Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Final Report

The final project report should be made available electronically (MS Word). Additional data tables and or graphs may be submitted in spreadsheet format. Due to formatting, printing and distribution requirements, final reports will not be accepted as PDF documents. Completed reports must be returned by email to Evaluation.Coordinator@gov.sk.ca.

Project Title: Demonstration of the effect of varying seeding rates on the yield and maturity of Winter Camelina

Project Number: 20230408, 20230409, 20230410 and 20230411

Producer Group Sponsoring the Project: South East Research Farm

Project Location(s): *Provide the name or number of the rural municipality, nearest town or legal land location if possible. Provide the name of any cooperating landowner(s).* Redvers, Prince Albert, Swift Current and Scott, SK

Project start date *(month & year):* 9/1/2023

Project end date *(month & year):* 1/31/2025

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Abstract *(maximum 200 words)*

Detail key elements from the project objectives, methodology, results and conclusions to provide a short concise summary of the project. List extension activities such as field days or workshops and include the number of people who visited the project.

Camelina is a relatively new crop to establish in Canada, so there is currently limited information available regarding its optimal cultivation practices. However, the crop is gaining popularity due to its versatile applications in several industries. Camelina seeds have significant potential in the renewable biofuel sector, the animal feed industry and the human food industry, particularly because of their healthy oil profile. Recognizing its growing importance, a trial was conducted in fall 2023 across four locations in Saskatchewan— Redvers, Swift Current, Scott and Prince Albert —with harvesting completed in 2024. Unfortunately, the trial at Scott was terminated at the later stages, leading to incomplete yield data from that location. Despite this setback, the data collected from the other sites revealed valuable insights. A significant increase in plant count was observed with increasing seeding rates during both fall and spring seasons across all sites. However, noticeable level of plant mortality was seen.

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Canada

Other parameters, such as weed percentage and yield, were also recorded during the trial. However, these factors showed no statistically significant response to seeding rate, suggesting that higher seeding rates may not necessarily affect these metrics. Redvers exhibited a shorter time to maturity compared to the other locations. This is likely attributed to its geographical position further south, where warmer temperatures and longer growing seasons may have accelerated crop development.

Project Objectives

Provide a short statement outlining the project objectives. Identify the key concept this project was designed to demonstrate. For example, you might use a statement such as *"This project was intended to demonstrate and compare the benefits of……" or "The objective of this project was to demonstrate the impact of…."*

The objective of this project was to demonstrate the effect of seven different seeding rates of camelina on yield, maturity and other agronomic aspects like plant count and weed control ratings.

Project Rationale

Briefly describe why this project is of interest to local producers. Why is it important to have this project? What are the potential beneficial outcomes? What is the perceived need?

Winter camelina has several benefits for Saskatchewan producers, both as a cash crop that can be straight cut in mid-late July allowing to spread the farmers' workload, and as a cover crop in the Fall and early spring promoting soil health and storing carbon (3). Camelina seeds have applications in the renewable biofuel industry, animal feed industry, as well as the human food industry due to its healthy oil profile (4, 5). Rotating Winter camelina with Winter cereals like winter wheat and fall rye could provide for a true winter crop rotation on the Canadian prairies (5).

Winter camelina, like Spring camelina, is also resistant to flea beetles and typically has low fertilizer rate demands which also make it an economical and environmentally friendly option for farmers. And despite being new to the prairies, there has been interest in growing Winter camelina commercially.

(3) https://www.country-guide.ca/crops/winter-camelina-showing-promise/
(4) https://www.grainews.ca/crops/camelina-poised-for-a-comeback/
(5) https://www.topcropmanager.com/camelina-on-the-rise/

Methodology

Fully describe how the project was set up and run. You should provide enough information so that any reader can understand what you did, and where and when you did it. From that they can determine if your report has any relevance to their own operation. For example, your description should include all relevant items such as 1) the number and size of any field plots, 2) what was seeded, 3) what treatments were applied to the plots, 4) the schedule or timing of any relevant activities such as seeding, treatment application or harvest, and 5) what was measured to evaluate the success of any treatment. If your project dealt with animals, you should be sure to include 1) the number of animals in each trial group, 2) the treatment or procedure applied to each group, and 3) what was measured to evaluate the success of each treatment.

