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: Chickpea Demonstration Trial: Investigating optimal seeding practices and cultivar selection

Project Number: Adopt 20241005

Producer Group Sponsoring the Project: Saskatchewan Pulse Growers

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).* Yorkton, SK; Indian Head, SK; Swift Current, SK; Melfort, SK

Project start date *(month & year):* 4/1/2025

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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.

Trials were established at Yorkton, Indian Head, Swift Current, and Melfort to determine the agronomic impact of seeding date and seeding rate on 3 chickpea varieties (CDC Lancer, CDC Pasqua, and CDC Orkney). The seeding rates targeted plant populations of 18, 37, 56 plants/m^2. CDC Lancer was consistently the shortest variety at each location, but differences were small between varieties and of little agronomic relevance. In most cases, increasing seeding rate decreased plant height as interplant competition for resources (ie: soil moisture) increased. In keeping with information from regional trials, CDC Pasqua was the longest maturing variety and CDC Lancer the shortest. Increasing seeding rate hastened maturity as anticipated, albeit the magnitude of the effect was not always consistent between varieties. Days from seeding to maturity were reduced as seeding was delayed. Yield rankings for varieties varied between locations. At Indian Head and Melfort, CDC Lancer and CDC Orkney yielded significantly more than CDC Pasqua, like regional trial data. In contrast, CDC Lancer yielded significantly less than both varieties at Yorkton, demonstrating how environment can affect the yield ranking of varieties. The effect of seeding rate on chickpea yield was highly variable. However, maximum yield was always achieved with either the standard or high seeding rate, never the low seeding rate. In a couple of instances, the high seeding rate numerically produced the lowest yield. The standard seeding rate recommendation should still be followed as it is most likely to provide adequate and consistent results. Early seeding led to greater seed size at two locations but had no effect at the other two sites. Early seeding can increase seed size by providing more time for flowering and pod filling. In keeping with regional information, seed size was generally greatest for CDC Pasqua followed by CDC Orkney and CDC Lancer. Seeding rate generally did not affect seed size. However, seed size was greater at Yorkton when seeding early at the lowest rate. Plant health was very good and Ascochyta disease levels were quite low in this study. While some significant effects were detected, they were small, inconsistent and difficult to explain. It should be noted that seed quality at Yorkton was quite poor due to the presence of moldy grain. Chickpea is not typically grown near Yorkton due to the moist climate. While there was a fair bit of variability in the results, seeding early at a standard seeding rate usually provided the best results. Seeding CDC Pasqua was most likely to provide a large seed size.

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 assess the yield performance and adaptability of three chickpea varieties under different combinations of seeding dates and seeding rates to identify the most suitable management for regionals conditions within Saskatchewan.

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?

The results of this demonstration will provide region specific recommendations for growing chickpeas in Saskatchewan. This may allow for the successful production of chickpea in northeastern Saskatchewan where the crop is not typically produced. The study may provide some insight into the ongoing "poor plant heath" issue for chickpea in Saskatchewan, first observed in 2019. The problem is believed to be a complex interaction between environmental conditions, and management practices on plant health. Agronomic observations suggest that early-seeded chickpeas may exhibit poorer health compared to later-seeded crops, although this relationship is not conclusive. Conversely, delayed seeding has been associated with yield reductions in previous studies, creating a challenging balance for producers. A significant gap in current research is the lack of comprehensive studies in northeastern Saskatchewan. To address these knowledge gaps and provide more robust, region-specific recommendations, a multi-location study encompassing three key factors (variety, seeding date, and seeding rate) across four distinct Saskatchewan locations is proposed.

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.

Trials were established at Yorkton, Indian head, Swift Current, and Melfort as a Split-Splitplot with treatments arranged in 4 replicate Randomized Complete Block Design. The main factor was seeding date (early vs late), where early seeding was targeted for the first week of May and late seeding was targeted for the third week of May (no later than 21st). Variety (CDC Lancer, CDC Pasqua, and CDC Orkney) were the subplot factors and seeding rates (Low, Standard, High) were the sub- subplot factors. All treatment combinations are listed in Table 1. The chickpeas received granular inoculant, and PKS was applied based on soil test recommendations. Plots were harvested with a small plot combine at all sites and final yields were adjusted to 14% moisture. Seed samples from each plot (500 grams) were submitted to WARC in Scott to determine the percentage of seed retained by round hole sieve sizes of 5, 6, 7, 8, 9, and 10 mm diameters. Table 2 lists the dates of operations for each site in 2025.

Table 1. Treatment list of Chickpea Demonstration Trial

Treatment No	Seeding Date	Variety[1]	Seeding Rate[2]
1	Early	CDC Lancer	Low
2	Early	CDC Lancer	Standard
3	Early	CDC Lancer	High
4	Early	CDC Pasqua	Low
5	Early	CDC Pasqua	Standard
6	Early	CDC Pasqua	High
7	Early	CDC Orkney	Low
8	Early	CDC Orkney	Standard
9	Early	CDC Orkney	High
10	Late	CDC Lancer	Low
11	Late	CDC Lancer	Standard
12	Late	CDC Lancer	High
13	Late	CDC Pasqua	Low
14	Late	CDC Pasqua	Standard
15	Late	CDC Pasqua	High
16	Late	CDC Orkney	Low
17	Late	CDC Orkney	Standard
18	Late	CDC Orkney	High

[1]Early-1st week May; Late-3rd week May (No later than 21st)

[2]Low, Standard and High seeding rate calculations are based on targeted plant stands of 18, 37, and 56 plants/m^2.

Seeding Rate (lbs/ac) = $\frac{Target\ Population/m^2 \times 1000\ seed\ weight\ (g)}{\%\ Expected\ Emergence\ (eg."85")} \times 0.89$

The following was assessed:

- Spring Soil Nutrients

- Emergence (plants/m^2)
- Plant height
- Yield (kg/ha)
- Chickpea seed size: % seed retained by 6 different round hole sieve sizes of 5,6,7,8,9 and 10 mm diameters. Protocol for sizing as outlined by Canadian Grain Commission will be followed. https://www.grainscanada.gc.ca/en/grain-quality/official-grain-grading-guide/22-chickpeas/determination-dockage.html
- Plant health rating (0-5) based on percent plant area affected (reference: Saskatchewan Chickpea Plant Health Issue: 2022 Update | Saskatchewan Pulse Growers (saskpulse.com))
- Ascochyta blight severity rating (0-9)
- Maturity (Julian days to physiological maturity)
- Weather Data

Table 2. Operation dates from all sites for the first year (2025) of the project.

	Yorkton	Indian Head	Swift Current	Melfort
Spring Soil Sampling	April 25, 2025	May 6	April 11	April 25
Pre-Seed/ Pre-Emergence Burn Off	May 8, 2025 *(Transorb 1 L/ac)*	All Plots May 4 *(Roundup Transorb HC @ 0.67 L/ac)*	April 18 *(Roundup Transorb @ 1 L/ac + Aim @ 47 ml/ac + Merge @ 1L/100L vol)*	May 5 *(Authority 480 @ 118 ml/ac and StartUp @ 1 L/ac)*
		Early Seeding May 10 *(Authority Supreme @ 243 ml/ac + Roundup Weathermax @ 0.67 L/ac)*	May 7 (All plots) *(Authority 480 SC @ 47 ml/ac)*	
		Delay Seeding May 29 *(Authority Supreme @ 243 ml/ac + Roundup Weathermax @ 0.67 L/ac)*		
Treat Seed	*Insure Pulse*		*Vibrance Total*	*Primo GX2 dual action granular inoculant*
Early Seeding	May 12 *Rolled May 14*	May 6 *Rolled May 9*	May 5	May 6
Late Seeding	May 26 *Rolled May 30*	May 24 *Rolled May 25*	May 16	May 20
Emergence Counts	June 2 (Early) June 9 (Late)	June 11 (Early) June 16 (Late)	June 19	May 26 (Early) June 3 (Late)
In-crop Herbicide	June 11 (Early) *(Solo ADV 325 ml/ac)*	June 5 (Early) *(12 g/ac Solo plus 154 ml/ac Assure 2, plus 0.5% v/v Merge)*	June 20 *(Tough EC @ 600 ml/ac)*	June 9 *(Centurion @ 75 ml/ac)*
	June 17 (Late) *(Solo ADV 325 ml/ac)*	June 17 (Late) *(12 g/ac Solo plus 154 ml/ac Assure 2, plus 0.5% v/v Merge)*		June 27 (Late only) *(Assure II @ 300 ml/ac)*

	June 13 (All) *(Select + Amigo 150 ml/ac)*			
In-crop Fungicide	July 14 *(Acapela 350 ml 20 GA)*	July 5 & July 17 Early Seeded *(356 ml/ac Delaro 325 SC plus 0.125% Agral 90)*	July 24 *(Dyax @ 160 ml/ac)*	July 10 *(Cotegra @ 283 ml/ac)*
		July 10 & July 23 Late Seeded *(356 ml/ac Delaro 325 SC plus 0.125% Agral 90)*	July 30 *(Miravis Neo @ 0.5 L/ac)*	
			August 6 *(Bravo @ 1.6 L/ac)*	
			August 13 *(Proline 480 SC @ 170 ml/ac)*	
In-crop Insecticide	N/A	N/A	July 4 *(Voliam Xpress @ 90 ml/ac – preventative)*	N/A
Plant Heights (cm)	August 13 *(as they were standing)*	August 12 – Early August 15 – Late	August 28	October 6
Plant Health Rating	July 10 August 15	July 11 – Early July 22 – Late	August 12	July 25 – Early August 8 – Late
Ascochyta Blight Severity Rating	July 9 August 15	July 28 – Early August 8 – Late	August 12	August 26 – Early August 27 – Late
Maturity – Early Seeded	August 15			
Maturity – Late Seeded				
Desiccation	September 27 (Early only) *(Reglone Ion 830 ml 25 ga/ac)*	September 10 Early Seeded *(Roundup Weathermax 0.67 L/ac)*	N/A	N/A
		September 16 Late Seeded *(Roundup Weathermax 0.67 L/ac)*		
Yield Early Seeded	October 8	September 26	September 23	October 27
Yield Late Seeded	October 9	September 30		

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.

Environmental Conditions

In 2025, All locations were warmer than their long-term averages except Swift Current where temperatures were near the long-term average (Table 3). July was cooler than average at all locations. Precipitation was substantially below average at Yorkton, and Indian Head. Every month from May to August was dry at Indian Head. At Yorkton, only August received above average rainfall. Precipitation was above average at Swift Current. However, June and most of July were very dry with most of the precipitation falling at the end of the month. While near average precipitation fell at Melfort, May and July were very dry.

