/m$^2$ seed rates.**

| Seed Rate | Indian Head | Scott | Swift Current [z] |
|---|---|---|---|
| | ---------------------------- Gross Revenue ($/ha) ---------------------------- | | |
| 130 seeds/m$^2$ | $1,127 | $1,012 | $810 |
| 190 seeds/m$^2$ | $1,186 | $1,066 | $806 |
| 250 seeds/m$^2$ | $1,218 | $1,115 | $766 |
| | ------------------------------ Seed Costs ($/ha) ------------------------------ | | |
| 130 seeds/m$^2$ | $33 | $33 | $33 |
| 190 seeds/m$^2$ | $49 | $49 | $49 |
| 250 seeds/m$^2$ | $64 | $64 | $64 |
| | --------------------------- Marginal Profits (S/ha) --------------------------- | | |
| 130 seeds/m$^2$ | $1,094 | $979 | $777 |
| 190 seeds/m$^2$ | $1,138 | $1,018 | $757 |
| 250 seeds/m$^2$ | $1,154 | $1,051 | $702 |

**Table 17. Basic economic analyses including estimated gross revenues and expenses associated with the fungicide treatments. The basic assumptions included a grain price of $0.53/kg red lentils and fungicide costs of approximately $58/ha for each product plus an application cost of $14 per pass.**

| Seed Rate | Indian Head | Scott | Swift Current [z] |
|---|---|---|---|
| | ---------------------------- Gross Revenue ($/ha) ---------------------------- | | |
| No Foliar Fungicide | $1,165 | $1,084 | $788 |
| 1x Foliar Fungicide | $1,182 | $1,054 | $808 |
| 2x Foliar Fungicide | $1,185 | $1,056 | $786 |
| | --------------------------- Fungicide Costs ($/ha) --------------------------- | | |
| No Foliar Fungicide | $0 | $0 | $0 |
| 1x Foliar Fungicide | $73 | $73 | $73 |
| 2x Foliar Fungicide | $146 | $146 | $146 |
| | --------------------------- Marginal Profits (S/ha) --------------------------- | | |
| No Foliar Fungicide | $1,165 | $1,084 | $788 |
| 1x Foliar Fungicide | $1,109 | $981 | $735 |
| 2x Foliar Fungicide | $1,038 | $909 | $640 |

Government of Saskatchewan

**Crops and Irrigation Branch**
**Crop Protection Laboratory**

**Ministry of Agriculture**
1610 Park St.
Regina, SK S4N 2G1

General Inquiries: 306-787-8130
Billing Inquiries: 306-787-7191
Email: cpl@gov.sk.ca

August 9, 2021

**Lab ID:** PD-296

**Test Requested:** Plant Disease

IHARF
Chris Holzapfel
Box 1568
INDIAN HEAD, SK, S0G 2K0
cholzapfel@iharf.ca

Field ID: 21-2502
Land Location: ----

**Results:**
Common Name: Inconclusive
Scientific Name: *N/A*

There was no disease identified in this sample.

For more information on crop protection please visit www.saskatchewan.ca, or contact the Agriculture Knowledge Centre at 1-866-457-2377, your Regional Crop Specialist, or a Crops and Irrigation Branch Provincial Specialist.

Sincerely,

Scott Hartley, P. Ag
Manager, Crop Protection Lab
Crops and Irrigation Branch

**Figure 11. Saskatchewan Ministry of Agriculture Crop Protection Laboratory disease report for lentils grown at Indian Head, Saskatchewan in 2021.**

Government of Saskatchewan

**Crops and Irrigation Branch**
**Crop Protection Laboratory**

**Ministry of Agriculture**
1610 Park St.
Regina, SK S4N 2G1

General Inquiries: 306-787-8130
Billing Inquiries: 306-787-7191
Email: cpl@gov.sk.ca

July 26, 2021

**Lab ID:** PD-293

**Test Requested:** Plant Disease

WARC
Kayla Slind
Box 89
Scott, SK, S0K 4A0
kayla.slind@warc.ca

Field ID: Hyland Field 2021
Land Location: SE-19-39-20-W3

**Results:**
Common Name: Root rot complex
Scientific Name: *Fusarium spp. oomycetes*

Fusarium present. Currently we do not perform DNA diagnostics for specific root rots at CPL; however diagnoses are made based on field history, symptomology, microscopy, and/or plating. Numerous oospores (indicative of Aphanomyces sp. or Pythium sp.) were observed in the samples.

For more information on crop protection please visit www.saskatchewan.ca, or contact the Agriculture Knowledge Centre at 1-866-457-2377, your Regional Crop Specialist, or a Crops and Irrigation Branch Provincial Specialist.

Sincerely,

Scott Hartley, P. Ag
Manager, Crop Protection Lab
Crops and Irrigation Branch

**Figure 12. Saskatchewan Ministry of Agriculture Crop Protection Laboratory disease report for lentils grown at Scott, Saskatchewan in 2021.**

15. **Reference papers or articles –** as applicable

There are no reference papers or articles to refer to at this time.