The experiment was set up as a Randomized Complete Block Design with four replicates and seven treatments. The treatments were:

1. Treatment 1 – Target plant density of 100 plants/m^2
2. Treatment 2 – Target plant density of 200 plants/m^2
3. Treatment 3 – Target plant density of 300 plants/m^2

4. Treatment 4 – Target plant density of 400 plants/m^2
5. Treatment 5 – Target plant density of 500 plants/m^2
6. Treatment 6 – Target plant density of 600 plants/m^2
7. Treatment 7 – Target plant density of 700 plants/m^2

An emergence mortality of 30% was assumed when calculating seeding rates. The mortality rate was based on previous research by Johnson et al. (2010) in which emergence mortality ranged between 20 to 30%. The trial was seeded at four locations in Saskatchewan near Scott, Swift Current, Prince Albert and Redvers. Seed depth is an important parameter to consider while seeding camelina as it is a small seed crop.

In the Fall after seeding, emergence was measured by doing plant counts in two 1m rows per plot. In the following Spring, winter survival was measured by doing plant counts in all plots again. Before weed control measures were undertaken in the Spring, weed rating was done (% of plot with weed growth). Maturity ratings were done at physiological maturity. Yield was collected at harvest and harvest seeds will be subsampled but quality analysis is pending.

Table A. Agronomic information:

Operations	**Redvers**	**Swift Current**	**Prince Albert**	**Scott**
Seeding date	13 Sep 2023	13 Sep 2023	15 Sep 2023	15 Sep 2023
Seeder type	4 row Fabro knife opener cone seeder	9 row disc-drill	6 row double disc	Fabro knife opener
Row spacing	12 inches	8.5 inches	10 inches	10 inches
Seeding Depth	3/8 inch	3/8 inch	¼ inch	1 inch
Previous crop	Perennial grasses	Durum	Canola	Canary seed
Fertilizer (lb/ac)	80.4N-32.5P-5.9K-7.9S	120N-68P-0K-24.5S-2B-1Zn	60N-38P-0K fall(seeding) 74N (spring Top dressed)	99.6N-9.6P-0K-9.6S
Weed control	Glyphosate@0.7 l/ac	Glyphosate@0.67 l/ac	Glyphosate Transorb @0.67 l/ac	Glyphosate 540 @ 1 l/ac
In-crop (Agrochemical)	N/A	Insecticide-Decis @30ml/acre	N/A	Herbicide-ConquerII@0.3 lt and Merge@0.5 lt per acre
Harvesting date	30 July 2024	29 July 2024	8 Aug 2024	N/A (Trial Terminated)

Results *(you must provide the following information)*

Present and discuss any project results, including any data or measurements taken to evaluate the demonstration. Include things that didn't appear to work. These results are just as important to share. List extension activities such as field days or workshops. List the activity, the date it occurred, and the number of people who attended.

Weather information is listed in Appendices

Fall plant count:

The first plant count was done in late fall before snowfall to get an idea of actual plant emergence compared to the target seed rate. The data clearly demonstrated a significant increase in plant count with higher seeding rates. This trend that was consistent across all four sites. At Swift Current, a seeding rate of 700 seeds/m² resulted in a significantly higher plant count compared to lower seeding rates of 100, 200, 300, and 400 seeds/m². However, the plant count at 700 seeds/m² was comparable to the counts observed at 500 and 600 seeds/m², indicating a leveling-off effect at higher seeding rates.

A similar pattern was observed at Redvers and Prince Albert, where the plant count at 700 seeds/m² was significantly greater than at 100, 200, and 300 seeds/m² but showed no significant difference compared to 400, 500, and 600 seeds/m². The overall plant count was low at Scott, possibly due early onset of cold weather or seeding depth.

Table 1. Plant count (plants/ m²).