Table 3. Mean monthly temperatures and precipitation amounts for 2025 along with long-term normals for Yorkton, Indian Head, Swift Current, and Melfort, Saskatchewan.

Location	Year	May	June	July	August	Avg./Total
			----------*Mean Temperature (°C)* ----------			
Yorkton	2025	12.4	15.7	17.5	18.3	15.98
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
Indian Head	2025	12.7	15.3	17.0	17.8	15.7
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Swift Current	2025	13.1	15.9	18.0	19.0	16.5
	Long-term	***11.5***	***16.3***	***19***	***18.6***	***16.4***
Melfort	2025	13.8	15.0	17.0	18.0	15.95
	Long-term	***10.1***	***15.2***	***17.8***	***16.7***	***14.95***
			----------Precipitation (mm) ----------			
Yorkton	2025	23.6	63.4	36.8	71.2	195.0
	Long-term	***51***	***80***	***78***	***62***	***272***
Indian Head	2025	42.6	39.4	27.1	26.9	136.0
	Long-term	***51.7***	***77.4***	***63.8***	***51.2***	***244.1***
Swift Current	2025	34.2	31.3	78.2	92.6	236.3
	Long-term	***43.4***	***60.5***	***56.4***	***40.4***	***200.7***
Melfort	2025	4.8	93.2	25.9	113.5	237.4
	Long-term	***33.4***	***79.5***	***69.6***	***45.9***	***228.4***

Plant Density

Significant effects of seeding rate were detected on chickpea plant density at all locations (Table 4). No interactions with either seeding date or variety were detected. At Yorkton, plant stands were significantly higher on average for the early seeding date (40.5 plants/m^2) compared to the late seeding date (35.9 plants/m^2) (Table 5). However, when averaged

over seeding date and variety, emergence was very near the targeted plant stands of 18, 37 and 56 plants/m^2. At Indian Head, plant emergence for the different seeding rates were reasonably close to targeted plant stands. While a little low, a good spread in emergence was achieved between seeding rates at Melfort. At Swift Current, plant stands were a little off target with the low, standard and high seeding rates achieving plant stands of 24.5, 41.3 and 48.0 plants/m^2, respectively.

Table 4. F-test results of mixed-effects models of **plant density** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects	---------- *Pr(>F)* ----------			
Block (B)	0.530	0.464	**<0.001**	**0.008**
Seeding Date (D)	**0.046**	0.889	0.485	0.851
Variety (V)	0.384	0.012	0.221	0.266
D x V	0.310	0.095	0.315	0.625
Seeding Rate (R)	**<0.001**	**<0.001**	**<0.001**	**<0.001**
R x D	0.525	0.241	0.641	0.233
R x V	0.512	0.485	0.776	0.156
R x D x V	0.978	0.401	0.454	0.963

Table 5. Means, and LSD separations for the main effects and interactions of product and N rate on **plant density** (plants/m2)**.** Only means for significant interactions are listed.

Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	40.5^{a}	32.2^{a}	38.6^{a}	25.6^{a}
Late	35.9^{b}	32.5^{a}	37.3^{a}	25.1^{a}
S.E.M.	*0.99*	*1.27*	*1.15*	*1.57*
Variety (V)				
CDC Lancer	40.1^{a}	34.6^{a}	39.6^{a}	26.8^{a}
CDC Pasqua	35.8^{a}	29.8^{b}	36.4^{a}	24.5^{a}
CDC Orkney	38.6^{a}	32.7^{ab}	37.7^{a}	24.8^{a}
S.E.M.	*2.18*	*0.97*	*1.22*	*1.00*
Seeding Rate (R)				
Low	19.0^{c}	16.9^{c}	24.5^{c}	13.4^{c}
Standard	39.5^{b}	33.7^{b}	41.3^{b}	24.7^{b}
High	56.0^{a}	46.5^{a}	48.0^{a}	37.9^{a}
S.E.M.	*1.93*	*0.87*	*1.15*	*1.05*

Plant Height

Plant heights significantly differed between varieties and seeding rates at all locations (Table 6). At Yorkton, Indian Head, and Melfort, CDC Pasqua and CDC Orkney were significantly taller than CDC Lancer (Table 7). This supports the provincial guide entitled “Varieties of Grain Crops 2025” which lists CDC Lancer as having an average height of 41 cm whereas, CDC Orkney and CDC Pasqua are both listed at 43 cm. Despite having the lowest yield of all sites, plants were much taller at Melfort. Similar results were observed at Swift Current, however only CDC Pasqua was significantly taller than CDC Lancer. Increasing seeding rate significantly decreased plant height at Yorkton, Swift Current, and Melfort. This was likely the result of increasing competition for resources (ie: soil moisture and nutrients) as seeding rate increased.

Indian Head was the only site where chickpeas were significantly taller when seeded late. However, this trend was also apparent at all other locations. There were significant seeding date by variety and seeding date by seeding rate interactions at Indian Head (Tables 6). Like the other locations, CDC Pasqua and CDC Orkney were significantly taller than CDC Lancer. However, when seeded early CDC Orkney was also significantly taller than CDC Pasqua at Indian Head (Table 1a in the appendices). In keeping with the other locations, increasing seeding rate reduced plant height at Indian Head but only for the early seeding date. Less competition for soil moisture with late seeding might explain this difference. However, precipitation records don't support this hypothesis.

Table 6. F-test results of mixed-effects models of **plant height** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects	---------- *Pr(>F)* ----------			
Block (B)	**0.019**	**0.034**	0.067	**0.014**
Seeding Date (D)	0.431	**0.007**	0.569	0.198
Variety (V)	**<0.001**	**<0.001**	**0.043**	**<0.001**
D x V	0.449	**0.019**	0.108	0.441
Seeding Rate (R)	**0.007**	**0.005**	**0.002**	**<0.001**
R x D	0.545	**<0.001**	0.535	0.57
R x V	0.162	0.164	0.401	0.121
R x D x V	0.541	0.527	0.300	0.185

Table 7. Means, and LSD separations for the main effects and interactions of product and N rate on **plant height** (cm)**.** Only means for significant interactions are listed.

Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	42.4^{a}	45.0^{b}	38.6^{a}	74.4^{a}
Late	44.6^{a}	47.0^{a}	39.8^{a}	76.8^{a}
S.E.M.	*1.68*	*0.21*	*1.31*	*1.02*
Variety (V)				
CDC Lancer	36.3^{b}	42.4^{c}	37.3^{b}	67.3^{b}
CDC Pasqua	48.0^{a}	47.1^{b}	41.1^{a}	81.0^{a}
CDC Orkney	46.2^{a}	48.4^{a}	39.2^{ab}	78.5^{a}
S.E.M.	*1.36*	*0.26*	*0.95*	*1.22*
Seeding Rate (R)				
Low	45.8^{a}	46.5^{a}	42.2^{a}	79.2^{a}
Standard	43.8^{ab}	46.3^{a}	38.1^{b}	73.1^{b}
High	40.8^{b}	45.2^{b}	37.4^{b}	74.4^{b}
S.E.M.	*1.04*	*0.28*	*0.94*	*1.09*

Plant Maturity

Significant main effects of variety and seeding rate on plant maturity were detected at all locations except Swift Current where the data was not statistically analyzed due to identical replicate values recorded for each treatment (Table 8). Maturity rankings between varieties were very similar at Yorkton and Melfort, with CDC Pasqua being the longest maturing and CDC Lancer being the shortest maturing (Table 9). There was about a 5-6 day difference in maturity

between the earliest and latest variety. Ranking of varieties in this study were supported by maturity ratings presented in the provincial "Varieties of Grain Crops" publication. Varietal differences in maturity were much tighter at Swift Current. Increasing seeding rate significantly hastened maturity at Yorkton and Melfort by about 3-4 days. A similar trend was observed at Swift Current but again, differences were much tighter. At Indian Head, there was a significant variety by seeding rate interaction (Table 8). While increasing seeding rate hastened maturity for all varieties at Indian Head, the effect was much more pronounced for CDC Orkney (Table 1a in appendices). The reason for this is unclear, as increasing seed rate provided similar increases in plant stands between varieties (data not shown). Plant maturity is based on Julian date, so it was anticipated that early seeded chickpeas would have an earlier maturity date. While this was true at all sites except Swift Current, the effect was only statistically significant at Indian Head. Delayed seeding within May by 14 days at Yorkton and Melfort and by 18 days at Indian Head only delayed maturity between 5 to 6.4 days depending on location. In other words, days from seeding to maturity were reduced as seeding was delayed. At Swift Current, late seeded chickpeas matured 2.2 days earlier. In theory, greater moisture stress associated with late seeding could have hasten maturity, but it is unclear how to account for this result.

Table 8. F-test results of mixed-effects models of **plant maturity** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects	---------- *Pr(>F)* ----------			
Block (B)	**0.031**	**<0.001**	Na	0.064
Seeding Date (D)	0.055	**0.002**	Na	0.12
Variety (V)	**<0.001**	**<0.001**	Na	**<0.001**
D x V	0.878	0.505	Na	0.806
Seeding Rate (R)	**0.004**	**<0.001**	Na	**<0.001**
R x D	0.905	0.688	Na	0.879
R x V	0.204	**0.012**	Na	0.370
R x D x V	0.774	0.911	Na	0.449

Table 9. Means, and LSD separations for the main effects and interactions of product and N rate on **plant maturity** (Julian days)**.** Only means for significant interactions are listed.

Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	263.9[a]	245.9[b]	250.1	272.8[a]
Late	269.3[a]	252.3[a]	247.9	277.1[a]
S.E.M.	*1.23*	*0.43*	*Na*	*1.41*
Variety (V)				
CDC Lancer	264.2[c]	247.7[c]	249.0	272.8[b]
CDC Pasqua	269.0[a]	250.6[a]	249.2	278.2[a]
CDC Orkney	266.6[b]	248.9[b]	248.8	274.0[b]
S.E.M.	*0.50*	*0.25*	*Na*	*0.64*
Seeding Rate (R)				
Low	268.7[a]	251.6[a]	249.0	277.4[a]
Standard	265.8[b]	248.4[b]	249.3	275.0[b]
High	265.4[b]	247.3[c]	248.7	272.5[c]
S.E.M.	*0.69*	*0.22*	*Na*	*0.76*

Yield

All sites were high yielding in this study, averaging 65.3, 64.9, 47.0 and 42.1 bu/ac at Yorkton, Indian Head, Swift Current, and Melfort, respectively. Significant main effects of variety on crop yield were detected at all locations (Table 10). Varietal standings were very similar between Indian Head and Melfort, with CDC Lancer yielding significantly more than CDC Orkney, which yielded significantly more than CDC Pasqua. The varietal rankings were largely in keeping with regional data published in "Varieties of Grain Crops 2025", which relative to CDC Lancer, lists the yield potential of CDC Orkney as 100 to 104% and CDC Pasqua at only 87 to 94%. However, CDC Lancer was significantly lower yielding than both varieties at Yorkton. A somewhat similar pattern with Pasqua being lower yielding than the other varieties was also observed at Swift Current, however a significant D by V by R interaction was detected which will be discussed further. Seeding rate effects on yield were detected at all locations except Yorkton. At Melfort, yield significantly increased with increasing seeding rate to the high rate. While yield increased with increasing seeding rate at Yorkton the effect was insignificant. Yield was also responsive to increasing seeding rate at Indian Head, but a significant seeding date by seeding rate interaction found the effect was greater for the late seeding date (Table 10). Yield was essentially maximized at the standard rate when seeded early, whereas yield continued to climb significantly to the high rate when seeded late (Table 1a in appendices). The significance of this interaction is not clear. Perhaps, hastening of maturity with increasing seeding rate was more beneficial to yield for the late seeding date. At Swift Current, a significant 3-way interaction between seeding date, variety, and seeding rate was detected (Table 10). Essentially the optimum seeding rate for yield varied with seeding date and variety (data not shown). It is difficult to account for the interactions; however, yield was either maximized by the standard or high seeding rate.

Table 10. F-test results of mixed-effects models of **plant Yield** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects	----------	*Pr(>F)*	----------	
Block (B)	**0.002**	**<0.001**	0.118	0.189
Seeding Date (D)	0.515	**0.017**	0.614	**0.007**
Variety (V)	**0.028**	**<0.001**	**<0.001**	**<0.001**
D x V	0.247	0.110	0.649	0.167
Seeding Rate (R)	0.222	**<0.001**	**<0.001**	**<0.001**
D x R	0.139	**0.014**	**0.034**	0.200
V x R	0.115	0.631	0.064	0.814
D x V x R	0.969	0.225	**0.005**	0.579

Table 11. Means, and LSD separations for the main effects and interactions of product and N rate on **crop yield** (Kg/ha)**.** Only means for significant interactions are listed.

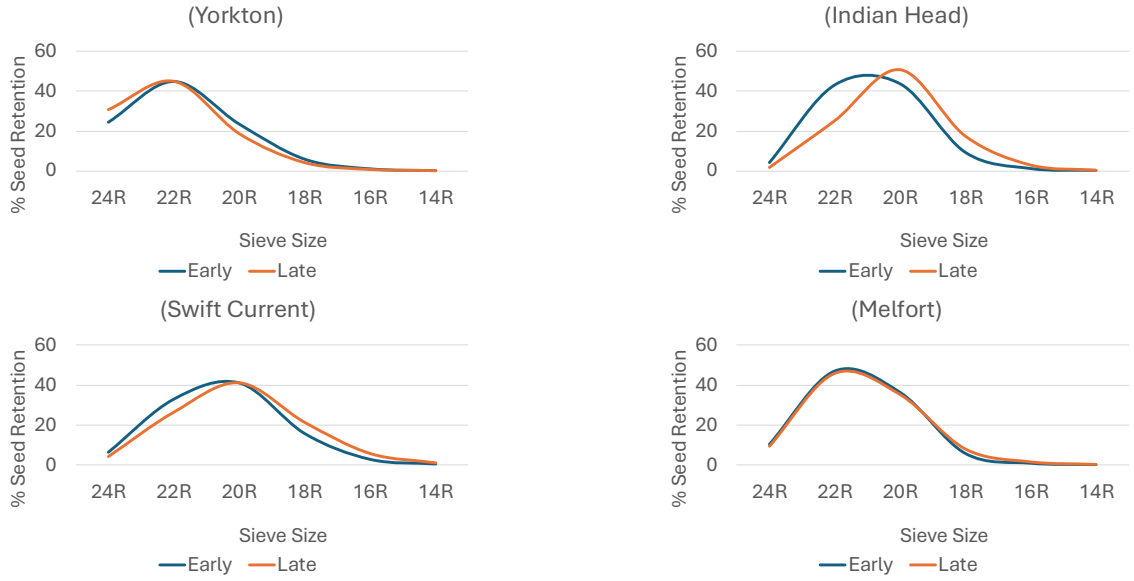
Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	4217.8[a]	4535.0[a]	3149.2[a]	3050.6[a]
Late	4560.6[a]	4196.6[b]	3173.7[a]	2610.3[b]
S.E.M.	*329.7*	*50.1*	*30.9*	*47.7*
Variety (V)				
CDC Lancer	4018.2[b]	4688.7[a]	3259.7[b]	3187.7[a]
CDC Pasqua	4524.8[a]	3922.2[c]	2768.4[c]	2391.6[c]
CDC Orkney	4624.6[a]	4486.5[b]	3456.3[a]	2912.0[b]
S.E.M.	*147.0*	*22.0*	*58.7*	*53.0*

Seeding Rate (R)				
Low	4245.1[a]	4084.7[c]	2965.5[b]	2279.6[c]
Standard	4379.7[a]	4461.1[b]	3293.6[a]	2976.4[b]
High	4542.9[a]	4551.6[a]	3225.4[a]	3235.3[a]
S.E.M.	*119.1*	*29.2*	*54.5*	*60.9*

Seed Size

Large sized chickpeas are desired, and the market will offer a premium to producers. Quality is determined by running chickpeas through a series of sieves with hole radii ranging from 24R (24/64 of an inch) to 14R in increments of 2R. Premiums will be determined based on percent of seed retained by each sieve. Exact specifications required for a premium will vary between years but let us assume a standard premium requires >60% seed on 24R; >90% seed above 22R and <5% seed on 18R or below. Visually, this would provide a response pattern that is heavily weighted to the left and comes crashing down to near zero by the 18R sieve. This standard was not achieved by any combination of seeding date, variety, and seeding rate in this study. Main effects have been graphed for each location to more effectively highlight treatment differences (Figures 1-3). However, values from each sieve have been analyzed separately and tabulated in the appendices. Tables in the appendices are indicated by the letter "a" following the table number. At Yorkton, and Melfort, the seed sizing followed a very similar pattern between seeding dates, albeit seed size was greater at Yorkton (Figure 1). Early seeding led to greater seed size at Indian Head and Swift Current, as indicated by a relative shift to the left of the blue line (Figure 1). Moreover, percent seed retention by sieves 22R and 24R was significantly higher for the early seeding date at Indian Head (Tables 5a and 6a) and Swift Current (Tables 8a and 9a). Early seeding can increase yield and seed size as it gives the plants more time for flowering and pod filling.

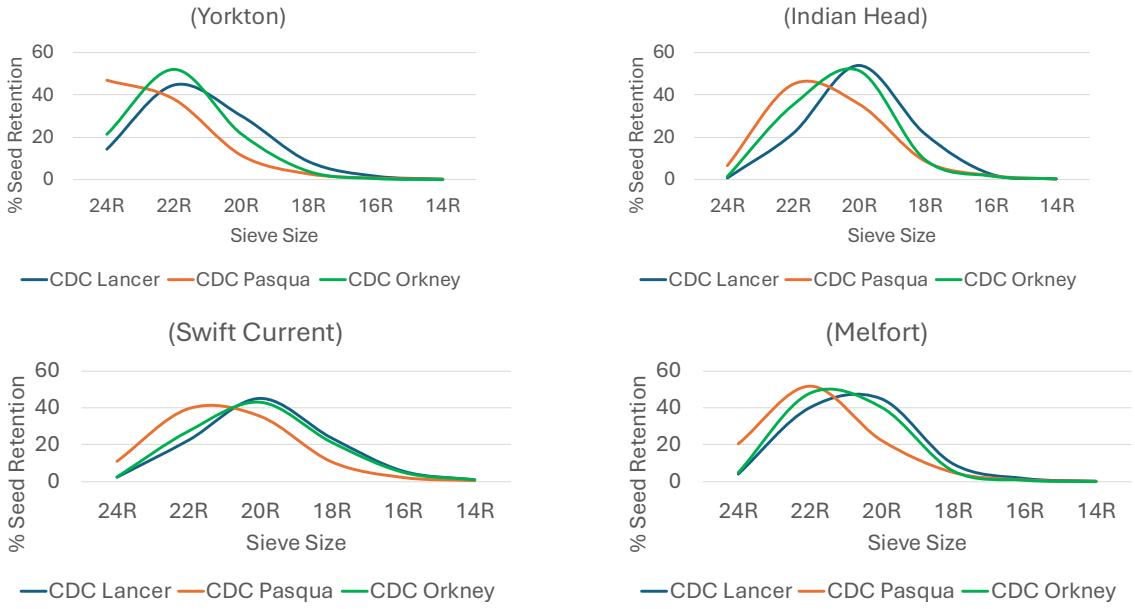
Figure 1. Effect of Seeding Date on Chickpea Seed Sizing



Seed sizing between varieties followed a consistent pattern at each location. A larger seed size for CDC Pasqua in orange is indicated by its relative shift to the left compared to the other varieties (Figure 2). In turn, CDC Orkney in green is shifted to the left relative to CDC Lancer in blue, indicating a larger seed size for CDC Orkney relative to CDC Lancer. These results are in keeping with those published in the Saskatchewan "Varieties of Grain Crops" Guide. Seed retention in the 24R sieve was much higher for CDC Pasqua compared to the other varieties at Yorkton (Tables 2a and 3a). The

