Progress Report for Saskatchewan Pulse Growers

Project Title: **Response of chickpea to granular and foliar applied Potassium**

Project Number: AP2503

Producer Group Sponsoring Project: Saskatchewan Pulse Crop Development Board (SPG)

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.*

Project Start (Month and Year): 4/30/2025

Project End (Month and Year): 2/28/2027

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Objectives and Progress *(add additional lines as needed)*

Please list the original objectives and/or revised objectives if ministry-approved revisions have been made to original objectives. A justification is needed for any deviation from original objectives.

Objective	**Progress** *(i.e., completed/in progress)*
Overall objective: To demonstrate the response of granular and foliar applied potassium fertilizer on chickpea health, quality, and yield.	Year 1 completed, Year 2 in progress
Specific objective 1: To assess the impact of granular and foliar applied K on chickpea yield and harvested seed quality across three different regions and soils in SK.	Year 1 completed, Year 2 in progress
Specific objective 2: To evaluate if granular and foliar K applications improve disease severity of ascochyta blight and emerging chickpea plant health issue in kabuli and desi chickpea.	Year 1 completed, Year 2 in progress

Sustainable Canadian Agricultural Partnership

Saskatchewan

Canada

Methodology

Specify project activities undertaken during this reporting period. Include approaches, experimental design, methodology, materials, sites, etc. Major changes from the original plan should be indicated and the reason(s) for the change should be specified.

For example, your description should include all relevant items such as 1) the number and size of any field plots, 2) what was seeded, 3) what treatments were applied to the plots, 4) the schedule or timing of any relevant activities such as seeding, treatment application or harvest, and 5) what was measured to evaluate the success of any treatment. If your project dealt with animals, you should be sure to include 1) the number of animals in each trial group, 2) the treatment or procedure applied to each group, and 3) what was measured to evaluate the success of each treatment.

The trial was conducted at three Agri-ARM sites in Saskatchewan – Northeast Agriculture Research Foundation (NARF) near Melfort, SK, Indian Head Agricultural Research Foundation (IHARF) near Indian Head, SK, and Wheatland Conservation Area (WCA) near Swift Current, SK. Each trial was set up as a split-plot with 4 replicates. Two varieties of chickpea were used – CDC Lancer (Market class - Kabuli) and CDC Kala (Market class - Desi). Two potassium products were used in the trial – Granular potash (KCl, 0-0-60) which was side-banded at seeding, and YaraVita's liquid Safe K (3-0-34) which was applied just before flowering. Variety was the main plot and treatments of granular and foliar K applications were randomized within each main plot. Both granular and foliar K products were applied at three different rates summarized in Table 1 below.

Table 1. Treatments for the trial 'Response of chickpea to granular and foliar applied Potassium'.

Trt #	Variety (Market class)	Treatment (K form - application rate)	Product and rate
1	CDC Lancer (Kabuli)	UTC (Untreated control)	Untreated control (no granular or foliar K)
2		Granular - low	Granular potash applied at seeding at 20 kg KCl/ha
3		Granular - mid	Granular potash applied at seeding at 40 kg KCl/ha
4		Granular - high	Granular potash applied at seeding at 60 kg KCl/ ha
5		Foliar - low	Foliar K applied just before flowering at 1.25 kg K/ha
6		Foliar - mid	Foliar K applied just before flowering at 2.5 kg K/ha
7		Foliar - high	Foliar K applied just before flowering at 3.75 kg K/ha
8	CDC Kala (Desi)	UTC (Untreated control)	Untreated control (no granular or foliar K)
9		Granular - low	Granular potash applied at seeding at 20 kg KCl/ha
10		Granular - mid	Granular potash applied at seeding at 40 kg KCl/ha
11		Granular - high	Granular potash applied at seeding at 60 kg KCl/ ha
12		Foliar - low	Foliar K applied just before flowering at 1.25 kg K/ha
13		Foliar - mid	Foliar K applied just before flowering at 2.5 kg K/ha
14		Foliar - high	Foliar K applied just before flowering at 3.75 kg K/ha

Seeding rate of CDC Lancer and CDC Kala was targeted at 44 live seeds/m^2 after adjusting for germination and thousand kernel weight. Seeds were inoculated with appropriate N-fixing Rhizobium inoculant at the time of seeding. Soil test of the trial area was conducted in the spring before seeding and based on soil test recommendations for 25 bu/ac (1500 lb/ac) chickpea yield, all plots were fertilized with phosphorous and sulfur for them to be non-limiting. Plots receiving foliar K (Treatments 5, 6, 7, 12, 13, and 14) did not receive any K at the time of seeding. YaraVita's Safe K product was applied at the rate of 2.5, 5, and 7.5 L/ha for rates of low, mid, and high respectively. Water rate of 30 to 200 L/ha was used depending on each site's spraying equipment. The trial was managed using best management practices for disease, insect, and weed control.