Treatment	Swift Current	Redvers	Prince Albert	Scott
100 seeds/m2	107^{D}	101^{D}	106^{C}	40
200 seeds/m2	185^{CD}	143^{CD}	308^{BC}	50
300 seeds/m2	285^{BC}	240^{BC}	283^{BC}	56
400 seeds/m2	289^{BC}	309^{AB}	401^{AB}	86
500 seeds/m2	336^{AB}	342^{AB}	450^{AB}	99
600 seeds/m2	349^{AB}	377^{A}	604^{A}	104
700 seeds/m2	441^{A}	403^{A}	641^{A}	123
P value	<0.0001	<0.0001	<0.0001	---

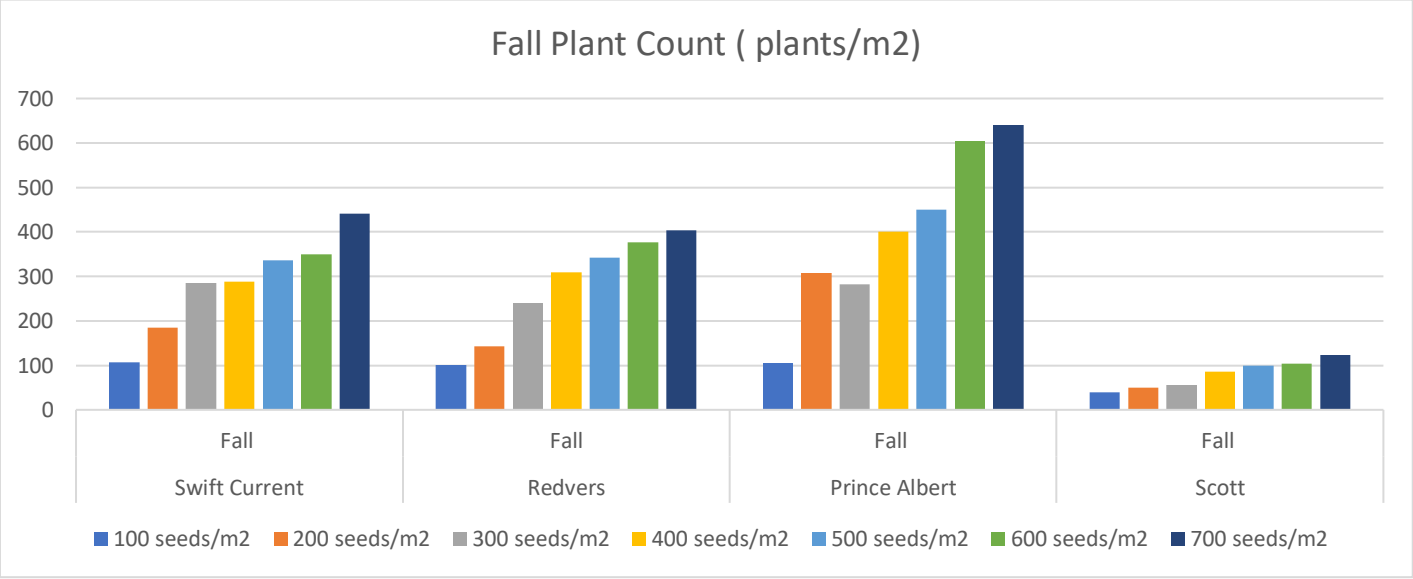

Figure 1.

Spring plant count:

The data for plant count was recorded again in spring after snow was melted to check the mortality of the crop. The data revealed that there was an increase in the plant density with seed rate increases. Data revealed some significant differences in the results at Swift Current and Redvers. At Prince Albert plant count did increase with seed rate, but remains non-significant (Table 2, Figure 2).

Table 2. Plant count (Plants/ m^2).

Treatment	Swift Current	Redvers	Prince Albert	Scott
100 seeds/m2	24^{B}	68^{C}	98	22
200 seeds/m2	35^{AB}	96^{BC}	133	31
300 seeds/m2	41^{AB}	141^{AB}	206	61
400 seeds/m2	43^{AB}	151^{AB}	142	79
500 seeds/m2	49^{A}	169^{A}	284	94
600 seeds/m2	56^{A}	162^{A}	226	99
700 seeds/m2	53^{A}	194^{A}	241	94
P- value	0.003	<0.0001	0.147	---

The data reveals that there was a higher level of mortality as seed rate increased.

