Project Identification

1. **Project Title:** Demonstrating benefits of seeding date and rate on canola yield and quality
2. **Project Number:** CARP ADOPT 20220479
3. **Producer Group(s):**
    a. Saskatchewan Conservation Learning Centre Inc. (CLC)
    b. Wheatland Conservation Area (WCA)
    c. Northeast Agriculture Research Foundation (NARF)
    d. Irrigation Crop Diversification Corporation (ICDC)
4. **Project Location(s):**
    a. Conservation Learning Centre located 18km south of Prince Albert (SW 20-46-26 W2, RM 461)
    b. Swift Current - WCA
    c. Melfort - NARF
    d. Outlook - ICDC
5. **Project Start and End Dates (month & year):** April 2023 – February 2024
6. **Project Contact Person and Contact Details:**
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Objectives and Rationale

7. Project Objectives

1. Demonstrate how different seeding dates and rates can improve canola yield and quality

2. Provide a backdrop to discuss methods of flea beetle control and proper scouting techniques at Field Days and/or extension activities.

8. Project Rationale

Early seeding dates can be a low-cost way to increase canola yields when spring conditions are favourable. Depending on location within the province, early canola seeding happens any time between late April and early May. Early seeding allows the crop to take advantage of spring moisture and to avoid flowering during the highest summer temperatures. In western Canada, seeding after May 20th can put the crop at risk of an early fall frost, which can degrade quality and yield. Early seeded canola has been found to have a positive effect on quality with higher oil content and grade, this also results in a lower protein content. While there is risk of a spring frost when seeding early, canola seedlings are slow and hardened off plants can withstand some frost. If spring stands are damaged by frost, there is still time for the plant to recover or to reseed if absolutely necessary (Canola Council of Canada, 2022).

Very early seeding does come with drawbacks. While canola can germinate in temperatures as low as 2-3 degrees Celsius, germination is lower and slower resulting in reduced plant stands and uneven emergence. Since canola in cool soils emerges more slowly, the protection offered by seed treatments can decline at a crucial time when plants need the protection from flea beetles. Slow growing canola may also be more susceptible to weed competition especially against winter annuals and perennials. Although early seeded canola faces higher risks such as early insect infestations, seedling disease, water ponding, soil crusting, frost damage, and slow emergence, it can still result in a yield benefit when compared to later seeding (Canola Council of Canada, 2022; Kirkland & Johnson, 2000). While there is likely to be a higher mortality rate with earlier seeded canola, the plants that survive have more time to branch out and compensate for a thinner stand. A way to compensate for high seedling mortality would be to increase seeding rates.

High seeding rates can increase early crop biomass improving weed competition, increase seed weight and oil content, and reduce days to flowering and maturity. When greater biomass is achieved, the flowering period occurs earlier and the risk of flowering during high temperatures is reduced (Harker et al., 2015). Increased seeding rates can also help late seeded canola mature faster. When canola stands are less than 40 plants per square meter, maturity can be delayed by 4-6 days (Canola Council of Canada, 2022). A higher seeding rate equates to a denser stand with less branching for an overall early maturity.

Best management practices to consider when seeding early include seeding at the low end of recommended seeding depths, use of a seed treatment, source better quality seed, apply starter

P, and spray early for weed control. Shallower seeding depths are encouraged as water should be available and this will allow the crop to germinate quicker. The use of a seed treatment and good quality seed is most beneficial when early seeding since germination and emergence is slower. A pre-seeding burn off is challenging prior to early seeding due to cool temperatures and lack of weed growth. Therefore, it is important to plan for an early in crop herbicide application (Weir, 2019).

Seeding rates and dates that promote good stand establishment are also considerations that could help reduce yield losses associated with flea beetles. Early seeding can be beneficial because larger plants will be less susceptible to flea beetles once they emerge and higher seeding rates can reduce the damage by diluting the injury to individual plants. It is estimated flea beetle damage results in over $300 million annually in crop losses in North America. Flea beetles feed on newly emerged canola seedlings and can cause considerable damage quickly. They invade canola fields from the edges, and if caught in time, can be controlled by an insecticide application to the field perimeter before spreading farther into the field. Seed treatments are standard practice in western Canada (Canola Council of Canada, 2022), but when flea beetle populations are high, an integrated approach utilizing cultural methods and foliar sprays can help.

Early seeding typically results in better yielding crops, especially for canola, barley, wheat, peas, and oats (Weir, 2019). But not all crops can be seeded early. This demonstration aims to show producers how their canola crop may have performed differently based on seeding date. It will also incorporate two different seeding rates, as seeding rate may reduce the severity of risks associated with seeding too early or too late.

2022 was a challenging spring for canola acres. Some parts of Saskatchewan were seeded late due to excess spring precipitation, and while other parts of the province could seed early, they struggled with a moisture deficit (Warner, 2022). Producers had to choose between early seeding, reseeding, and late seeding their canola crops. This demonstration will show when the most ideal time to seed is in a given year across different regions of the province. Due to the high cost of inputs, some producers may be hesitant to seed earlier. Information from this demo will help producers make a more informed decision about when canola should be seeded. It could also demonstrate a low-cost method for increasing canola yields.

This demonstration will also provide opportunity to discuss and show methods to control flea beetles. Regardless of wet or dry conditions, a common 2022 issue throughout the whole province was flea beetle pressure (Warner, 2022). While early seeding can help reduce crop damage from flea beetles, sometimes the opposite is observed due to the species present and timing of arrival. Seeding rate can also be beneficial for flea beetle control. While both of these methods were included in a 2019 ADOPT study, the canola used was untreated, which is not common practice. There were also only two different seeding dates and the higher seeding rate was not successfully established.

While the core idea of seeding date is believed to be well researched and understood by producers, this common practice needs to be revisited due to population changes in the species of flea beetles present in Saskatchewan. Previously understood, early seeding dates avoided flea

beetle pressure when the common species present was the crucifer flea beetle. Later seeding dates may actually be more beneficial for avoiding striped flea beetles that emerge two weeks before crucifers (Arnason, 2023).