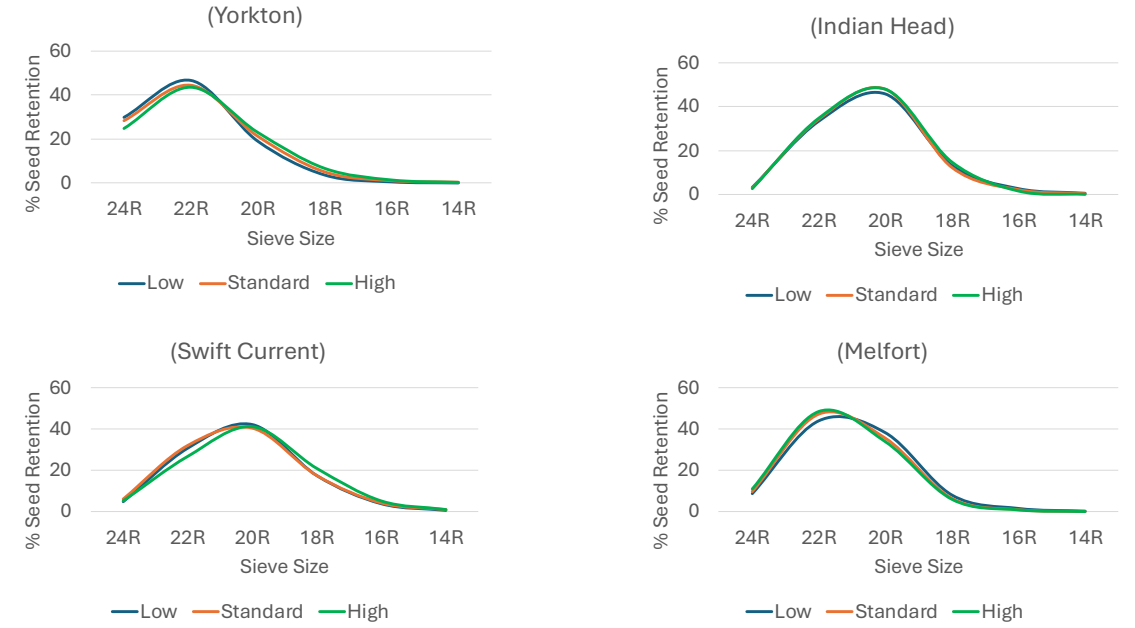
difference was so great that less seed of CDC Pasqua was retained compared to the other varieties in every sieve from R22 and below. For the other 3 sites, less seed was retained by R24. However, larger quantities of CDC Pasqua were still retained by sieves R24 and R22 relative to the other varieties (Tables 5a, 6a, 7a, 8a, 9a, 10a, 11a, 12a and 13a).

Figure 2. Effect of Variety on Chickpea Seed Sizing



Significant differences in seed retention between seeding rates were detected for various sieves. While inconsistent, the differences were extremely small. The response curves between seeding rates can hardly be separated from one another (Figure 3).

Figure 3. Effect of Seeding Rate on Chickpea Seed Sizing



Across sites, many interactions for various sieves were detected, indicating that the response pattern varied between treatments (Tables 2a, 5a, 8a and 11a). However, upon close inspection many of the interactions were inconsequential or difficult to explain. The largest interactions occurred at Yorkton. There were several significant D by V interactions with the seed sizing data (Table 2a), indicating that the seed retention pattern for the varieties differed between seeding dates. Figure 4 (Table 4A) shows the amount of seed retained by sieve R24 was significantly higher for CDC Orkney relative to CDC Lancer but only for the late seeding. At Yorkton, several significant R by D interactions were also detected (Table 2a). In this case, lower seeding rate increased the quantity of seed retained by R24 but the effect was only significant when chickpeas were seeded early (Table 4a Figure 5). Reduced interplant competition with lower seeding rate may account for larger seed development. However, these effects were not consistent between locations. Several interactions were detected at the other locations, but they were often small, inconsequential, inconsistent, and difficult to explain.

Figure 4. Effect of Seeding Date and Variety on Chickpea Seed Sizing at Yorkton

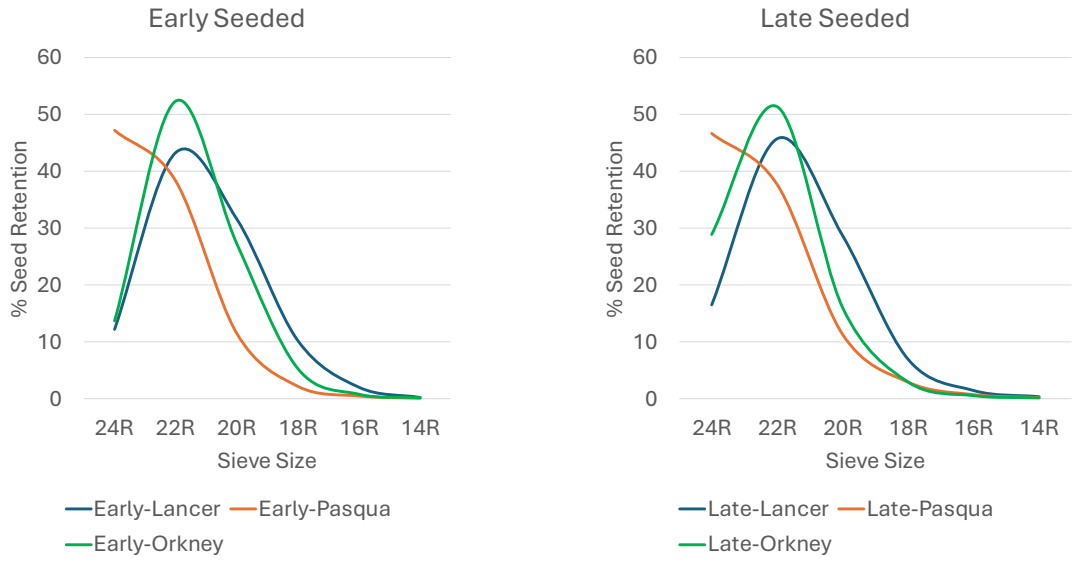
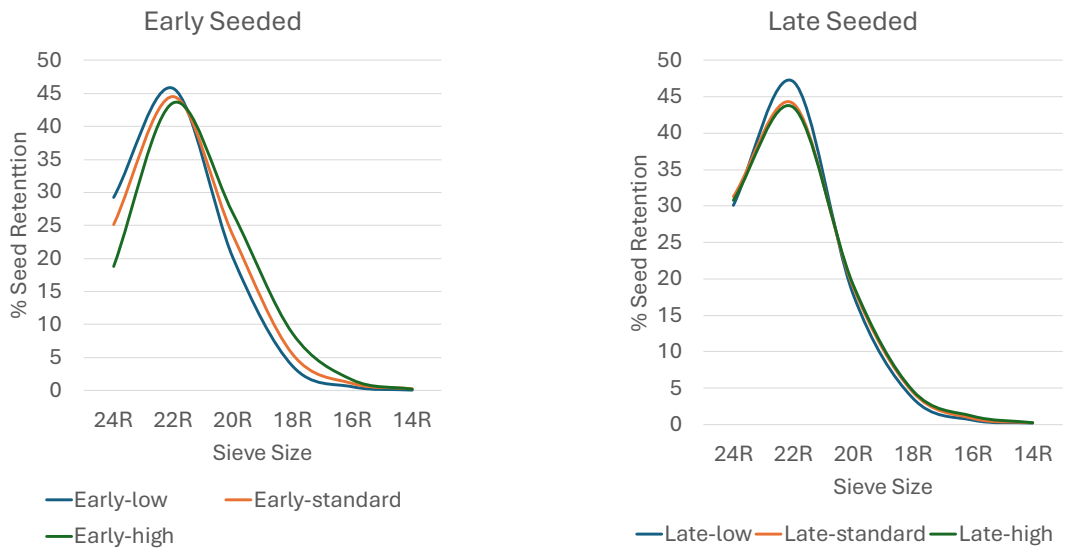


Figure 5. Effect of Seeding Date and Seeding Rate on Chickpea Seed Sizing at Yorkton



Plant health

Plant health ratings were assessed on a 0-5 scale, with 5 being completely unhealthy. Ratings have been omitted from Yorkton and Indian Head. At Yorkton, the plots looked extremely healthy, and every plot was assigned a rating of zero. At Swift Current, slightly poorer plant health was significantly associated with the low seeding rate (Tables 12 and 13). Chickpeas seeded early had slightly better plant health at Melfort. However, a significant 3-way interaction found the effect of seeding rate on plant health was inconsistent, differing between seeding date and variety.

Table 12. F-test results of mixed-effects models of **plant health** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects	----------	----------	*Pr(>F)* ----------	----------
Block (B)	Na	Na	**0.014**	0.656
Seeding Date (D)	Na	Na	0.388	**0.005**
Variety (V)	Na	Na	0.143	**0.053**
D x V	Na	Na	0.260	0.970
Seeding Rate (R)	Na	Na	**<0.001**	0.892
R x D	Na	Na	0.915	0.367
R x V	Na	Na	0.765	0.993
R x D x V	Na	Na	0.925	**0.03**

Table 13. Means, and LSD separations for the main effects and interactions of product and N rate on **plant health** (0-5)**.** Only means for significant interactions are listed.

Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	Na	Na	1.78[a]	0.58[b]
Late	Na	Na	1.58[a]	1.10[a]
S.E.M.			*0.14*	*0.049*
Variety (V)				
CDC Lancer	Na	Na	1.83[a]	0.79[b]
CDC Pasqua	Na	Na	1.44[a]	0.95[a]
CDC Orkney	Na	Na	1.76[a]	0.78[b]
S.E.M.			*0.14*	*0.048*
Seeding Rate (R)				
Low	Na	Na	1.26[b]	0.84[a]
Standard	Na	Na	1.75[a]	0.83[a]
High	Na	Na	2.02[a]	0.86[a]
S.E.M.			*0.12*	*0.049*
D by V by R				
Early – CDC Lancer - Low				0.50[e]
Early – CDC Lancer - Standard				0.60[de]
Early – CDC Lancer - High				0.50[e]
Early – CDC Pasqua - Low				0.70[cde]
Early – CDC Pasqua - Standard				0.50[e]
Early – CDC Pasqua - High				0.90[bcd]
Early – CDC Orkney - Low				0.40[e]
Early – CDC Orkney - Standard				0.60[de]
Early – CDC Orkney - High				0.55[e]
Late – CDC Lancer - Low				1.05[ab]
Late – CDC Lancer - Standard				0.95[bc]
Late – CDC Lancer - High				1.15[ab]
Late – CDC Pasqua - Low				1.20[ab]
Late – CDC Pasqua - Standard				1.35[a]
Late – CDC Pasqua - High				1.05[ab]
Late – CDC Orkney - Low				1.20[ab]
Late – CDC Orkney - Standard				0.95[bc]
Late – CDC Orkney - High				1.00[bc]

Ascochyta

Ascochyta was rated on a scale of 0-9, with 9 being completely diseased. Again, Yorkton ratings have been omitted as every plot was completely disease free since chickpeas had never been grown on site. Disease ratings were very low at the remaining sites. At Swift Current, no significant effects of seeding date, variety, or seeding rate on Ascochyta were

detected (Tables 14 and 15). At Indian Head, seeding late and using a low seeding rate significantly increased disease. However, the magnitude of the differences were extremely small. Only variety had a significant impact on disease at Melfort with CDC Orkney having significantly more disease than CDC Lancer. Again, differences were small and likely inconsequential. Moreover, Ascochyta ratings in the Saskatchewan "Varieties of Grain Crops" publication do not differ by much between varieties.