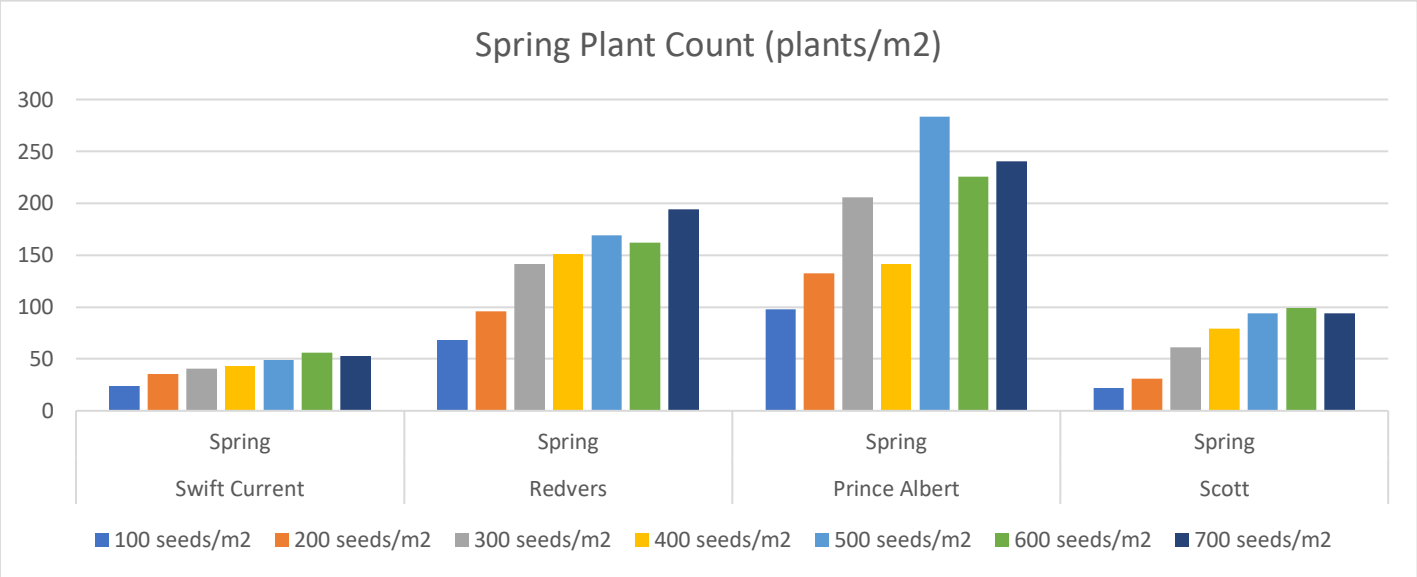

Figure 2.

The data indicates that a certain level of plant mortality occurred across all seeding rates and this trend was consistent across all sites included in the study. Tables 3 provides a detailed breakdown of the mortality rates observed at each site and for each seeding rate. While the pattern of mortality appeared uneven, a clear trend emerged; mortality rates tended to increase as seeding rates increased. Figure 3 shows the combined site average of seed mortality across seed rates.

Table 3. Camelina mortality for each treatment and site (%).