Methodology and Results

9. Methodology

The trial was set up as a 4-replicate split plot design. Seeding date was seeded in blocks and seeding rate was randomized within each block. Five seeding dates occurred every 10 -14 days in order to capture an ultra-early seeding date and a late seeding date that falls just before the Crop Insurance Seeding deadline (June 20th for Prince Albert). These dates were adjusted for each site based on spring conditions and local crop insurance deadlines.

Plots measured approximately 2m x 7m depending on site equipment. The standard seeding rate was 80 seeds/m^2 and the higher seeding rate was 160 seeds/m^2. Assuming 50% mortality, the seeding rates were used to target final plant stands of 40 and 80 plants/m^2. Seeding rate was increased in Outlook to 200 and 250 seeds/m^2 to achieve 100 and 125 plants/m^2 due to the site being under irrigation. Weeds and disease were kept non-limiting and fertility was applied based on spring soil test results. Site specific agronomic practices used can be found in the appendix (Table A1).

Soil temperature was recorded at time of seeding for three days (day before, of, and after seeding) to determine general soil temperature. It is recommended that seeding occurs when average soil temperature is at least 4-5 degrees Celsius when measured over three days. All seeding dates across all sites occurred at temperatures above the 4–5-degree Celsius recommendation (Table 3). Plant emergence was recorded as days until approximately 75% of the plot had emerged. Plant density was determined as count of plants in four 1 m sections of crop row at two weeks after emergence.

Flea beetle damage was assessed when the second leaf was visible but not unfolded. Digital photos were collected at two locations per plot (front, edge, and middle of plot) and rated for damage as an estimate of % seedling defoliation using the visual rating key provided at: https://www.canolawatch.org/2011/05/09/estimating-flea-beetle-damage-in-canola/. Ratings were determined as the average damage that occurred on 10-20 plants at each of the two locations per plot.

Days to maturity was recorded as the days from seeding to 60% seed color change. Yield was collected using plot combines, and samples were cleaned and corrected to 10% moisture. Oil content was measured in house using NIR technology. Weather-related conditions such as precipitation, temperature, hail, spring and fall frost days were recorded.

Data analysis was completed by ANOVA using Statistix 10 software. Post-hoc test used was LSD data at the p=0.05 level. Co-efficient of variation (CV) is reported along with grand mean and p-values. Box plots are included for selected results.

10. Results

Weather

All sites were warmer in 2023 than long term averages (Table 1). Outlook was exceptionally dry, but the trial site received 4.6, 3.4 and 1.7 inches of irrigation in June, July, and August respectively. Prince Albert and Melfort were drier than long-term averages. While Swift Current received close to normal precipitation, the site did experience hail damage on July 22nd (Appendix A1).

Table 1. Weather data from four Saskatchewan sites investigating canola seeding dates and rates in 2023.

Location	Year	May	June	July	August	Sept	Oct	Avg/Total
				--- Total Precipitation (mm) ---				
Prince Albert	2023	22.8	52.8	40.8	51.2	3.8	26.9	198.3
	2015-2022	34.1	62.0	67.6	42.9	34.5	20.3	261.4
Swift Current	2023	48.8	33.8	76.7	47.5			207
	2010-2023	44.2	73.9	52.4	43.0			214
Outlook	2023	17.5	15.3	15.5	16.6	16.6		81.5
	1993-2023	41.5	65.3	55.8	43.9	30.5		237
Melfort[a]	2023	31.5	26.4	16.4	50	17.5+	7.2+	149+
	1997-2021	33.4	79.5	69.6	45.9	36.0	28.4	292.8
				--- Mean Temperature (°C) ---				
Prince Albert	2023	14.4	18.8	16.6	17.1	13.9	3.5	14.1
	2015-2022	11.1	16.3	18.6	16.9	11.2	3.3	12.9
Swift Current	2023	14.8	17.8	18.5	17.8			17.2
	2010-2023	10.9	15.4	18.7	17.7			15.7
Outlook	2023	15.2	19.45	18.6	18.7	15.45		17.5
	1993-2023	11.25	16.1	18.85	17.9	13		15.4
Melfort[a]	2023	14.1	19.2	16.9	17.3	14.5	2.9	14.2
	1997-2021	10.1	15.2	17.8	16.7	11.7	3.3	12.5

[a]The Environment Canada Weather Station at Melfort is missing weather data from September 18th and September 23-October 6th of 2023; therefore, average temperatures and cumulative precipitation from September and October 2023 do not include these dates.

Soil Test Results

Soil test results are included for all sites (Table 2). Each site applied fertilizer based on soil test recommendations (Appendix A1). As to be expected, Melfort and Prince Albert, located in the Black Soil Zone, had greater organic matter and residual soil N.

Table 2. Spring soil test results from the four Saskatchewan sites investigating canola seeding dates and rates. CLC in Prince Albert, SK.

Prince Albert							
Depth (cm)	**N (lb/ac)**	**P (ppm)**	**K (ppm)**	**S (lb/ac)**	**OM (%)**	**pH**	**Salts (mmho/cm)**
0 to 15	25	5	262	18	6.1	6.0	0.20
15 to 30	27			22		6.6	0.21
Swift Current							
Depth (cm)	**N (lb/ac)**	**P (ppm)**	**K (ppm)**	**S (lb/ac)**	**OM (%)**	**pH**	**Salts (mmho/cm)**
0 to 15	5	14	364	10	2.6	6.4	0.15
15 to 30	6			8		6.8	0.07
Outlook							
Depth (cm)	**N (lb/ac)**	**P (ppm)**	**K (ppm)**	**S (lb/ac)**	**OM (%)**	**pH**	**Salts (mmho/cm)**
0 to 15	5	5	393	30	3.1	7.9	0.27
15 to 30	4			20		8.3	0.26
Melfort							
Depth (cm)	**N (lb/ac)**	**P (ppm)**	**K (ppm)**	**S (lb/ac)**	**OM (%)**	**pH**	**Salts (mmho/cm)**
0 to 15	19	14	401	20	7.8	6.6	0.37
15 to 60	15			60		7.6	0.58

Table 3. Soil temperature averaged over three days for each seeding date across four Saskatchewan sites. Emergence dates are also included.