Following data were collected at each site:

1) Emergence counts were done in at least two 1m rows in front and back of each plot and values converted to plants/m^2.
2) Just prior to foliar app of K, tissue sampling of above-ground plant material was done for Treatments 1 and 8 and

samples were sent to an accredited lab for total K analysis.
3) Days to flowering were recorded for each plot when 50% of the plants in a plot had at least one open flower.
4) 5 plants per plot were rated for Chickpea Health Issue (CHI) on a scale of 0-5 when plants were at flowering to early podding stage (R6, pod initiation stage). Average rating was calculated for each plot. Disease rating sheet is included in the Appendix (A8).
5) 5 plants per plot were rated for Ascochyta blight at late podding stage when pods were green and before the chickpeas changed colour (R8-R9 stage). Average rating was calculated for each plot. Disease rating sheet is included in the Appendix (A9).
6) To determine the uptake of K from foliar application, tissue sampling of above-ground plant material at podding stage was done for treatments 1, 5, 6, 7 (for kabuli chickpea) and treatments 8, 12, 13, 14 (for desi chickpea). Samples were sent to an accredited lab for total K analysis.
7) Days to maturity were calculated for each plot. Plot was considered mature when 95% of the pods had turned brown.
8) Harvest yield was determined after adjusting to 14% moisture and adjusting for missing area in treatments from which biomass was collected.
9) Thousand kernel weight of harvested seed was recorded for each plot.

Dates of operation for activities conducted throughout the field season at all sites are summarized in Table A1 of the Appendix. Data analysis was done using Statistix 10 data analysis software. Split-plot ANOVA (analysis of variance) was conducted with variety as the main-plot factor, treatment as the subplot factor, and replicate as the replication variable. After determining significant effect(s) of variety, treatment, or their interaction through ANOVA, post-hoc testing was done using Tukey's HSD with alpha = 0.05.

Results

Present and discuss any project results, including any data or measurements taken to evaluate the demonstration during the reporting period. List extension activities such as field days or workshops. List the activity, the date it occurred, and the number of people who attended. Identify any other materials such as posters, pamphlets, video etc. that have been produced to describe this project and where those items have been displayed. Estimate the number of producers who have viewed these items.

Trials were successfully conducted at all three sites in 2025. Soil test results from the trial area revealed high soil K levels at all sites, ranging from 370 and 382 ppm at Melfort and Swift Current, respectively, to 850 ppm at Indian Head. Complete soil test results can be found in Table A2 of the Appendix. Weather at each site varied during seeding and into harvest – At Melfort, spring was very dry with virtually no rain in April or May, but conditions improved as the field season progressed. In contrast, spring started out relatively wet at Indian Head and Swift Current but conditions became progressively drier into the field season. While Melfort and Swift Current received higher-than-average monthly rainfall in August, conditions remained dry at Indian Head. Complete weather summary for all sites is provided in Table A3 of the Appendix. Among the three sites, the trial was harvested first at Swift Current, the most Southern site, on September 22, 2025. Indian Head followed soon with harvest on September 26, 2025. The trial was harvested last at Melfort, the northern-most site, on October 24, 2025.

<u>Statistical analysis of agronomic parameters</u>

The effect of treatment (i.e., K form and rate of application) was not statistically significant for any of the measured agronomic parameters of plant emergence, days to flowering, disease, days to maturity, yield, or thousand kernel weight of harvested seed at any of the three sites. The effect of the interaction of variety and treatment was also not significant at any site. Where significant differences were present, only the effect of variety was significant. These results are summarized in Table 2 below. Means grouped by treatment and means for the interaction of variety x treatment can be found in Tables A4 and A5 of the Appendix, respectively.

At Melfort, plant emergence was similar between kabuli and desi chickpea varieties. However, at both Indian Head and

Swift Current, the kabuli variety, CDC Lancer, had significantly better plant emergence (up to 10 plants/m^2 higher) compared to the desi variety, CDC Kala.