Seed rate	Swift Current	Redvers	Prince Albert	Scott
100 seeds/m2	76	32	3	78
200 seeds/m2	82	52	34	85
300 seeds/m2	86	53	32	80
400 seeds/m2	89	62	65	80
500 seeds/m2	90	66	43	81
600 seeds/m2	91	73	62	84
700 seeds/m2	92	72	66	87

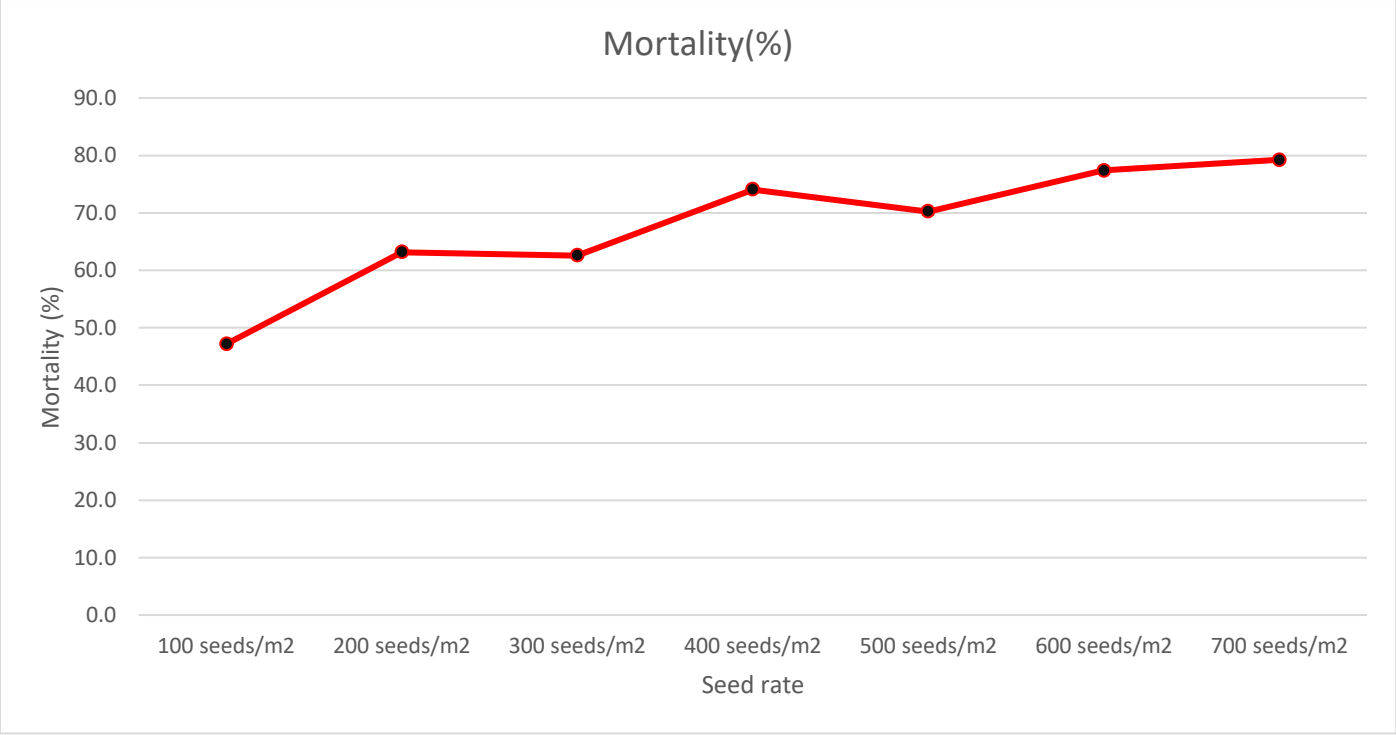

Figure 3.

Weed Rating %

The weed rating was collected as percentage of area covered by weeds. In order to evaluate whether there is some reasonable effect of the seeding rate on weed control (Table 4). The data recorded at Scott suggests that weed population decreases as seed rate increases. Although, the data did not result in a significant difference among the seed rates. The weed rating at Swift Current and Prince Albert revealed uneven weed rating and data was unavailable for the Redvers site.

Table 4. Weed Rating (%)

Seed rate	Swift Current	Prince Albert	Scott
100 seeds/m2	8	1	5
200 seeds/m2	5	5	4
300 seeds/m2	5	6	3
400 seeds/m2	5	4	1
500 seeds/m2	5	11	2
600 seeds/m2	8	4	2
700 seeds/m2	5	4	2
P- value	0.557	0.319	---

Days to maturity

Days to maturity is an important parameter to measure the effect of different seed rate on maturity duration of the crop. The data at Swift current, Prince Albert and Redvers shows non- significant effects of the seeding rates to the duration of maturity (Table 5). At Redvers, all the plots were considered mature on the same day. Unfortunately, the trial was terminated at Scott before maturity.