Prince Albert			Swift Current			Outlook			Melfort		
Seeding Date	**Soil Temp** ˚C	**Emergence Date (Days)**	**Seeding Date**	**Soil Temp** ˚C	**Emergence Date (Days)**	**Seeding Date**	**Soil Temp** ˚C	**Emergence Date (Days)**	**Seeding Date**	**Soil Temp** ˚C	**Emergence Date (Days)**
May 11	6.8	May 24 (13)	May 3	7.1	May 19 (16)	May 12	15.7	June 3 (22)	May 12	14.3	May 25 (13)
May 19	7.8	May 29 (10)	May 13	10.5	May 26 (13)	May 22	16.5	June 4 (13)	May 24	13.1	June 2 (9)
May 31	13.2	June 6 (7)	May 23	14.6	June 4 (11)	June 1	20.2	June 13 (11)	May 31	18.9	June 7 (7)
June 12	15.2	June 20 (8)	June 2	17.8	June 23 (21)	June 11	21.1	June 19 (8)	June 9	20.2	June 19 (10)
June 21	14	June 28 (7)	June 12	18.3	June 28 (16)	June 21	19.2	June 29 (8)	June 19	19.3	July 4 (15)
Spring Frost:	May 19 (-0.4˚C)		April 29 (-0.7˚C)						April 30 (-3.3°C)		
Fall Frost:	September 20 (-0.3˚C)								October 15 (-0.6°C)		

Data Analysis

Spring Emergence

Emergence can be delayed if canola is planted into cool soils. All canola was seeded into soils warmer than the recommended three-day average minimum of 4-5°C (Table 3). Days to emergence was high across all sites for the first seeding date and shorter for the later May seeding dates. Days to emergence increased again for Melfort and Swift Current with later seeding dates, but remained shorter for both the Prince Albert and Outlook sites. Soil moisture is likely affecting days to emergence more than cool soil temperatures. The Prince Albert site has an onsite SRC climate station that monitors soil moisture. Soil moisture at the CLC was consistent at 32 – 33% (by volume at 10 cm depth) from the first seeding date until May 25th, when it increased to 37%. The only substantial precipitation that fell in the month of May was 19.2 mm from May 24th-25th. June 1st received an additional 22.5 mm of precipitation. These precipitation events likely aided with emergence of the first three seeding dates. Soil moisture was as low as 22.5% in June, but timely precipitation on June 14th and June 19th aided with later seeded canola emergence. While Outlook was dry, the plots were irrigated in June aiding with emergence. Spring frost can be detrimental for early seeded canola crops, but was not an issue across sites in 2023. A spring frost did occur on May 19th after the first seeding date in Prince Albert, but crop had yet to emerge.

Seeding Rate

Seeding rate affected plant density across all sites except for the irrigated location in Outlook. Seeding rate had no affect on the other data collected. The different seeding rates used at Outlook only varied by 25 plants/m^2, whereas the other sites had a greater difference between low and high seeding rates. The irrigation site also would not have been as affected by low soil moisture, but did note that dry conditions for the first seeding date resulted in non-uniform emergence. Plant densities were similar at Prince Albert (47 and 82 plants/m^2) and Melfort (55 and 80 plants/m^2), lowest at Swift Current (25 and 36 plants/m^2), and greatest at Outlook (154 and 151 plants/m^2) (Tables 4-7). Seeding rates were expected to be beneficial for reducing yield losses associated with flea beetle damage and as insurance for a late spring frost. Late spring frost and high flea beetle pressure was not present in 2023. Although there was some flea beetle pressure in Melfort, no differences in % defoliation was observed for seeding rates.

Table 4. Statistical analyses and treatment mean for canola yield and quality response to seeding date and rate at Prince Albert, SK, in 2023. Means within a column followed by the same letter do not significantly differ (LSD, P ≤ 0.05).

Prince Albert					
	Plant Density[z]	**Flea Beetle Defoliation**	**Maturity**	**Grain Yield**	**Oil**
	Plants/m^2	**%**	**Days to**	**Kg/Ha**	**% DMB**
Seeding Rate					
80 PPMS	47 b	0	96	2054	46.7
160 PPMS	82 a	0	96	2327	49.4
Seeding Date					
May 11	51 b	0	99 a	2507 a	49.7 ab
May 19	75 a	0	93 c	2593 a	50.5 a
May 31	61 ab	0	94 bc	2655 a	50.4 a
June 12	75 a	0	98 ab	1830 b	48.9 bc
June 21	60 ab	0	97 ab	1367 c	48.3 c
Rate * Date					
May 11 x 80 PPMS	46 e	0	99	2464	49.5
May 11 x 160 PPMS	57 cde	0	99	2551	49.9
May 19 x 80 PPMS	54 de	0	93	2564	50.7
May 19 x 160 PPMS	95 ab	0	93	2621	50.3
May 31 x 80 PPMS	48 e	0	95	2397	50.1
May 31 x 160 PPMS	74 bcd	0	93	2913	50.7
June 12 x 80 PPMS	44 e	0	99	1549	48.6
June 12 x 160 PPMS	105 a	0	96	2110	49.2
June 21 x 80 PPMS	41 e	0	97	1294	48.2
June 21 x 160 PPMS	79 bc	0	97	1439	48.5
Rate (p-value)	0.0000***	--	0.0849	0.0741	0.1704
Date (p-value)	0.0339*	--	0.0144*	0.0001***	0.0015**
Date * Rate (p-value)	0.0207*	--	0.1273	0.6144	0.4977
Grand Mean	64.3	0	95.9	2187.9	49.6
CV	38.04	--	3.66	29.7	2.97

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Table 5. Statistical analyses and treatment mean for canola yield and quality response to seeding date and rate at Swift Current, SK, in 2023. Means within a column followed by the same letter do not significantly differ (LSD, P ≤ 0.05).