At Melfort, the desi chickpea variety CDC Kala flowered and matured significantly faster than the kabuli variety CDC Lancer. CDC Kala at Melfort matured 19 days earlier than CDC Lancer. However, no such difference in days to flowering and maturity was observed at Indian Head or Swift Current.

Very low disease was recorded at all sites in 2025. On a scale of 0-5, average disease rating for Chickpea Health Issue was around 0 at both Melfort and Indian Head and 1.5 at Swift Current. On a scale of 0-9, ascochyta blight ratings averaged 1.5 at Melfort, 1.3 at Indian Head, and 0 at Swift Current.

Yield of the kabuli variety was higher than the desi variety at all sites but this difference was only statistically significant for Melfort and Indian Head. Higher yield for CDC Lancer was likely due to its higher TKW (larger seed size) compared to CDC Kala. In comparing TKW of harvested seed between sites, Swift Current had the smallest/ lightest seeds for both varieties. CDC Kala produced at Indian Head had the highest TKW out of all sites, and Melfort and Indian Head were tied for average TKW of CDC Lancer.

Table 2. Summary of ANOVA results and varietal means of agronomic parameters for the trial, 'Response of chickpea to granular and foliar applied Potassium' conducted at Melfort, Indian Head, and Swift Current in 2025. Means were compared using Tukey's HSD test at 95% confidence interval. Within the same site, means followed by the same letter within a column do not significantly differ from each other.

Site: NARF (Melfort, SK)							
	Emergence (plants/m^2)	**Days to flowering**	**CHI rating (0-5)**	**Ascochyta blight rating (0-9)**	**Days to maturity**	**Yield (kg/ha)**	**TKW (g)**
p-value (Variety)	0.7050	0.0001	0.0017	0.6273	0.0008	0.0206	<0.0001
p-value (Treatment)	0.1771	0.1180	0.6280	0.7561	0.6891	0.8744	0.2222
p-value (Variety x Treatment)	0.6539	0.6850	0.9493	0.6098	0.6571	0.7686	0.2259
Grand mean	40	46	0.3	1.5	119	2746	282
CV	20	1	27	103	4	26	4
Variety	---- Means ----						
CDC Lancer	40 A	48 A	0.2 B	1.4 A	129 A	3172 A	358 A
CDC Kala	39 A	45 B	0.4 A	1.6 A	110 B	2320 B	205 B
Site: IHARF (Indian Head, SK)							
	Emergence (plants/m^2)	**Days to flowering**	**CHI rating (0-5)**	**Ascochyta blight rating (0-9)**	**Days to maturity**	**Yield (kg/ha)**	**TKW (g)**
p-value (Variety)	0.0019	See footnote 1	See footnote 2	0.7059	0.7487	0.0002	0.0002
p-value (Treatment)	0.6611			0.4635	0.8817	0.1486	0.1014
p-value (Variety x Treatment)	0.6962			0.7694	0.9746	0.4848	0.9177
Grand mean	35	56.5	0.0	1.3	116	4139	294
CV	5	0	-	25	0	5	7
Variety	---- Means ----						
CDC Lancer	38 A	56.5	0.0	1.3 A	117 A	4754 A	358 A
CDC Kala	33 B	56.5	0.0	1.3 A	116 A	3523 B	230 B

Site: WCA (Swift Current, SK)							
	Emergence (plants/m^2)	**Days to flowering**	**CHI rating (0-5)**	**Ascochyta blight rating (0-9)**	**Days to maturity**	**Yield (kg/ha)**	**TKW (g)**
p-value (Variety)	0.0004	0.3910	0.8460	0.3910	See footnote 3	0.1589	0.0001
p-value (Treatment)	0.3197	0.4242	0.2019	0.4404		0.8541	0.1838
p-value (Variety x Treatment)	0.8463	0.0090	0.2019	0.4404		0.8184	0.1137
Grand mean	36	47	1.5	0.0	115	3207	261
CV	6	5	42	748	0	19	6
Variety	---- Means ----						
CDC Lancer	41 A	47 A	1.5 A	0.0 A	112	3361 A	332 A
CDC Kala	31 B	47 A	1.5 A	0.0 A	117	3054 A	189 B

Footnotes:

1. Days to flowering at Indian Head were the same for all plots in Replicates 1 & 2 (56 days) and Replicates 3 & 4 (57 days). As a result, variance was too small (essentially zero) and data perfectly fit the linear model ($R^2 = 1$). ANOVA could not be reliably performed.
2. Ratings for Chickpea Health Issue were 0 for all observations at Indian Head.
3. Values for days to maturity at Swift Current were the same for all replicates of the same treatment, meaning there was zero spread/variance between observations for all treatments. Data fit the linear model perfectly ($R^2 = 1$) and split-plot ANOVA could not be reliably performed. However, when data were analysed as a simple factorial grouped by variety, p-value (Variety) was <0.0001, CV was 1.18, and difference in days to maturity between CDC Lancer and CDC Kala was significant. When data were grouped by treatment and analysed as a simple factorial, p-value (Treatment) was > 0.05.

Tissue K analysis

While not statistically significant, tissue K prior to foliar K application tended to be higher in CDC Lancer compared to CDC Kala at Melfort and Indian Head but not at Swift Current (Table 3).

Table 3. ANOVA results and means of tissue K in above-ground biomass of chickpea prior to foliar K application at all sites.

Site	Variety	Pre-application Tissue K (%)	p-value	CV
NARF, Melfort	CDC Lancer	2.74	0.1669	3
	CDC Kala	2.63		
IHARF, Indian Head	CDC Lancer	2.31	0.0779	6
	CDC Kala	2.08		
WCA, Swift Current	CDC Lancer	2.50	1	16
	CDC Kala	2.50		

Tissue sampling after foliar K application showed declined K concentration in tissues compared to pre-foliar K application (Table 4). Concentration of K varied with variety at Melfort and Indian Head whereas the effect of treatment (in this case, rate of K applied) and the interaction of variety x treatment was not significant at any site.

Table 4. ANOVA results and means of tissue K in above-ground biomass of chickpea after foliar K application at all sites. Means were compared using Tukey's HSD test at 95% confidence interval; means followed by the same letter within a column do not significantly differ from each other.

	NARF, Melfort	IHARF, Indian Head	WCA, Swift Current
p-value (Variety)	0.0011	0.0053	0.154

p-value (Treatment)	0.8263	0.9467	0.2285
p-value (Variety x Treatment)	0.4738	0.7566	0.3225
CV	5	6	12
Variety	---- Tissue K (%) post foliar application ----		
CDC Lancer	1.85 A	1.66 A	1.39 A
CDC Kala	1.46 B	1.43 B	1.51 A

At Melfort and Indian Head, CDC Lancer had significantly higher tissue K than CDC Kala, implying that CDC Lancer took up foliar applied K more readily compared to CDC Kala. Tissue K concentration was similar between varieties at Swift Current.

Figures 1, 2, and 3 below show the response of increasing rates of foliar K application on tissue K levels at Melfort, Indian Head, and Swift Current, respectively. UTC refers to Untreated Control. Note that the differences in tissue K were not significant for treatment (or foliar K product rate) for any site as shown in Table 4 above.

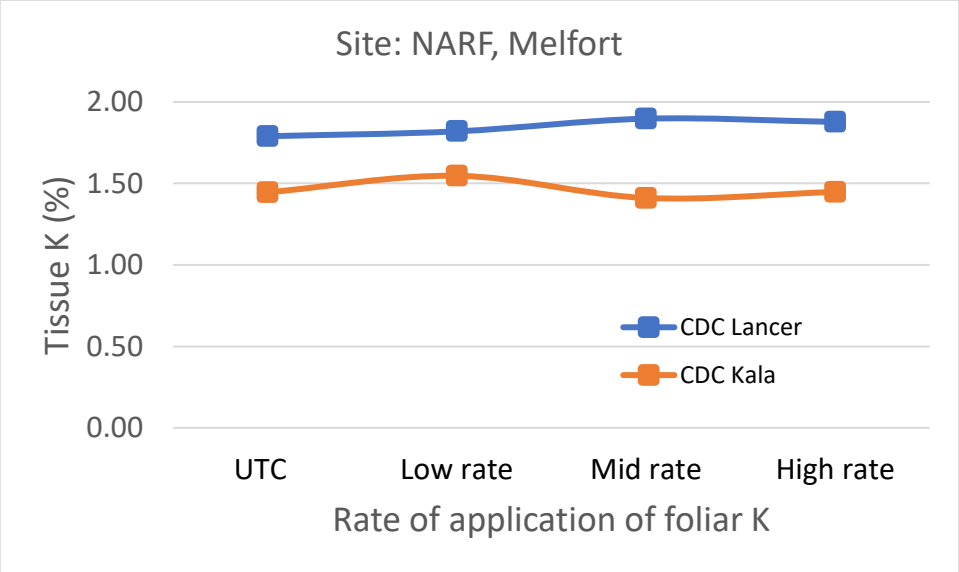

Figure 1. Response of increasing rates of foliar K product on chickpea tissue K levels at NARF, Melfort.