Table 14. F-test results of mixed-effects models of **Ascochyta** assessing the presence of interactions at each site individually. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

	Yorkton	Indian Head	Swift Current	Melfort
Fixed effects		*Pr(>F)*		
Block (B)	Na	0.911	**0.034**	**<0.001**
Seeding Date (D)	Na	**0.022**	0.728	0.160
Variety (V)	Na	0.798	0.104	**0.028**
D x V	Na	0.572	0.623	0.183
Seeding Rate (R)	Na	**0.024**	0.424	0.122
R x D	Na	0.797	0.281	0.091
R x V	Na	0.599	0.458	0.343
R x D x V	Na	0.623	0.319	0.500

Table 15. Means, and LSD separations for the main effects and interactions of product and N rate on **Ascochyta** (0-9)**.** Only means for significant interactions are listed.

Seeding Date (D)	Yorkton	Indian Head	Swift Current	Melfort
Early	Na	1.18b	1.78a	1.71a
Late	Na	1.36a	1.91a	2.44a
S.E.M.		*0.03*	*0.22*	*0.28*
Variety (V)				
CDC Lancer	Na	1.24a	1.60a	1.88b
CDC Pasqua	Na	1.29a	1.94a	2.08ab
CDC Orkney	Na	1.28a	2.00a	2.26a
S.E.M.		*0.06*	*0.13*	*0.09*
Seeding Rate (R)				
Low	Na	1.38a	1.94a	2.21a
Standard	Na	1.22b	1.76a	2.03a
High	Na	1.22b	1.83a	1.98a
S.E.M.		*0.04*	*0.10*	*0.08*

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.

Seeding Chickpeas early at the standard seeding rate was most likely to provide the best results in terms of high yield and large seed size. While the high seeding rate could hasten maturity further without typically affecting seed size, the highest seeding rate occasionally produced the lowest yield which is clearly uneconomical. The standard seeding rate seems to be the best hedge because it could result in the highest yield, whereas the highest yield was never associated with the low seeding rate. CDC Pasqua was often the lowest yielding, later maturing variety but it had the greatest seed size. CDC Lancer was consistently a little shorter than the other varieties. In most cases, increasing seeding rate decreased plant height as interplant competition for resources (ie: soil moisture) increased. Plant health was very good and Ascochyta disease levels were quite low in this study. While some significant effects were detected, they were small, inconsistent and difficult to explain. It should be noted that seed quality at Yorkton was quite poor due to the presence of moldy grain. Despite the high yield in this study, chickpeas are not ideally suited to the black soil zone.

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	
• Accepted for publication	
Highly Qualified Personnel (HQPs) trained during this project	
• Master's students	
• PhD students	
• Post docs	
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)	

[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.
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)
ECRF Annual Plot Tour 2025	Yorkton SK	90	
Video: Chickpea Boldly Growing across Saskatchewan	Youtube	Growing: just uploaded	https://www.youtube.com/watch?v=6NLWa-WBj7c&t=1s
Some highlights presented at IHARF Soil and Crop Management Seminar Feb 4	Balgonie	185	
WCA Radio Program	CKSW 570, Magic 97.1 and Country 94.1	Unknown	https://wheatlandconservation.ca/news-events/ (recording coming soon)
Presentation	SPG Swift Current Pulse Days, Sky Centre (Feb. 2026)	130	https://wheatlandconservation.ca/project/spg-swift-current-pulse-days-february-4-2026-2025-applied-research-demonstration-trial-overview/

Northern Plains Program Field Day	NARF, Melfort, SK	28	
Trial passed by on NARF and AAFC Joint Field days, Mike Brown from SPG spoke about chickpea agronomy trials	NARF, Melfort, SK	162	

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).

Support has been acknowledged in a variety of ways. At farm tours, verbal acknowledgements have been made and trials have been signed. At the beginning or end of presentations developed for Youtube and industry events, a slide acknowledging support from S-Cap is always shown. Support is also acknowledged when projects are highlighted in popular magazines.

Appendices

Include any additional materials supporting the previous sections, e.g. detailed data tables, maps, graphs, specifications, literature cited (Use a consistent reference style throughout).

Table 1a. Means, and LSD separations for various interactions between Seeding date (D), Variety (V), and Seeding Rate (R) at **Indian Head** for **plant height** (cm), **plant maturity** (Julian days), and **crop yield** (kg/ha). Only means for

significant interactions are listed.				
Interaction	Plant Height	Crop Yield	**Interaction**	Plant Maturity
D by V			**V by R**	
Early – CDC Lancer	40.9[d]		CDC Lancer - Low	249.9[b]
Early – CDC Pasqua	46.0[b]		CDC Lancer - Standard	247.1[cd]
Early – CDC Orkney	48.1[a]		CDC Lancer - High	246.1[d]
Late – CDC Lancer	43.9[c]		CDC Pasqua - Low	252.5[a]
Late – CDC Pasqua	48.3[a]		CDC Pasqua - Standard	250.3[b]
Late – CDC Orkney	48.7[a]		CDC Pasqua - High	249.2[b]
S.E.M.	*0.37*		CDC Orkney - Low	252.4[a]
			CDC Orkney - Standard	248.0[c]
D by R			CDC Orkney - High	246.4[d]
Early – Low	46.5[ab]	4321.4[c]	*S.E.M.*	*0.38*
Early – Standard	45.3[b]	4622.4[a]		
Early – High	43.2[c]	4661.3[a]		
Late – Low	46.4[ab]	3848.0[d]		
Late – Standard	47.3[a]	4299.9[c]		
Late – High	47.2[a]	4442.0[b]		
S.E.M.	*0.41*	*41.2*		

Table 2a. F-test results of mixed-effects models of **Seed sizing** assessing the presence of interactions at **Yorkton**. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Fixed effects	---------- *Pr(>F)* ----------					
Block (B)	0.198	**0.013**	0.625	**0.022**	**0.042**	**0.004**
Seeding Date (D)	0.122	0.909	**0.042**	0.204	0.424	0.451
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.022**
D x V	***0.06***	0.548	**0.016**	**0.016**	0.079	0.134
Seeding Rate (R)	**0.017**	0.111	**0.002**	**<0.001**	**<0.001**	0.152
R x D	**0.007**	0.803	**0.045**	**0.008**	0.097	0.354
R x V	0.717	0.196	0.801	**0.043**	**0.019**	0.414
R x D x V	0.083	**0.015**	0.680	0.319	**0.023**	0.875

Table 3a. Means, and LSD separations for the main effects of seeding date (D), variety (V) and seeding rate (R) on chickpea seed seizing (%) at **Yorkton**.

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Early	24.4[a]	44.7[a]	23.4[a]	5.9[a]	1.1[a]	0.2[a]
Late	30.8[a]	45.0[a]	18.7[b]	4.2[a]	0.8[a]	0.2[a]
S.E.M.	*2.09*	*1.73*	*0.99*	*0.74*	*0.17*	*0.04*
Variety (V)						
CDC Lancer	14.4[c]	44.6[b]	30.1[a]	8.6[a]	1.7[a]	0.3[a]

CDC Pasqua	47.0[a]	38.0[c]	11.4[c]	2.6[c]	0.6[b]	0.1[b]
CDC Orkney	21.4[b]	51.9[a]	21.6[b]	4.0[b]	0.6[b]	0.1[b]
S.E.M.	*2.11*	*1.20*	*1.19*	*0.44*	*0.11*	*0.03*
Seeding Rate (R)						
Low	29.8[a]	46.5[a]	19.0[b]	3.7[b]	0.6[c]	0.1[a]
Standard	28.2[a]	44.3[ab]	21.1[ab]	4.9[b]	0.9[b]	0.2[a]
High	24.8[b]	43.6[b]	23.0[a]	6.6[a]	1.3[a]	0.2[a]
S.E.M.	*1.18*	*0.97*	*0.74*	*0.43*	*0.07*	*0.03*

Table 4a. Means, and LSD separations for the interactions of seeding date (D), variety (V) and seeding rate (R) for chickpea seed seizing (%) at **Yorkton**