Swift Current						
	Plant Density[z]	**Flea Beetle Defoliation**	**Maturity**	**Grain Yield**	**Adj. Grain Yield**	**Oil**
	Plants/m²	**%**	**Days to**	**Kg/Ha**	**Kg/Ha**	**% DMB**
Seeding Rate						
80 PPMS	25 b	0.03	86	484.2	1278.0	39.7
160 PPMS	36 a	0.18	86	483.5	1239.3	39.9
Seeding Date						
May 3	38 b	0	84 b	441.8 b	1767.1 ab	39.9 b
May 13	28 c	0.31	82 c	600.8 ab	2002.5 a	41.8 a
May 23	49 a	0.19	75 d	687.7 a	1375.4 bc	40.3 b
June 2	22 c	0	82 c	585.1 ab	975.1 c	39.7 b
June 12	14 d	0	108 a	103.8 c	173.0 d	37.3 c
Rate * Date						
May 3 x 80 PPMS	32	0	85	457.9	1831.4	39.5 d
May 3 x 160 PPMS	45	0	84	425.7	1702.9	40.2 cd
May 13 x 80 PPMS	23	0	82	621.2	2070.5	41.5 ab
May 13 x 160 PPMS	32	0.63	81	580.4	1934.5	42.1 a
May 23 x 80 PPMS	41	0.13	76	754.6	1509.2	40.9 bc
May 23 x 160 PPMS	57	0.25	75	620.9	1241.7	39.7 d
June 2 x 80 PPMS	19	0	82	510.4	850.6	39.5 d
June 2 x 160 PPMS	26	0	82	660.0	1099.7	39.8 cd
June 12 x 80 PPMS	10	0	108	76.9	128.2	37.1 e
June 12 x 160 PPMS	19	0	108	130.7	217.8	37.4 e
Rate (p-value)	0.0007***	0.2577	0.1369	0.9856	0.6154	0.4748
Date (p-value)	0.0000***	0.4083	0.0000***	0.0000***	0.0000***	0.0000***
Date * Rate (p-value)	0.8371	0.4864	0.7858	0.2067	0.2550	0.0349*
Grand Mean	30.275	0.10	86.125	483.82	1258.6	39.783
CV	49.7	411.4	13.4	50.2	57.4	4.4

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Table 6. Statistical analyses and treatment mean for canola yield and quality response to seeding date and rate at Outlook, SK, in 2023. Means within a column followed by the same letter do not significantly differ (LSD, P ≤ 0.05).

Outlook					
	Plant Density[z]	**Flea Beetle Defoliation**	**Maturity**	**Grain Yield**	**Oil**
	Plants/m²	**%**	**Days to**	**Kg/Ha**	**% DMB**
Seeding Rate					
200 PPMS	154	0	-	3438.5	41.2
250 PPMS	151	0.5	-	3540.9	41.5
Seeding Date					
May 12	122 c	1.25	109	5193.4 a	42.8 b
May 22	160 ab	0	99	4937.4 a	43.6 a
June 1	137 bc	0	95	3937.3 b	42.1 b
June 11	169 a	0	93	2704.1 c	39.8 c
June 21	175 a	0	94	676.4 d	38.6 d
Rate * Date					
May 12 x 200 PPMS	124	2.5	-	5244.0	42.9
May 12 x 250 PPMS	121	0	-	5142.8	42.8
May 22 x 200 PPMS	175	0	-	5036.8	43.3
May 22 x 250 PPMS	145	0	-	4838.0	43.8
June 1 x 200 PPMS	133	0	-	3772.3	42.2
June 1 x 250 PPMS	140	0	-	4102.3	42.1
June 11 x 200 PPMS	165	0	-	2574.3	39.6
June 11 x 250 PPMS	172	0	-	2834.0	40.0
June 21 x 200 PPMS	174	0	-	565.3	38.2
June 21 x 250 PPMS	177	0	-	787.5	39.1
Rate (p-value)	0.7857	0.3332	-	0.5556	0.1304
Date (p-value)	0.0100*	0.4449	-	0.0000***	0.0000***
Date * Rate (p-value)	0.8010	0.4380	-	0.8149	0.4207
Grand Mean	152.5	0.25	98.0	3489.7	41.4
CV	24.9	632.5	6.1	49.9	5.0

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Table 7. Statistical analyses and treatment mean for canola yield and quality response to seeding date and rate at Melfort, SK, in 2023. Means within a column followed by the same letter do not significantly differ (LSD, P ≤ 0.05).

Melfort					
	Plant Density[z]	**Flea Beetle Defoliation**	**Maturity**	**Grain Yield**	**Oil**
	Plants/m²	**%**	**Days to**	**Kg/Ha**	**% (10% moisture)**
Seeding Rate					
80 PPMS	55 b	10.2	101	2195.2	45.5
160 PPMS	80 a	10.1	101	2313.3	45.7
Seeding Date					
May 12	84 a	19.1 a	94 d	2510.2 b	48.9 a
May 24	64 bc	16.4 b	96 bc	2994.2 a	48.8 a
May 31	71 ab	10.7 c	97 b	2421.4 b	47.6 b
June 9	56 c	2.4 d	95 cd	1840.3 c	43.7 c
June 19	63 bc	2.1 d	122 a	1505.2 d	39.2 d
Rate * Date					
May 12 x 80 PPMS	83	19.5 a	94	2504.3	48.8
May 12 x 160 PPMS	85	18.7 a	94	2516.0	49.0
May 24 x 80 PPMS	46	16.6 b	96	2915.7	48.7
May 24 x 160 PPMS	82	16.1 b	96	3072.7	48.8
May 31 x 80 PPMS	53	10.4 c	97	2363.5	47.4
May 31 x 160 PPMS	88	11.0 c	97	2479.3	47.9
June 9 x 80 PPMS	50	1.5 ef	95	1858.8	43.3
June 9 x 160 PPMS	63	3.3 d	95	1821.8	44.0
June 19 x 80 PPMS	45	2.9 de	122	1333.7	39.3
June 19 x 160 PPMS	81	1.3 f	121	1676.6	39.1
Rate (p-value)	0.0023**	0.6882	0.3332	0.1144	0.3456
Date (p-value)	0.0110*	0.0000***	0.0000***	0.0000***	0.0000***
Date * Rate (p-value)	0.3759	0.0128*	0.4380	0.4988	0.8685
Grand Mean	67.4	10.1	100.7	2254.3	45.6
CV	33.9	71.5	10.5	28.3	8.4

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001. Rate*date post hoc test p=0.15.