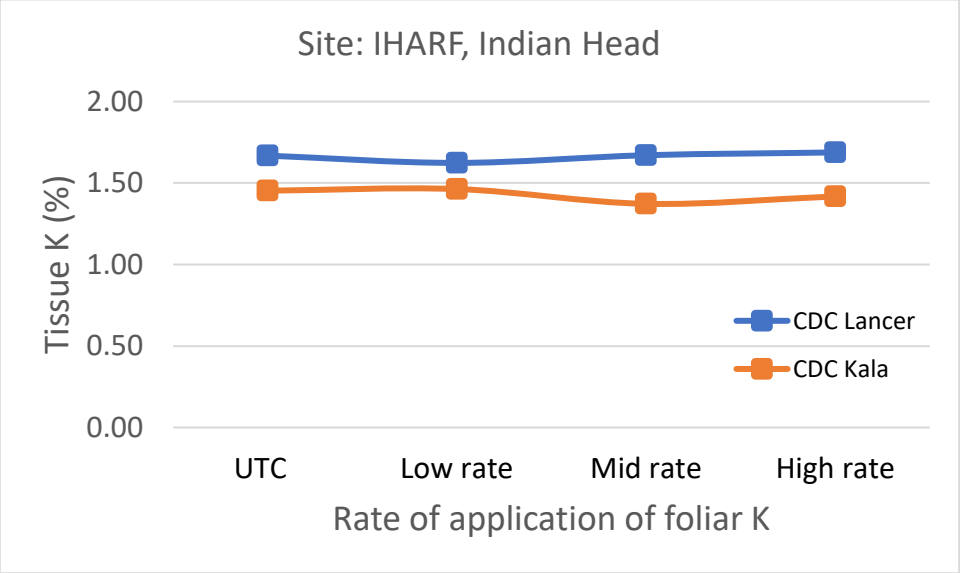

Figure 2. Response of increasing rates of foliar K product on chickpea tissue K levels at IHARF, Indian Head.

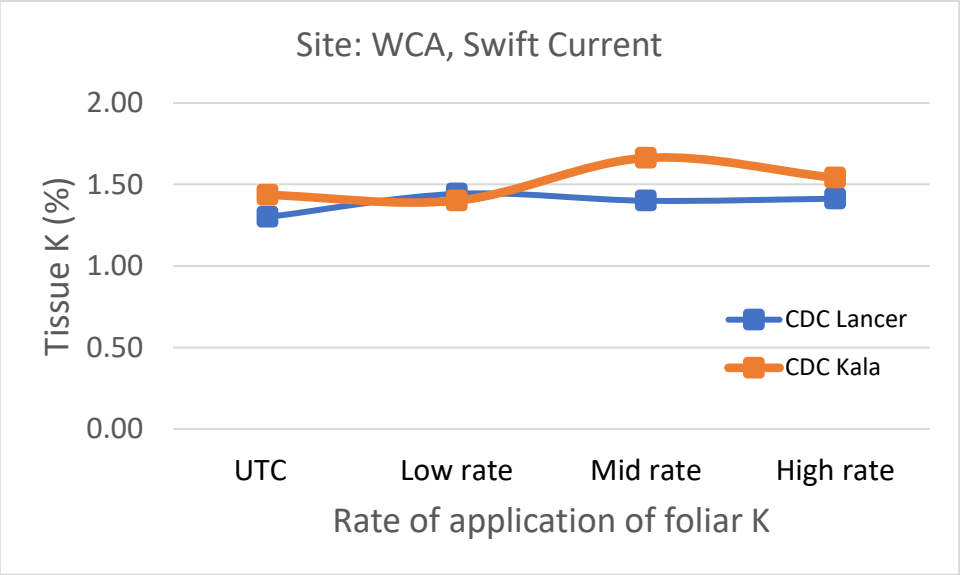

Figure 3. Response of increasing rates of foliar K product on chickpea tissue K levels at WCA, Swift Current.