D by V	24R	22R	20R	18R	16R	14R
Early - CDC Lancer	12.2[c]	43.3[bc]	31.6[a]	10.2[a]	2.0[a]	0.2[ab]
Early - CDC Pasqua	47.2[a]	38.3[cd]	11.5[b]	2.2[c]	0.5[c]	0.1[c]
Early - CDC Orkney	13.7[c]	52.4[a]	27.3[a]	5.3[b]	0.8[c]	0.2[abc]
Late - CDC Lancer	16.5[c]	45.8[b]	28.7[a]	6.9[b]	1.4[b]	0.3[a]
Late - CDC Pasqua	46.7[a]	37.7[d]	11.3[b]	2.9[c]	0.7[c]	0.2[ab]
Late - CDC Orkney	28.9[b]	51.4[a]	16.0[b]	2.9[c]	0.5[c]	0.1[bc]
S.E.M.	*2.99*	*1.70*	*1.69*	*0.62*	*0.16*	*0.04*
D by R						
Early – Low	29.3[ab]	45.8[a]	20.1[c]	3.7[bc]	0.6[c]	0.1[b]
Early - Standard	25.1[b]	44.5[a]	23.4[b]	5.4[b]	1.0[b]	0.2[ab]
Early - High	18.8[c]	43.6[a]	26.8[a]	8.6[a]	1.6[a]	0.2[a]
Late - Low	30.1[a]	47.1[a]	17.9[c]	3.6[c]	0.6[c]	0.2[a]
Late - Standard	31.3[a]	44.1[a]	18.9[c]	4.4[bc]	0.8[bc]	0.2[ab]
Late - High	30.8[a]	43.6[a]	19.2[c]	4.6[bc]	1.1[b]	0.2[a]
S.E.M.	*1.67*	*1.37*	*1.04*	*0.61*	*0.11*	*0.03*
V by R						
CDC Lancer - Low	16.0[de]	48.3[bc]	27.7[b]	6.3[bc]	1.2[bc]	0.2[abc]
CDC Lancer - Standard	15.6[de]	44.6[cd]	29.9[ab]	7.8[b]	1.5[b]	0.2[ab]
CDC Lancer - High	11.5[e]	40.9[de]	32.8[a]	11.7[a]	2.4[a]	0.3[a]
CDC Pasqua - Low	50.9[a]	37.8[e]	8.8[e]	1.6[f]	0.3[e]	0.1[bc]
CDC Pasqua - Standard	46.0[ab]	37.6[e]	12.1[de]	3.1[def]	0.6[de]	0.2[bc]
CDC Pasqua - High	43.9[b]	38.6[e]	13.3[d]	3.0[ef]	0.7[de]	0.1[bc]
CDC Orkney - Low	22.2[c]	53.4[a]	20.5[c]	3.1[def]	0.4[e]	0.1[c]
CDC Orkney - Standard	22.9[c]	50.9[ab]	21.4[c]	3.8[de]	0.6[de]	0.1[bc]
CDC Orkney - High	18.9[cd]	51.5[ab]	23.0[c]	5.2[cd]	0.9[cd]	0.2[abc]
S.E.M.	*2.05*	*1.68*	*1.28*	*0.74*	*0.13*	*0.05*
D by V by R						
Early – CDC Lancer - Low	15.3[fg]	48.9[abcd]	28.1[bc]	6.3[bcde]	1.1[cd]	0.2[bcd]
Early – CDC Lancer - Standard	13.8[fg]	43.8[defg]	30.9[ab]	9.2[b]	1.9[b]	0.3[abc]
Early – CDC Lancer - High	7.7[g]	37.4[ghi]	35.8[a]	15.4[a]	3.1[a]	0.4[ab]
Early – CDC Pasqua - Low	57.2[a]	33.8[i]	7.6[h]	1.1[g]	0.3[fg]	0.1[d]
Early – CDC Pasqua - Standard	46.9[b]	38.9[fghi]	11.3[efgh]	2.2[fg]	0.5[fg]	0.1[cd]
Early – CDC Pasqua - High	37.7[cd]	42.3[defgh]	15.7[def]	3.5[efg]	0.7[defg]	0.1[d]
Early – CDC Orkney - Low	15.6[fg]	54.9[a]	24.8[c]	3.9[efg]	0.6[defg]	0.1[cd]
Early – CDC Orkney - Standard	14.7[fg]	51.0[abc]	28.1[bc]	5.1[cdef]	0.8[def]	0.2[bcd]
Early – CDC Orkney - High	11.1[fg]	51.3[ab]	29.1[bc]	7.0[bcd]	1.1[cde]	0.3[ab]

Late – CDC Lancer - Low	16.7^{f}	47.7^{bcde}	27.3^{bc}	6.4^{bcde}	1.3^{bc}	0.3^{ab}
Late – CDC Lancer - Standard	17.5^{f}	45.5^{bcdef}	29.0^{bc}	6.5^{bcde}	1.2^{cd}	0.3^{abc}
Late – CDC Lancer - High	15.3^{fg}	44.4^{cdef}	29.8^{bc}	8.0^{bc}	1.7^{b}	0.4^{a}
Late – CDC Pasqua - Low	44.8^{bc}	42.0^{efgh}	10.2^{gh}	2.3^{fg}	0.5^{fg}	0.2^{abcd}
Late – CDC Pasqua - Standard	45.3^{bc}	36.3^{hi}	12.9^{defg}	4.2^{def}	0.8^{cdef}	0.3^{abc}
Late – CDC Pasqua - High	50.3^{ab}	35.0^{i}	11.1^{fgh}	2.5^{fg}	0.9^{cdef}	0.2^{bcd}
Late – CDC Orkney - Low	28.9^{e}	51.9^{ab}	16.4^{de}	2.4^{fg}	0.2^{g}	0.2^{bcd}
Late – CDC Orkney - Standard	31.2^{de}	50.8^{abc}	14.8^{defg}	2.6^{fg}	0.5^{efg}	0.1^{cd}
Late – CDC Orkney - High	26.8^{e}	51.7^{ab}	16.9^{d}	3.5^{efg}	0.8^{cdef}	0.2^{bcd}
S.E.M.	*2.90*	*2.37*	*1.81*	*1.05*	*0.19*	*0.06*

Table 5a. F-test results of mixed-effects models of **Seed sizing** assessing the presence of interactions at **Indian Head**. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Fixed effects	---------- *Pr(>F)* ----------					
Block (B)	**<0.001**	**<0.001**	**<0.001**	0.062	0.648	0.203
Seeding Date (D)	**0.008**	**<0.001**	**0.001**	**0.008**	**<0.001**	**0.012**
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	0.930
D x V	**<0.001**	0.872	**0.002**	0.982	0.091	0.798
Seeding Rate (R)	0.137	0.372	**0.025**	0.512	0.007	**<0.001**
R x D	0.808	0.367	**0.047**	0.155	**0.004**	**<0.001**
R x V	0.288	0.316	0.080	0.149	0.131	0.435
R x D x V	0.490	**0.032**	0.741	0.675	0.228	0.885

Table 6a. Means, and LSD separations for the main effects of seeding date (D), variety (V) and seeding rate (R) on chickpea seed seizing (%) at **Indian Head**

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Early	4.2^{a}	43.0^{a}	43.6^{b}	9.3^{b}	1.2^{b}	0.3^{b}
Late	1.9^{b}	25.3^{b}	50.8^{a}	17.6^{a}	3.1^{a}	0.5^{a}
S.E.M.	*0.26*	*0.83*	*0.41*	*0.94*	*0.09*	*0.02*
Variety (V)						
CDC Lancer	0.8^{b}	21.9^{c}	54.1^{a}	21.8^{a}	2.7^{a}	0.4^{a}
CDC Pasqua	6.8^{a}	45.2^{a}	35.9^{c}	9.0^{b}	2.1^{b}	0.4^{a}
CDC Orkney	1.5^{b}	35.3^{b}	51.5^{b}	9.6^{b}	1.8^{b}	0.4^{a}
S.E.M.	*0.22*	*0.64*	*0.77*	*1.68*	*0.13*	*0.03*
Seeding Rate (R)						
Low	3.3^{a}	33.5^{a}	45.9^{b}	13.3^{a}	2.7^{a}	0.6^{a}
Standard	2.9^{a}	34.2^{a}	47.8^{a}	12.2^{a}	2.1^{b}	0.3^{b}
High	2.9^{a}	34.8^{a}	47.9^{a}	14.9^{a}	1.8^{b}	0.3^{b}
S.E.M.	*0.15*	*0.62*	*0.55*	*1.65*	*0.19*	*0.03*

Table 7a. Means, and LSD separations for the interactions of seeding date (D), variety (V) and seeding rate (R) for chickpea seed seizing (%) at **Indian Head**

D by V	24R	22R	20R	18R	16R	14R
Early - CDC Lancer	1.4^{c}	30.8^{d}	53.2^{a}	17.4^{b}	1.7^{c}	0.3^{c}
Early - CDC Pasqua	9.4^{a}	53.9^{a}	29.9^{d}	4.9^{c}	0.9^{d}	0.3^{c}
Early - CDC Orkney	1.8^{c}	44.4^{b}	47.5^{b}	5.6^{c}	1.1^{cd}	0.3^{bc}
Late - CDC Lancer	0.3^{d}	12.9^{f}	55.0^{a}	26.2^{a}	3.7^{a}	0.5^{a}
Late - CDC Pasqua	4.2^{b}	36.6^{c}	41.9^{c}	13.1^{b}	3.2^{a}	0.5^{a}
Late - CDC Orkney	1.2^{cd}	26.3^{e}	55.4^{a}	13.6^{b}	2.5^{b}	0.5^{ab}
S.E.M.	*0.31*	*0.91*	*1.09*	*2.38*	*0.19*	*0.05*
D by R						
Early – Low	4.5^{a}	42.2^{a}	43.3^{c}	7.7^{b}	1.2^{c}	0.3^{b}
Early - Standard	4.2^{a}	43.8^{a}	43.2^{c}	6.8^{b}	1.1^{c}	0.3^{b}
Early - High	4.0^{a}	43.1^{a}	44.2^{c}	13.4^{ab}	1.3^{c}	0.3^{b}
Late - Low	2.1^{b}	24.8^{b}	48.5^{b}	18.9^{a}	4.2^{a}	0.8^{a}
Late - Standard	1.7^{b}	24.6^{b}	52.4^{a}	17.6^{a}	3.0^{b}	0.3^{b}
Late - High	1.8^{b}	26.4^{b}	51.5^{a}	16.4^{a}	2.3^{b}	0.3^{b}
S.E.M.	*0.22*	*0.88*	*0.77*	*2.33*	*0.27*	*0.05*
V by R						
CDC Lancer - Low	0.8^{d}	22.6^{c}	54.5^{a}	17.8^{bc}	3.1^{a}	0.6^{a}
CDC Lancer - Standard	0.9^{d}	21.9^{c}	54.3^{a}	19.5^{b}	2.3^{abc}	0.3^{c}
CDC Lancer - High	0.9^{d}	21.1^{c}	53.6^{a}	28.1^{a}	2.7^{a}	0.3^{c}
CDC Pasqua - Low	7.4^{a}	43.8^{a}	34.5^{c}	10.4^{cd}	2.5^{ab}	0.6^{a}
CDC Pasqua - Standard	6.5^{b}	45.2^{a}	36.8^{c}	8.6^{d}	2.5^{ab}	0.3^{c}
CDC Pasqua - High	6.5^{b}	46.7^{a}	36.5^{c}	8.1^{d}	1.2^{d}	0.3^{c}
CDC Orkney - Low	1.7^{c}	34.1^{b}	48.7^{b}	11.6^{bcd}	2.6^{a}	0.5^{ab}
CDC Orkney - Standard	1.4^{cd}	35.5^{b}	52.2^{a}	8.6^{d}	1.4^{cd}	0.3^{c}
CDC Orkney - High	1.3^{cd}	36.4^{b}	53.5^{a}	8.6^{d}	1.5^{bcd}	0.4^{bc}
S.E.M.	*0.27*	*1.08*	*0.95*	*2.86*	*0.33*	*0.06*
D by V by R						
Early – CDC Lancer - Low	1.1^{efgh}	29.0^{fg}	55.1^{ab}	12.2^{bcd}	1.7^{c}	0.4^{b}
Early – CDC Lancer - Standard	1.5^{def}	32.6^{def}	52.3^{bc}	11.4^{cd}	1.6^{c}	0.3^{b}
Early – CDC Lancer - High	1.6^{de}	31.1^{ef}	52.5^{bc}	28.8^{a}	1.8^{bc}	0.3^{b}
Early – CDC Pasqua - Low	10.1^{a}	53.0^{a}	29.4^{g}	5.5^{d}	1.1^{c}	0.4^{b}
Early – CDC Pasqua - Standard	9.3^{a}	54.4^{a}	30.5^{g}	4.4^{d}	1.0^{c}	0.3^{b}
Early – CDC Pasqua - High	9.0^{a}	54.4^{a}	30.0^{g}	5.1^{d}	0.8^{c}	0.3^{b}
Early – CDC Orkney - Low	2.4^{d}	44.7^{b}	45.5^{e}	5.5^{d}	1.1^{c}	0.3^{b}
Early – CDC Orkney - Standard	1.8^{de}	44.6^{b}	46.9^{de}	4.9^{d}	1.0^{c}	0.4^{b}
Early – CDC Orkney - High	1.5^{def}	44.1^{b}	50.3^{cd}	6.6^{cd}	1.5^{c}	0.5^{b}
Late – CDC Lancer - Low	0.5^{fgh}	16.3^{i}	53.9^{abc}	23.5^{ab}	4.5^{a}	0.9^{a}
Late – CDC Lancer - Standard	0.3^{gh}	11.4^{j}	56.5^{a}	27.7^{a}	3.2^{ab}	0.4^{b}
Late – CDC Lancer - High	0.2^{h}	11.3^{j}	54.9^{ab}	27.6^{a}	3.6^{a}	0.3^{b}
Late – CDC Pasqua - Low	4.9^{b}	34.7^{de}	39.6^{f}	15.5^{bcd}	3.9^{a}	0.9^{a}
Late – CDC Pasqua - Standard	3.8^{c}	36.1^{cd}	43.2^{ef}	12.9^{bcd}	4.1^{a}	0.4^{b}
Late – CDC Pasqua - High	4.0^{bc}	39.2^{c}	43.0^{ef}	11.2^{cd}	1.8^{c}	0.4^{b}
Late – CDC Orkney - Low	1.2^{efgh}	23.6^{h}	52.8^{bc}	17.7^{abc}	4.2^{a}	0.8^{a}
Late – CDC Orkney - Standard	1.2^{efgh}	26.5^{gh}	57.5^{a}	12.4^{bcd}	1.9^{bc}	0.3^{b}