Seeding Date

Seeding date consistently had an effect on plant density, maturity, grain yield, and oil content at all sites.

Prince Albert – Plant density was lowest for the earliest seeding date, but still above the desired plant stand of 40 plants/m^2. The earliest seeding date had the longest days to maturity (DTM),

with May 19th and 31st having the shortest DTM. Yield and oil content decreased for both June seeding dates (Table 4).

Swift Current – Plant stands were lowest at Swift Current, with the mid-May seeding date having the greatest plant stand (49 plants/m^2) and the latest seeding date having the lowest plant stand (14 plants/m^2). The earliest and latest seeding dates, had the longest DTM. In field observations found that losses due to hail damage were greater for earlier seeded canola (Appendix A1). An adjusted grain yield is also presented, estimating yields had hail damage not occurred. Canola yield decreased with June seeding dates. Oil content also decreased with the latest seeding date (Table 5).

Outlook – Plant stands in Outlook were lowest for the first and third seeding dates, but were well above desired plant stands. The earliest seeding date (May 12th) had the greatest DTM. Overall yields were greatest at Outlook and decreased as the seeding date became later. Oil content also decreased with delayed seeding (Table 6).

Melfort – Plant stands were greatest for the first and third seeding dates. Flea beetle pressure in Melfort was highest for the earliest seeding dates, but did not reach the threshold of 25% leaf loss for control. Cotyledons can withstand up to 50% leaf loss before economic losses occur, but since damage can progress quickly, the recommendation is to spray at 25% (Canola Council, 2017). The earliest seeding date had the shortest DTM and the latest seeding date was the longest to mature. Even with higher flea beetle damage, yield and oil content was still greatest for earlier seeding dates (Table 7).

Overall, there were no consistent interaction effects of seeding rate and date across the sites (Tables 4-7). Prince Albert did have a significant interaction for plant density. The greatest plant stand was achieved by seeding on June 12th at the high seeding rate and the lowest plant stands occurred at all seeding dates with the lower seeding rate. Swift Current had an interaction effect on oil content showing highest oil content was achieved with the May 13th seeding date using a higher seeding rate. June 12th had the lowest oil content with both seeding rates. Melfort, the only site to have notable flea beetle pressure, had an interaction on flea beetle defoliation, where flea beetle defoliation was significantly reduced at the lower seeding rate for June 9th and for the higher seeding rate on June 19th. Although this interaction was significant the differences between seeding rates were minimal for each seeding date, and flea beetle defoliation was low for these dates ranging from 1.3-3.3%.

This demonstration was a valuable tool to showcase to producers at extension events the importance of recommended best agronomic practices when growing canola. In particular, it provided an excellent opportunity to discuss methods of flea beetle control and proper scouting techniques. Below are site-specific extension events where the project was or will be featured:

WCA - Featured on “Walk the Plots” Radio Show with Glenda Lee Allan on CKSW (570) August 20th. Project was also presented at WCA’s annual tour July 20th (80+ participants) and was toured by the Canola Council and SWT (Shawn Senko + 10 participants).

CLC – Annual Field Tour July 27, 2023 (68 attendees). Will be featured at Top Notch Farming in Spiritwood on February 6, 2024 and CropTalk in Prince Albert on March 13, 2024.

ICDC – Project was highlighted on Irrigation field day held on July 12, 2023 (>200 attendees). Results were also presented at the Irrigation conference held on December 7, 2023 at TCU place (>250 attendees). Results will also be presented at the Independent Crop Advisory Network (ICAN) annual conference in Moosejaw on February 8, 2024.

NARF – This demonstration was highlighted at the NARF & AAFC Joint Annual field day on July 26th, 2023. The SaskCanola Policy Manager, Dale Leftwich provided the presentation to the 70 people attending the tour. The results of the demonstration will also be shared at Top Notch Farming in Melfort on February 13, 2024.

11. Conclusions and Recommendations

Early seeding dates, when spring conditions are favourable, is a recommended practice that was clearly demonstrated with the seeding dates used in this project. Across all sites, yields decreased when canola was seeded in early June and sites experienced yield losses of up to 48% in Prince Albert, 87% in Outlook, 91% in Swift Current, and 50% in Melfort when canola was seeded in mid to late June. Quality of harvested canola also decreased with seeding date as was evident with decreasing oil content. Late seeding dates had issues with uniform dry down and harvest was delayed as late as October 25th for the Melfort site.

Seeding rates were included in this study to demonstrate how the practice can compensate for high seedling mortality during unfavourable growing conditions that can occur particularly for early seeded canola. While conditions were relatively dry compared to long term averages, early seeded canola did not face anticipated higher risks like flea beetle pressure, cool soils, and frost damage. Only Melfort had notable flea beetle pressure that was greater on earlier seeded canola. However, economic thresholds were not met and no yield differences were detected for seeding rate. Past research suggests earlier seeded canola is a better option, so canola seedlings can establish before large numbers of crucifer flea beetles appear. The earlier damage and field observations confirm that the flea beetles present in Melfort were predominantly striped flea beetles (Fig 1) and while researchers believe slightly later seeding dates may be more appropriate than early seeding dates for striped flea beetles (Arnason, 2023), pressure was not great enough in 2023 to capture this.

Figure 1. Early striped flea beetle pressure observed in Melfort in 2023.

It is also valuable to note, high seeding rates are necessary to target plant stands of a minimum 40 plants/m^2, as seed mortality was often 50% or greater. Canola Council of Canada recommends a target plant density of 50-80 plants/m^2, as yield potential drops with 30-40 plants/m^2 (Canola Council of Canada, 2023). Plant stands were very low at Swift Current, making recovery from hail damage more difficult. Unadjusted canola yields were very poor.