Table 5. Days to maturity

Seed rate	Swift Current	Redvers	Prince Albert
100 seeds/m2	317	304	321
200 seeds/m2	316	304	320
300 seeds/m2	317	304	320
400 seeds/m2	317	304	320
500 seeds/m2	317	304	320
600 seeds/m2	316	304	319
700 seeds/m2	317	304	320
P- value	0.624	----	0.537

Yield

The plot was harvested with a plot combine at all sites except Scott, where the trial was terminated before harvest. Plot yield was converted to kg/ha with standardization on moisture to 10%. The data revealed non-significant differences in yield with seed rates (Table 6, Figure 4). However, at Swift Current there was a general trend for yield to increase with seed rate.

Table: 6 Yield (kg/ha)

Seed rate	Swift Current	Redvers	Prince Albert
100 seeds/m2	1459.0	1959.4	1725.4
200 seeds/m2	1522.5	2109.6	1712.0
300 seeds/m2	1563.7	1823.4	1731.7
400 seeds/m2	1606.6	1755.8	1652.9
500 seeds/m2	1612.5	1937.0	1550.9
600 seeds/m2	1629.6	1740.3	1628.7
700 seeds/m2	1653.5	1849.0	1595.4
P- value	0.718	0.113	0.521

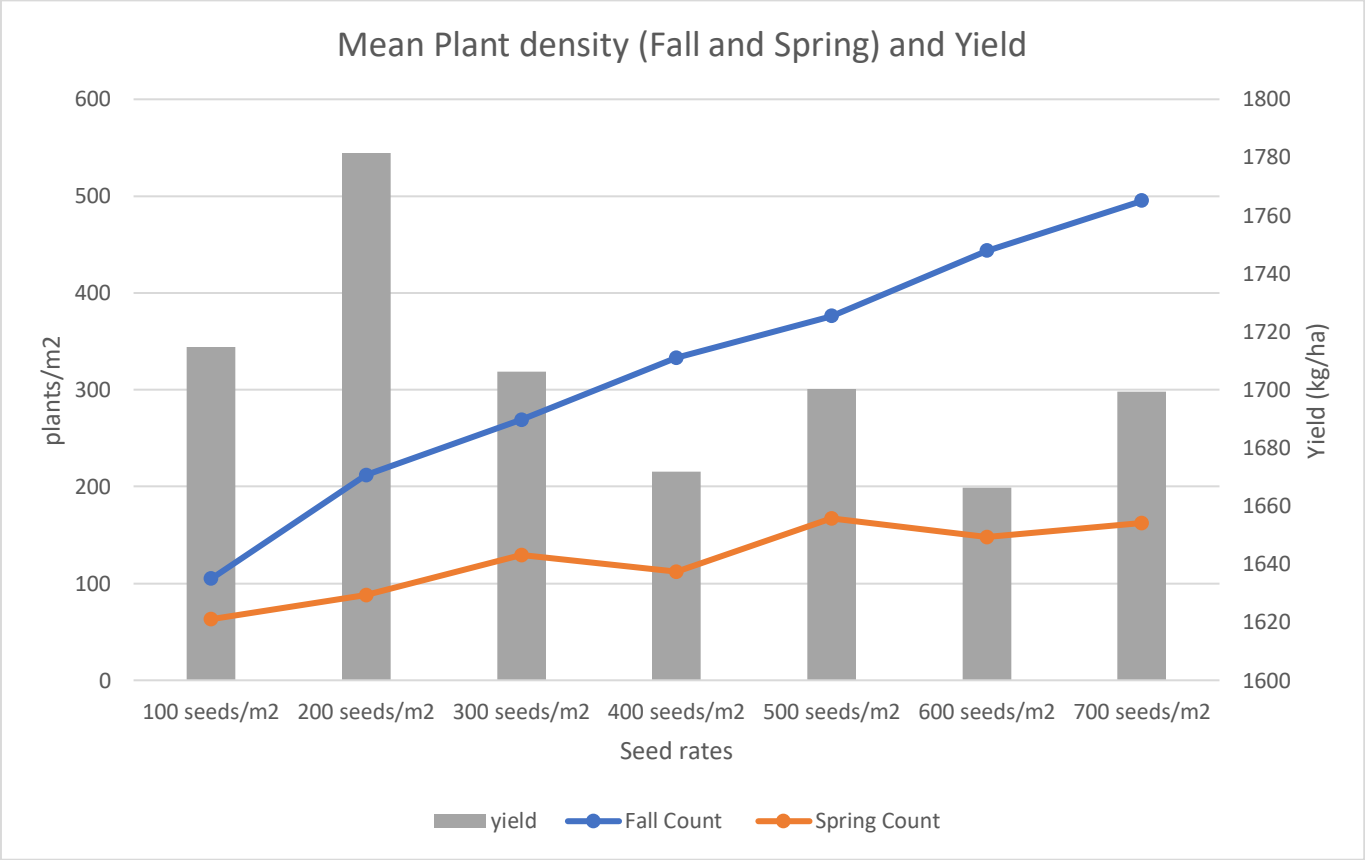

Figure 4. Mean plant count (Fall and Spring) and combined site yield (Redvers, Swift Current and Prince Albert).

Conclusions and Recommendations

Describe what was learned from the demonstration. Highlight any significant conclusions and provide recommendations for the application and adoption of the project results. Be sure that you have presented the relevant data to support your conclusions. Identify any further research, development and communication needs, if applicable.

This trial demonstrated a significant impact of seeding rate on winter camelina establishment. Higher seeding rates positively influenced plant densities in both fall and spring at all the sites. Trial results revealed a considerable amount of mortality with increasing seed rates reaching up to 90% in the dry brown soil zone. Weed control ratings were generally insignificant with only one site showing better weed control with an increasing seed rate. The days to maturity varied across locations and maturity was earlier at Redvers compared to Prince Albert and Swift Current. It was noted that the days to maturity varied