Increasing application rates of foliar K product did not lead to a consistent or significant increase in tissue K concentration in either chickpea variety at any site. In most cases, high application rate resulted in similar tissue K levels as the medium/low rate. Mean values for these treatments can be found in Table A7 of the Appendix.

Extension

At NARF, signage was put in front of this trial and it was passed by on NARF and AAFC Joint Field Day on July 23, 2025 with 126 attendees. This trial was a formal stop on NARF's minor/ niche crops field day on July 24, 2025 and Mike Brown from Saskatchewan Pulse Growers presented on this trial and other pulse projects before 36 attendees. This trial was not a formal stop at IHARF or WCA field days but SPG staff were given a tour of the trial at IHARF by Chris Holzapfel.

Interim Conclusions *(if any)*

No significant agronomic response to potassium fertilization at any site was observed for kabuli or desi chickpea varieties tested in this trial (CDC Lancer and CDC Kala, respectively) in the year 2025. Where present, significant

differences were only observed between varieties: CDC Kala flowered earlier and matured 19 days earlier than CDC Lancer at Melfort (Northeast SK) but no significant differences in maturity were seen at Indian Head or Swift Current, which are located in Southeast and Southwest SK, respectively. Yield of CDC Lancer was generally higher than CDC Kala, likely due to bigger seed size of CDC Lancer. CDC Lancer had higher tissue K concentration compared to CDC Kala before and after foliar application of a K product, indicating that CDC Lancer might be quicker than CDC Kala at taking up K or it might have a higher requirement for K compared to CDC Kala. Overall disease pressure was low at all sites, likely due to drought stress either early or later in the season at each site. Environmental stress could also be a reason for the unresponsiveness of chickpea to potassium, and year 2 of this trial will help elucidate this further.

Appendices

If necessary, include any materials supporting the previous sections, i.e., detailed data tables, maps, graphs, specifications.

Table A1. Dates of operation for field activities at all sites in 2025.

Activity	**Chemical and/or date of operation**		
	NARF, Melfort	**IHARF, Indian Head**	**WCA, Swift Current**
Previous crop	Wheat	Oat	Durum
Soil Sample	May 7, 2025	May 13, 2025	Apr 11, 2025
Seeded	May 20, 2025	May 8, 2025	May 14, 2025
Seed treatment and/or Inoculant	Seed treatment - Apron Maxx RTA @ 325 ml/100 kg seed and Vibrance 500 FS @ 10 ml/100 kg seed. Inoculant - Primo GX2 dual action granular inoculant @ 3.6 lb/ac.	Seed treatment - Insure Pulse @ 300 ml/100 kg seed. Inoculant - TagTeam BioniQ Chickpea @ 3.0 kg/ha	Seed treatment - Vibrance Total; Inoculant - TagTeam BioniQ chickpea inoculant @ 4.1 lb/ac
Fertility	Monoammonium phosphate and ammonium sulphate side-banded in all treatments to provide 13-28-0-9 kg N-P-K-S/ha	Monoammonium phosphate and ammonium sulphate side-banded in all treatments to provide 12-34-0-6 kg N-P2O5-K2O-S/ha	MESZ (12-40-0-10S) @ 53 lb/ac side-banded at seeding for all treatments.
Pre-Emergent Herbicide	May 9, 2025: Authority 480 @ 118 ml/ac and StartUp @ 1 L/ac	May 4, 2025: 0.67 l/ac Roundup Transorb HC; May 10, 2025: 243 ml/ac Authority Supreme plus 0.67 l/ac Roundup Weathermax.	Apr 18, 2025: Roundup Transorb @1L/ac + Aim @47ml/ac + Merge @1L/100L; May 15, 2025: Authority 480 @118ml/ac.
Post-Emergent Herbicide	Jun 9, 2025: Centurion @ 75 ml/ac; Jun 27, 2025: Assure II @ 300 ml/ac	June 5, 2025: 12 g/ac Solo plus 154 ml/ac Assure 2, plus 0.5% v/v Merge. The Solo product used was the old, dry formulation which was 70% imazamox	Jun 20, 2025: Tough EC @600ml/ac
Fungicide	July 10, 2025: Cotegra @ 283 ml/ac	July 5 and July 17, 2025: 356 ml/ac Delaro 325 SC plus 0.125% Agral 90	Jul 24, 2025: Dyax @160ml/ac; Jul 30, 2025: Miravis Neo @ 0.5 L/ac; Aug 6, 2025: Bravo ZNC @ 1.6 L/ac; Aug 13, 2025: Proline 480 SC @ 170 ml/ac.
Insecticide	None	None	None
TRT applications	July 1, 2025	Jun 25, 2025	Jun 26, 2025