While it is difficult to predict the likelihood of flea beetle pressure in an upcoming growing season, it would be valuable to repeat this demonstration with higher flea beetle populations. Selecting an earlier seeding date could help showcase how less desirable growing conditions can affect canola yields and how seeding rates can help compensate and reduce yield losses.

Supporting Information

12. Acknowledgements

The Conservation Learning Centre graciously acknowledged the SaskCanola support through signage directly in field, verbally during the Field Day, and on the Field Day, agenda handed out to all visitors. Prince Albert, Swift Current, Outlook, and Melfort would like to acknowledge all of their staff for their support in conducting this trial.

13. Appendices

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Table A1. Selected agronomic information for Canola Seeding Date and Rate trials across Saskatchewan in 2023.

Factor / Field Operation	Prince Albert	Swift Current	Outlook	Melfort
Pre-emergent herbicide	Roundup Transorb HC @0.67L/ha (May 12)	RT540 @ 0.5L/ac (April 29)	Liberty (June 5)	1L/ac StartUp (May 16)
Seeding Date	May 11, May 19, May 31, June 12, June 21	May 3, May 13, May 23, June 2, June 12	May 12, May 22, June 1, June 11, and June 22	May 12, May 24, May 31, June 9, June 19
Cultivar	Nuseed NC527CRTF	Dekalb TFLLSC 21	L340 PC	B3010M
Seeding Rate	80 and 160 seeds/m^2 (4.4 or 8.8 kg/ha)	80 and 160 seeds/m^2	200 and 250 seeds/m^2	80 and 160 seeds/m^2 (5 or 10 kg/ha)
Row spacing	6 rows @ 25.4 cm (10 in)	9 rows @ 21 cm (8.25 in)	25.4 cm (10 in)	30.48 cm (12 in)
N:P:K:S applied	115:22:0:17 kg/ha	120:60:0:24 lb/ac	135:30:0:0 kg/ha	173:56:0:17 kg/ha
In-crop herbicide	Poast Ultra @ 1.1L/ha (June 8)	Liberty150SN @1.35L/ac for T7-T8 (June 22) Hand weeded T9-T10	Liberty (June 5)	Centurion (June 2); Liberty & Facet L (June 10)
Insecticide	N/A	Decis @60ml/ac (July 1)	Matador for grasshopper control May 30 and June 9	N/A
Pre-harvest herbicide or dessicant	T1-T4 Aug 25, T5-T6 Sept 7, T7-T8 Sept 21, T9-T10 Sept 29 with Reglone Ion @2.04L/ha	T7-T8 with Reglone Ion @.83L/ac +LI700 @.25L/100L (Sept 6)	T1-T6 Sept 8, T7-T8 Sept 15, T9-T10 Oct 2 with Reglone Ion @2.04L/ha	T1-T2 1.6L/ha StartUp (Aug 29) and T9-T10 1.9 L/ha Reglone (Oct. 20)
Harvest date	Sept 7, Sept 15, Sept 29, Oct 11	T1-T6 Aug 21, T7-T8 Sept 12, T9-T10 Sept 25	T1-T6 Sept 12, T7-T8 Sept 20, T9-T10 Oct 10	T1-2 Sept 11, T3-4 Sept 19, T5-8 Oct 10, T9-10 Oct 25
Additional information	Spring frost May 19 (-0.4◦C)	No spring or fall frost Hail damage July 22 Seed date 1 **75% loss** Seed date 2 **70% loss** Seed date 3 **50% loss** Seed date 4 **40% loss** Seed date 5 **40% loss**	No spring or fall frost	No spring or fall frost

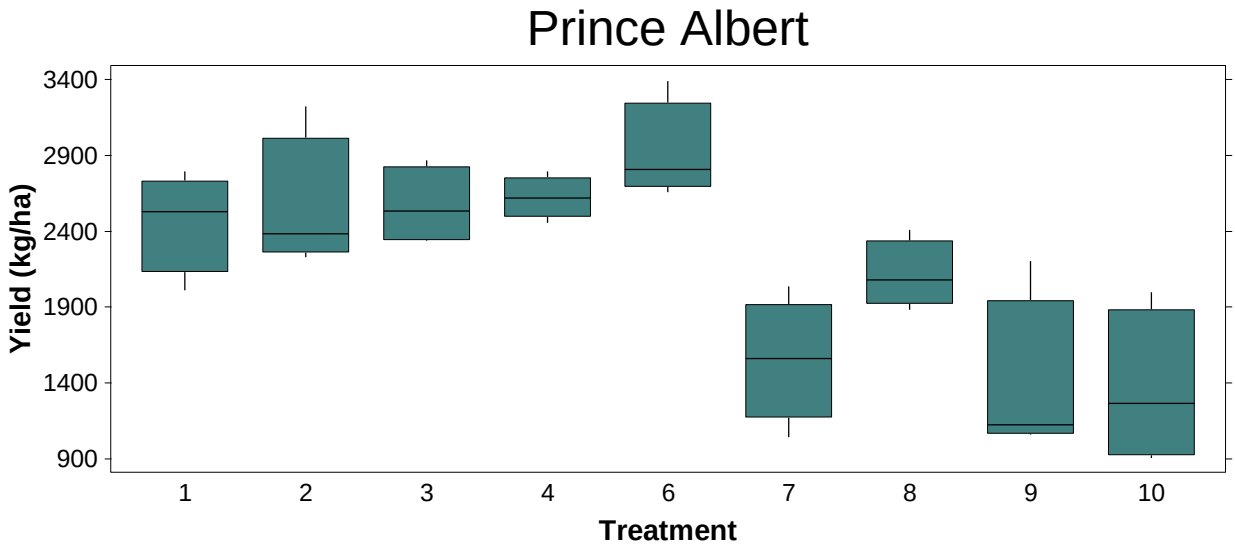

Figure A2. 2023 Canola yield results in Prince Albert, SK. Trial investigated different seeding dates and rates. Treatments 2,4,6,8, and 10 are high seeding rates. Treatments 7-10 were later seeded in June. Treatment 5 is omitted due to a missing data point.