between 304 days to 320 days. Yield was not significantly affected by the variation in seed rate. Environmental factors during fall and winter may have also played a role in these outcomes. Future trials could explore a broader range of seeding rates, soil types and environmental conditions. It appears that fall camelina has a high degree of plasticity to respond to seeding density.

Sustainable Canadian Agricultural Partnership (Sustainable CAP) Performance Indicators

a) List of performance indicators

Sustainable CAP Indicator	Total Number
Scientific publications from this project (List the publications under section b)	
• Published	None
• Accepted for publication	None
Highly Qualified Personnel (HQPs) trained during this project	
• Master's students	N/A
• PhD students	N/A
• Post docs	N/A
Knowledge transfer products developed based on this project (presentations, brochures, factsheets, flyers, guides, extension articles, podcasts, videos)[1]. List the knowledge transfer products under section (c)	The trial was presented at field days.

[1] Please only include the number of unique knowledge transfer products.

b) List of scientific journal articles published/accepted for publication from this project. Please ensure that each line includes the following: **Title, Author(s), Journal, Date Published or Accepted for Publication and Link to Article (if available).** *Add additional lines as needed*.

1.N/A
2.
3.
4.

c) List of knowledge transfer products/activities developed from this project.

Knowledge Transfer Product or Activity	Event/Location Where Knowledge Transfer Was Conducted	Estimated Number of Producers Participated in Knowledge Transfer	Link (if available)
"Walk the Plots" radio program – August 29, 2023	Country 94.1, Magic 97.1, CKSW 570	Broadcasted across Southwest Saskatchewan	https://wheatlandconservation.ca/news-events/

Acknowledgements

Include actions taken to acknowledge support by the Ministry of Agriculture, the Canadian Agriculture Partnership (for projects approved between 2017 and 2023) and the Sustainable Canadian Agriculture Partnership (for projects approved between 2023 and 2028).