Late – CDC Orkney - High	1.3^{defg}	28.9^{fg}	56.8^{a}	10.7^{cd}	1.6^{c}	0.4^{b}
S.E.M.	*0.38*	*1.52*	*1.34*	*4.04*	*0.47*	*0.08*

Table 8a. F-test results of mixed-effects models of **Seed sizing** assessing the presence of interactions at **Swift Current**. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Fixed effects	---------- *Pr(>F)* ----------					
Block (B)	0.250	**<0.001**	0.505	**0.007**	**0.024**	0.462
Seeding Date (D)	**0.006**	**0.003**	0.859	**0.003**	**0.002**	**0.006**
Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.001**
D x V	**<0.001**	0.953	**0.006**	0.613	**0.024**	0.911
Seeding Rate (R)	0.152	**<0.001**	0.148	**0.003**	**0.028**	0.736
R x D	0.764	0.814	0.121	0.662	0.724	0.323
R x V	0.961	0.659	0.520	0.588	0.370	0.649
R x D x V	0.593	0.866	0.909	0.936	0.871	0.996

Table 9a. Means, and LSD separations for the main effects of seeding date (D), variety (V) and seeding rate (R) on chickpea seed seizing (%) at **Swift Current**

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Early	6.4^{a}	33.0^{a}	41.1^{a}	15.7^{b}	2.8^{b}	0.5^{b}
Late	4.0^{b}	26.4^{b}	41.2^{a}	21.2^{a}	5.5^{a}	0.8^{a}
S.E.M.	*0.25*	*0.52*	*0.42*	*0.46*	*0.20*	*0.03*
Variety (V)						
CDC Lancer	2.2^{b}	22.3^{c}	45.0^{a}	23.5^{a}	5.5^{a}	0.8^{a}
CDC Pasqua	11.0^{a}	39.6^{a}	35.5^{b}	10.7^{c}	2.2^{b}	0.5^{b}
CDC Orkney	2.3^{b}	27.3^{b}	43.1^{a}	21.2^{b}	4.8^{a}	0.7^{a}
S.E.M.	*0.26*	*0.82*	*0.72*	*0.61*	*0.29*	*0.05*
Seeding Rate (R)						
Low	4.8^{a}	30.7^{a}	42.1^{a}	17.4^{b}	3.8^{b}	0.6^{a}
Standard	5.8^{a}	31.8^{a}	40.2^{a}	17.2^{b}	3.9^{b}	0.7^{a}
High	4.9^{a}	26.7^{b}	41.2^{a}	20.8^{a}	4.9^{a}	0.7^{a}
S.E.M.	*0.42*	*0.83*	*0.68*	*0.81*	*0.30*	*0.06*

Table 10a. Means, and LSD separations for the interactions of seeding date (D), variety (V) and seeding rate (R) for chickpea seed seizing (%) at **Swift Current**

D by V	24R	22R	20R	18R	16R	14R
Early - CDC Lancer	2.8^{c}	25.4^{d}	45.5^{a}	21.2^{b}	4.0^{b}	0.6^{b}
Early - CDC Pasqua	13.5^{a}	43.0^{a}	33.1^{d}	8.0^{e}	1.5^{c}	0.3^{c}
Early - CDC Orkney	2.9^{c}	30.5^{c}	44.8^{a}	18.0^{c}	2.9^{b}	0.5^{bc}
Late - CDC Lancer	1.6^{d}	19.1^{e}	44.5^{ab}	25.9^{a}	7.1^{a}	1.0^{a}
Late - CDC Pasqua	8.5^{b}	36.1^{b}	37.8^{c}	13.5^{d}	2.8^{bc}	0.6^{b}
Late - CDC Orkney	1.8^{cd}	24.0^{d}	41.5^{b}	24.4^{a}	6.8^{a}	0.9^{a}

S.E.M.	*0.38*	*1.15*	*1.03*	*0.87*	*0.42*	*0.07*
D by R						
Early – Low	6.1^{ab}	34.1^{a}	42.3^{a}	14.2^{d}	2.4^{c}	0.5^{bc}
Early - Standard	7.2^{a}	35.3^{a}	39.0^{b}	14.9^{cd}	2.7^{c}	0.5^{c}
Early - High	5.8^{ab}	29.5^{b}	42.1^{a}	18.1^{bc}	3.4^{c}	0.5^{c}
Late - Low	3.4^{c}	27.2^{b}	42.0^{a}	20.7^{ab}	5.3^{ab}	0.7^{ab}
Late - Standard	4.5^{bc}	28.2^{b}	41.4^{ab}	19.4^{b}	5.0^{b}	0.9^{a}
Late - High	3.9^{c}	23.8^{c}	40.4^{ab}	23.9^{a}	6.4^{a}	0.9^{a}
S.E.M.	*0.60*	*1.17*	*0.97*	*1.13*	*0.43*	*0.08*
V by R						
CDC Lancer - Low	1.8^{b}	24.7^{d}	46.5^{a}	21.0^{bc}	4.5^{b}	0.9^{a}
CDC Lancer - Standard	2.5^{b}	23.6^{d}	44.1^{ab}	22.9^{abc}	5.4^{ab}	0.8^{ab}
CDC Lancer - High	2.1^{b}	18.5^{e}	44.3^{ab}	26.7^{a}	6.7^{a}	0.8^{ab}
CDC Pasqua - Low	10.5^{a}	40.1^{ab}	35.6^{c}	10.7^{d}	2.1^{c}	0.4^{c}
CDC Pasqua - Standard	12.0^{a}	41.9^{a}	33.8^{c}	9.2^{d}	2.0^{c}	0.5^{bc}
CDC Pasqua - High	10.4^{a}	36.7^{b}	36.9^{c}	12.2^{d}	2.4^{c}	0.5^{bc}
CDC Orkney - Low	1.9^{b}	27.2^{cd}	44.3^{ab}	20.6^{bc}	4.8^{b}	0.6^{abc}
CDC Orkney - Standard	3.1^{b}	29.7^{c}	42.6^{b}	19.3^{c}	4.2^{b}	0.7^{abc}
CDC Orkney - High	2.1^{b}	24.8^{d}	42.5^{b}	23.7^{ab}	5.5^{ab}	0.8^{ab}
S.E.M.	*0.74*	*1.44*	*1.19*	*1.39*	*0.52*	*0.10*
D by V by R						
Early – CDC Lancer - Low	2.3^{d}	28.9^{ef}	47.4^{a}	17.7^{cde}	2.8^{efgh}	0.9^{abc}
Early – CDC Lancer - Standard	3.2^{d}	26.7^{fg}	43.5^{abc}	21.2^{bc}	4.4^{def}	0.6^{bcdef}
Early – CDC Lancer - High	3.0^{d}	20.7^{hij}	45.7^{ab}	24.9^{ab}	4.9^{cde}	0.6^{bcdef}
Early – CDC Pasqua - Low	13.9^{a}	43.4^{ab}	33.0^{gh}	7.6^{h}	1.6^{gh}	0.3^{f}
Early – CDC Pasqua - Standard	14.7^{a}	46.3^{a}	30.3^{h}	6.7^{h}	1.4^{h}	0.4^{def}
Early – CDC Pasqua - High	12.0^{ab}	39.5^{bc}	36.2^{fg}	9.7^{gh}	1.9^{gh}	0.4^{ef}
Early – CDC Orkney - Low	2.3^{d}	30.1^{ef}	46.6^{ab}	17.3^{cdef}	2.9^{efgh}	0.6^{cdef}
Early – CDC Orkney - Standard	3.8^{d}	33.1^{de}	43.4^{abc}	17.0^{cdef}	2.5^{fgh}	0.5^{cdef}
Early – CDC Orkney - High	2.8^{d}	28.5^{ef}	44.6^{abc}	19.8^{bcd}	3.5^{efg}	0.6^{cdef}
Late – CDC Lancer - Low	1.5^{d}	20.5^{ij}	45.7^{ab}	24.5^{ab}	6.3^{bcd}	1.0^{ab}
Late – CDC Lancer - Standard	2.0^{d}	20.6^{ij}	45.0^{abc}	24.8^{ab}	6.4^{bcd}	1.1^{a}
Late – CDC Lancer - High	1.4^{d}	16.4^{j}	43.0^{abcd}	28.5^{a}	8.6^{a}	1.1^{a}
Late – CDC Pasqua - Low	7.3^{c}	36.8^{cd}	38.4^{def}	13.9^{efg}	2.7^{fgh}	0.6^{cdef}
Late – CDC Pasqua - Standard	9.3^{bc}	37.7^{bcd}	37.5^{efg}	11.8^{fgh}	2.8^{efgh}	0.8^{abcde}
Late – CDC Pasqua - High	9.0^{bc}	33.9^{cde}	37.7^{efg}	14.9^{defg}	3.0^{efgh}	0.8^{abcde}
Late – CDC Orkney - Low	1.6^{d}	24.4^{fghi}	42.2^{bcde}	23.9^{ab}	6.9^{abc}	0.8^{abcd}
Late – CDC Orkney - Standard	2.5^{d}	26.5^{fgh}	41.8^{bcde}	21.8^{bc}	6.0^{bcd}	0.9^{abc}
Late – CDC Orkney - High	1.5^{d}	21.3^{ghij}	40.5^{cdef}	27.7^{a}	7.6^{ab}	1.1^{a}
S.E.M.	*1.04*	*2.04*	*1.68*	*1.97*	*0.74*	*0.14*

Table 11a. F-test results of mixed-effects models of **Seed sizing** assessing the presence of interactions at **Melfort**. Effects are considered significant if P<0.05 and significant effects are bolded for emphasis.