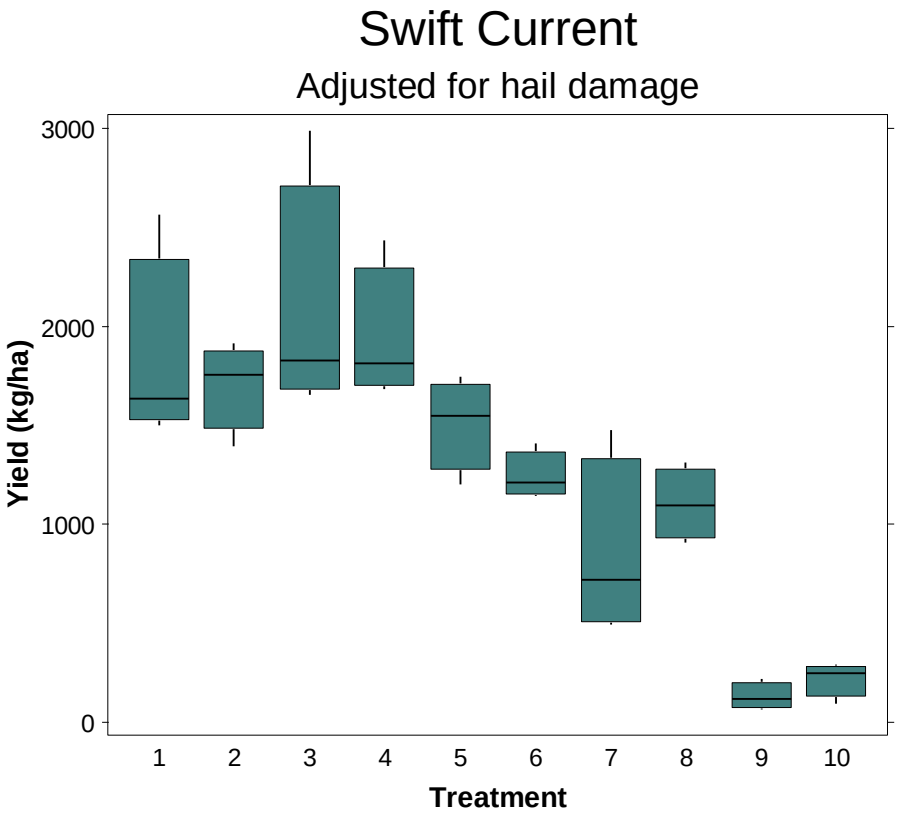

Figure A2. 2023 Canola yield results in Swift Current, SK. Trial investigated different seeding dates and rates. Treatments 2,4,6,8, and 10 are high seeding rates. Treatments 7-10 were later seeded in June. Yields were adjusted for hail damage that occurred in July 2023.

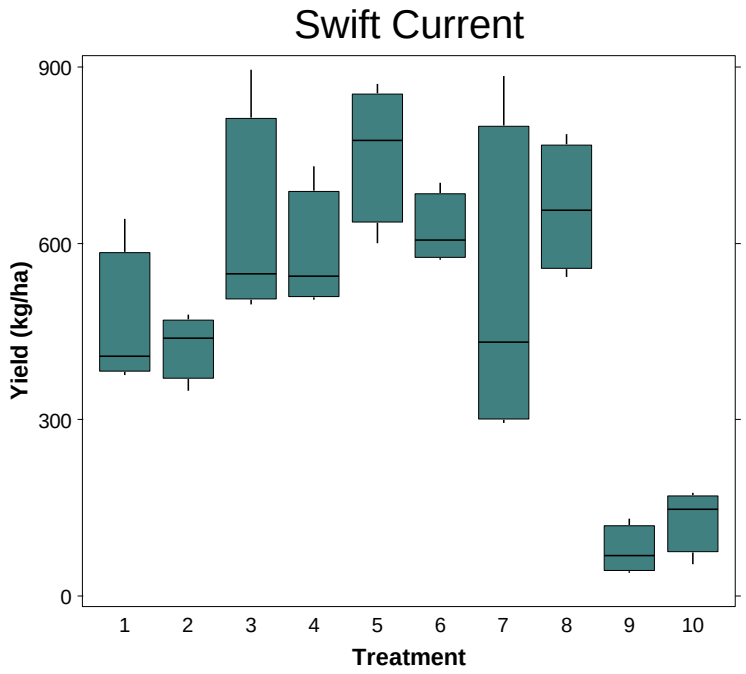

Figure A3. 2023 Canola yield results in Swift Current, SK. Trial investigated different seeding dates and rates. Treatments 2,4,6,8, and 10 are high seeding rates. Treatments 7-10 were later seeded in June. Yields were low due to hail damage that occurred in July 2023.

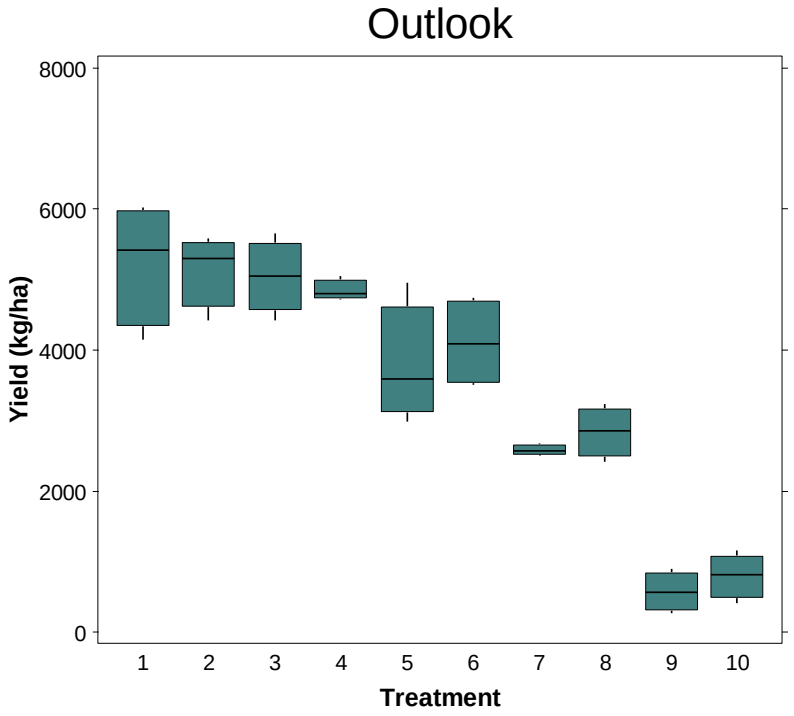

Figure A4. 2023 Canola yield results in Outlook, SK. Trial investigated different seeding dates and rates. Treatments 2,4,6,8, and 10 are high seeding rates. Treatments 7-10 were later seeded in June.