During field days at all sites the support by the Ministry of Agriculture, Canadian Agriculture Partnership and Sustainable Canadian Agriculture Partnership was acknowledged.

Appendices

Identify any changes expected to industry contributions, in-kind support, collaborations or other resources.

1. The trial got terminated at Scott in its later stages due to chemical drift incident in the producer field where it was located left in lacking the data for yield and maturity.

2. 50% funding and quality analysis of camelina was assured by Yield 10, but the company filed bankruptcy, leading to pending quality analysis.

Weather
Temperature:

	Redvers		Swift Current		Scott		Prince Albert	
2023-2024	Temp(°C)	Long term(°C)	Temp(°C)	Long term(°C)	Temp(°C)	Long term(°C)	Temp(°C)	Long term(°C)
September	14.5	12.5	15.5	12.7	13.4	10.4	13.9	11.6
October	3.9	4.5	4.3	4.9	3.7	3.3	3.5	3.1
November	-2.7	-4.9	-0.4	-3.2	-2.2	-1.8	-2.1	-7.1
December	-6.1	-12.0	-0.3	-9.3	-4.3	-13.9	-5.8	-14.6
January	-----	-14.8	-12.2	-10.8	-16.3	-15.5	-16.7	-14.6
February	-----	-11.9	-5.7	-9.3	-9.3	-12.9	-10.3	-16.1
March	3.2	-5.4	6.8	-3.1	-9.9	-5.5	-10.9	-7.1
April	19.5	4.4	6.8	4.5	5.7	2.8	3.8	1.5
May	92.0	11.1	10.6	10.7	9.8	10.8	8.4	11.2
June	156.2	16.2	14.3	15.2	13.3	15.3	11.3	16.0
July	13.4	18.7	21.3	18.3	18.9	17.1	18.1	18.3
August	39.0	18.0	19.4	18.0	17.4	16.5	15.2	16.7

Precipitation:

	Redvers		Swift Current		Scott		Prince Albert	
2023-2024	Precipitation (mm)	Long term(mm)	Precipitation (mm)	Long term(mm)	Precipitation (mm)	Long term(mm)	Precipitation (mm)	Long term(mm)
September	35.2	32.7	25.1	40.6	3.0	36.0	3.5	28.3
October	32.2	27.0	19.8	24.4	3.7	17.9	26.9	20.0
November	4.2	20.0	16.7	17.9	3.3	22.2	11.7	24.7
December	7.2	23.3	0.2	15.0	7.8	14.0	15.9	10.3
January	----	20.0	9.4	16.1	14.0	14.9	9.1	17.9
February	----	11.5	21.6	11.4	22.1	9.1	10.6	9.8
March	-7.5	19.2	13.7	16.2	16.8	14.4	15.8	14.1
April	5.4	22.8	22.2	21.3	22.1	21.6	17.2	19.6
May	10.9	60.0	73.6	45.3	74.2	36.3	69.6	36.5
June	14.7	95.2	52.1	91.7	112.0	61.8	118.8	66.8
July	20.0	65.5	18.6	46.2	26.7	72.1	31.4	61.3
August	17.7	46.6	18.2	48.1	42.8	45.7	42.0	43.6

References

Johnson, E.N., Falk, K., Klein-Gebbinck, H., Lewis, L., Vera, C., Gan, Y., Hall, L., Topinka, K., Phelps, S. and Davey, B., 2010, February. Optimizing seeding rates and plant densities for Camelina sativa. In *Soils and Crops Workshop*.

Expenditure Statement

You must provide an expenditure statement showing how ADOPT funds were used. Expenditures must be reported using the budget categories shown in Appendix B of your contract. We recommend that you report your expenditures using the Excel spreadsheet we have developed for this purpose (ADOPT Expenditure Statement.xls). That spreadsheet is available from the research branch project manager or the evaluation coordinator.

Note that the ADOPT contract requires you to retain all receipts and financial records relating to the project for at least six years after the project is completed.

Spreadsheet Attached