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Fixed effects	---------- *Pr(>F)* ----------					
Block (B)	0.533	**0.016**	0.825	**0.039**	0.275	0.546
Seeding Date (D)	**0.043**	0.479	0.460	**0.019**	**0.032**	**0.036**

Variety (V)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.072
D x V	**<0.001**	0.242	**0.040**	**0.026**	**0.008**	0.365
Seeding Rate (R)	**0.006**	**<0.001**	**<0.001**	**<0.001**	**0.002**	1.00
R x D	0.403	**0.006**	0.070	**0.013**	0.068	0.936
R x V	0.074	0.476	0.685	0.569	0.942	0.538
R x D x V	0.530	0.434	0.448	0.423	0.305	0.238

Table 12a. Means, and LSD separations for the main effects of seeding date (D), variety (V) and seeding rate (R) on chickpea seed seizing (%) at **Melfort**

Seeding Date (D)	24R	22R	20R	18R	16R	14R
Early	10.2^{a}	46.9^{a}	36.2^{a}	5.6^{b}	0.7^{b}	0.002^{b}
Late	9.2^{b}	46.0^{a}	35.3^{a}	7.8^{a}	1.3^{a}	0.01^{a}
S.E.M.	*0.22*	*0.83*	*0.69*	*0.34*	*0.12*	*0.00*
Variety (V)						
CDC Lancer	3.9^{c}	39.9^{c}	44.7^{a}	9.5^{a}	1.5^{a}	0.007^{ab}
CDC Pasqua	20.3^{a}	51.6^{a}	22.2^{c}	4.8^{c}	0.7^{b}	0.001^{b}
CDC Orkney	4.9^{b}	47.8^{b}	40.3^{b}	5.9^{b}	0.8^{b}	0.01^{a}
S.E.M.	*0.25*	*0.98*	*0.82*	*0.31*	*0.08*	*0.00*
Seeding Rate (R)						
Low	8.5^{b}	43.9^{b}	38.1^{a}	7.8^{a}	1.3^{a}	0.007^{a}
Standard	9.7^{ab}	47.2^{a}	35.5^{b}	6.4^{b}	0.9^{b}	0.007^{a}
High	10.9^{a}	48.3^{a}	33.7^{b}	5.9^{b}	0.8^{b}	0.007^{a}
S.E.M.	*0.49*	*0.59*	*0.66*	*0.27*	*0.09*	*0.00*

Table 13a. Means, and LSD separations for the interactions of seeding date (D), variety (V) and seeding rate (R) for chickpea seed seizing (%) at **Melfort.**

D by V	24R	22R	20R	18R	16R	14R
Early - CDC Lancer	4.3^{cd}	41.4^{c}	45.4^{a}	7.6^{b}	0.9^{b}	0.001^{b}
Early - CDC Pasqua	21.9^{a}	52.4^{a}	20.8^{c}	4.0^{d}	0.6^{c}	0.000^{b}
Early - CDC Orkney	4.5^{cd}	46.9^{b}	42.3^{a}	5.3^{cd}	0.6^{c}	0.005^{b}
Late - CDC Lancer	3.5^{d}	38.5^{c}	44.0^{a}	11.4^{a}	2.1^{a}	0.01^{ab}
Late - CDC Pasqua	18.8^{b}	50.7^{ab}	23.6^{c}	5.6^{c}	0.9^{bc}	0.003^{b}
Late - CDC Orkney	5.2^{c}	48.7^{ab}	38.4^{b}	6.5^{bc}	1.0^{b}	0.02^{a}
S.E.M.	*0.36*	*1.39*	*1.16*	*0.45*	*0.11*	*0.00*
D by R						
Early – Low	9.5^{ab}	45.9^{b}	37.3^{ab}	6.1^{cd}	0.8^{cd}	0.001^{a}
Early - Standard	10.3^{a}	47.4^{ab}	36.0^{b}	5.3^{d}	0.7^{cd}	0.003^{a}
Early - High	10.9^{a}	47.5^{ab}	35.2^{b}	5.4^{cd}	0.6^{d}	0.001^{a}
Late - Low	7.6^{b}	41.9^{c}	38.8^{a}	9.6^{a}	1.8^{a}	0.01^{a}
Late - Standard	9.0^{ab}	46.9^{ab}	35.0^{b}	7.5^{b}	1.2^{b}	0.01^{a}
Late - High	10.9^{a}	49.1^{a}	32.2^{c}	6.5^{bc}	1.0^{bc}	0.01^{a}

S.E.M.	*0.69*	*0.83*	*0.93*	*0.38*	*0.13*	*0.01*
V by R						
CDC Lancer - Low	3.1^{c}	36.4^{f}	47.2^{a}	11.1^{a}	1.9^{a}	0.002^{ab}
CDC Lancer - Standard	4.1^{c}	40.7^{e}	44.4^{ab}	8.9^{b}	1.5^{ab}	0.01^{ab}
CDC Lancer - High	4.5^{c}	42.8^{de}	42.5^{bc}	8.5^{b}	1.2^{bc}	0.007^{ab}
CDC Pasqua - Low	18.1^{b}	49.9^{abc}	24.8^{d}	5.9^{c}	1.0^{cde}	0.000^{b}
CDC Pasqua - Standard	19.7^{b}	52.4^{ab}	22.5^{de}	4.4^{de}	0.6^{de}	0.002^{ab}
CDC Pasqua - High	23.2^{a}	52.5^{a}	19.3^{e}	4.1^{e}	0.6^{e}	0.002^{ab}
CDC Orkney - Low	4.4^{c}	45.5^{d}	42.1^{bc}	6.5^{c}	1.1^{bcd}	0.02^{a}
CDC Orkney - Standard	5.2^{c}	48.5^{c}	39.5^{c}	5.8^{cd}	0.7^{de}	0.007^{ab}
CDC Orkney - High	5.0^{c}	49.5^{bc}	39.3^{c}	5.3^{cde}	0.6^{de}	0.01^{ab}
S.E.M.	*0.85*	*1.02*	*1.13*	*0.47*	*0.16*	*0.01*
D by V by R						
Early – CDC Lancer - Low	3.4^{d}	39.3^{gh}	41.2^{c}	8.4^{cd}	1.0^{cdef}	0.0^{b}
Early – CDC Lancer - Standard	5.0^{d}	42.7^{efgh}	42.8^{bc}	6.7^{defg}	1.1^{cdef}	0.0^{b}
Early – CDC Lancer - High	4.7^{d}	42.4^{fgh}	44.0^{abc}	7.7^{cde}	1.0^{cdef}	0.0^{b}
Early – CDC Pasqua - Low	20.5^{ab}	51.5^{ab}	46.7^{ab}	4.6^{hi}	0.9^{def}	0.0^{b}
Early – CDC Pasqua - Standard	21.8^{a}	52.9^{a}	41.7^{c}	3.8^{i}	0.5^{f}	0.0^{b}
Early – CDC Pasqua - High	23.5^{a}	53.1^{a}	47.9^{a}	3.8^{i}	0.5^{f}	0.0^{b}
Early – CDC Orkney - Low	4.8^{d}	47.1^{cd}	19.0^{g}	5.4^{fghi}	0.7^{ef}	0.0^{b}
Early – CDC Orkney - Standard	4.2^{d}	46.7^{cde}	19.6^{fg}	5.7^{fghi}	0.6^{ef}	0.0^{ab}
Early – CDC Orkney - High	4.7^{d}	47.0^{cd}	36.0^{d}	4.8^{ghi}	0.5^{f}	0.0^{b}
Late – CDC Lancer - Low	3.0^{d}	33.6^{i}	22.6^{fg}	13.9^{a}	2.9^{a}	0.0^{b}
Late – CDC Lancer - Standard	3.3^{d}	38.7^{h}	27.2^{e}	11.3^{b}	2.0^{b}	0.0^{ab}
Late – CDC Lancer - High	4.4^{d}	43.3^{defg}	42.7^{bc}	9.3^{c}	1.6^{bc}	0.0^{ab}
Late – CDC Pasqua - Low	15.9^{c}	48.3^{bc}	21.0^{fg}	7.3^{def}	1.3^{cde}	0.0^{b}
Late – CDC Pasqua - Standard	17.7^{bc}	52.0^{ab}	24.1^{ef}	5.2^{ghi}	0.9^{def}	0.0^{b}
Late – CDC Pasqua - High	23.0^{a}	52.0^{ab}	36.5^{d}	4.5^{hi}	0.8^{ef}	0.0^{b}
Late – CDC Orkney - Low	4.1^{d}	44.0^{def}	44.4^{abc}	7.8^{cde}	1.5^{bcd}	0.0^{a}
Late – CDC Orkney - Standard	6.3^{d}	50.3^{abc}	42.6^{bc}	6.0^{efgh}	0.9^{def}	0.0^{b}
Late – CDC Orkney - High	5.4^{d}	52.0^{ab}	44.4^{abc}	5.9^{efgh}	0.8^{def}	0.0^{ab}
S.E.M.	*1.19*	*1.44*	*1.61*	*0.66*	*0.22*	*0.01*

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.