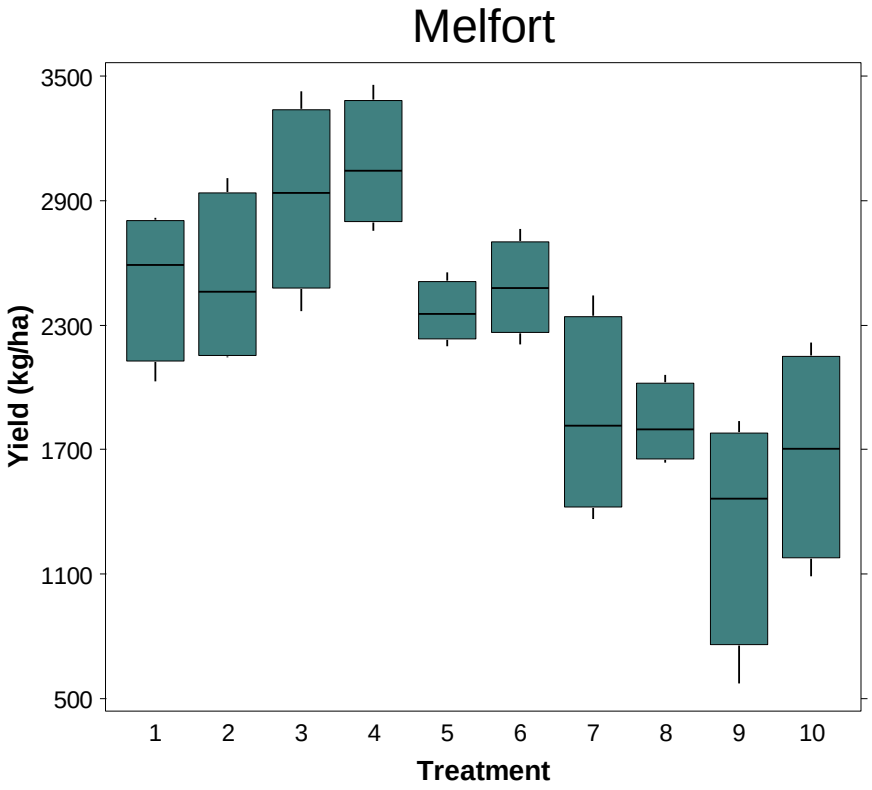

Figure A4. 2023 Canola yield results in Melfort, SK. Trial investigated different seeding dates and rates. Treatments 2,4,6,8, and 10 are high seeding rates. Treatments 7-10 were later seeded in June.

14. Abstract/Summary (350 words or less)

This trial aimed to demonstrate how different seeding dates and rates can improve canola yield and quality, and to provide a backdrop to discuss methods of flea beetle control and proper scouting techniques. Small plot trials were established in 2023 at Wheatland Conservation Area (WCA) in Swift Current, Northeast Agriculture Research Foundation (NARF) in Melfort, Irrigation Crop Diversification Corporation (ICDC) in Outlook, and Conservation Learning Centre (CLC) in Prince Albert. Five seeding dates occurred every 10-14 days, at a low and a high seeding rate, to capture an ultra-early seeding date and a late seeding date. Overall, yields decreased when canola was seeded late in June; sites experienced yield losses of up to 48% in Prince Albert, 50% in Melfort, 87% in Outlook, and 91% in Swift Current. Quality of harvested canola also decreased with seeding date as was evident with decreasing oil content. Late seeding dates had issues with uniform dry down and harvest was delayed as late as October 25th. Only Melfort experienced flea beetle pressure on earlier seeded canola.

However, populations did not meet economic thresholds and no yield differences were detected for seeding rate. Seeding rates were included in this study to demonstrate how the practice can compensate for high seedling mortality during unfavorable growing conditions, especially for early seeded canola. In 2023, conditions were dry compared to long term averages, but anticipated risks such as high flea beetle pressure, cool soils, and frost damage did not occur. High seeding rates are still recommended to target minimum plant stands, as seed mortality was often 50% or greater. This study clearly demonstrated that, when spring conditions are favourable, early seeding is a recommended practice to maximize yield potential. While it is difficult to predict the likelihood of flea beetle pressure in an upcoming growing season, it would be valuable to repeat this demonstration with higher flea beetle populations. Selecting an earlier seeding date could help showcase how less desirable growing conditions can affect canola yields and how seeding rates can help compensate and reduce yield losses.

15. **Finances**

Categories	Total approved Budget.	Actual Spent on Project
Salaries and Benefits		
· Students	$0.00	$0.00
· Postdoctoral / Research Associates	$0.00	$0.00
· Technical / professional assistants	$0.00	$0.00
Consultant Fees & Contractual Services	$32,000	$32,000
Rental Costs	$0.00	$0.00
Material and Supplies	$0.00	$0.00
Project Travel		
· Field Work	$0.00	$0.00
· Collaborations / consultations	$0.00	$0.00
Other		
· Field Day	$0.00	$0.00
· Administration	$0.00	$0.00
· Miscellaneous	$0.00	$0.00
TOTAL	**$32,000**	**$32,000**

$8,750 x 1 site (CLC lead and responsible for report writing) and $7,750 x 3 sites (ICDC, WCA, NARF)