Desiccant	None	Sep 10, 2025: 0.67 l/ac Roundup Weathermax.	None
Harvested	Oct 24, 2025	Sep 26, 2025	Sep 22, 2025
Data Collection:			
Plant counts	June 17, 2025	Jun 11, 2025	Jun 25, 2025
Pre- foliar application tissue sampling	Jun 27, 2025	Jun 24, 2025	Jun 25, 2025
Chickpea Health Issue ratings	Jul 30, 2025	Jul 11, 2025	Jul 9, 2025
Ascochyta blight rating	Aug 15, 2025	Jul 28, 2025	Aug 12, 2025
Post-foliar application tissue sampling	Around Aug 5, 2025	Jul 25, 2025	Jul 22, 2025

Table A2. Soil test results from the trial area taken prior to seeding at all sites in spring 2025.

		NARF, Melfort			IHARF, Indian Head			WCA, Swift Current		
	Depth (inch)	**0-6”**	**6-24”**	**0-24”**	**0-6”**	**6-24”**	**0-24”**	**0-6”**	**6-24”**	**0-24”**
	N (lb/ac)	18	15	33	9	9	18	42	75	117
	P (ppm)	9			8			13		
	K (ppm)	370			850			382		
	Cl (lb/ac)			20			72			212
	S (lb/ac)	10	36		14	60		96	360+	
	Boron (ppm)	0.3			1.6			0.4		
	Zinc (ppm)	1.95			0.71			0.78		
	Iron (ppm)	151.6			24.3			40.1		
	Manganese (ppm)	8.6			11.4			7.5		
	Copper (ppm)	1.07			2.37			0.79		
	Magnesium (ppm)	821			1265			512		
	Calcium (ppm)	3993			6631			2330		
	Sodium (ppm)	21			60			38		
	OM (%)	7.8			6.4			3		
	Carbonate (CCE) (%)	0.2			0.6			0.2		
	pH	5.8	7.7		7.6	8		6.6	7.8	
	Salts (mmho/cm)	0.26	0.62		0.63	0.69		0.5	1.97	
	Cation Exchange Capacity (meq)	35.6			46.1			18.2		
% Base Saturation	**% Ca**	56			71.9			64.1		
	% Mg	19.2			22.8			23.5		
	% K	2.7			4.7			5.4		
	% Na	0.3			0.6			0.9		
	% H	21.8			0			6.1		

Table A3. Mean and total monthly and long-term temperature and precipitation for May-September 2025 for all sites. Long term data comprises the years 1997-2021 for Melfort, 1981-2010 for Indian Head, and 2014-2024 for Swift Current.

Location	Year	April	May	June	July	August	Sept	Avg. / Total
---------- Mean Temperature (°C) ----------								
Melfort	2025	2.4	13.8	15	17	18	15	13.5
	Long-term	**2.1**	**10.1**	**15.2**	**17.8**	**16.7**	**11.7**	**12.3**
Indian Head	2025	2.8	12.7	15.3	17	17.8	15.3	13.5
	Long-term	**4.2**	**10.8**	**15.8**	**18.2**	**17.4**	**11.5**	**13.0**
Swift Current	2025	6.1	13.1	15.9	18.0	19.0	16.7	14.8
	Long-term	**4.0**	**11.9**	**16.4**	**19.1**	**18.7**	**14.0**	**14.0**
---------- Precipitation (mm) ----------								
Melfort	2025	1.6	4.8	93.2	25.9	113.5	20.3	259.3
	Long-term	**16.9**	**33.4**	**79.5**	**69.6**	**45.9**	**36**	**281.3**
Indian Head	2025	29.2	42.6	39.4	27.1	26.9	43.1	208.3
	Long-term	**22.6**	**51.7**	**77.4**	**63.8**	**51.2**	**35.3**	**302.0**
Swift Current	2025	39.5	34.2	31.3	78.2	92.6	0.8	276.6
	Long-term	**22.5**	**47.5**	**56.0**	**56.3**	**38.0**	**32.0**	**252.3**

Table A4. Means for agronomic parameters for the trial, 'Response of chickpea to granular and foliar applied Potassium' grouped by treatment (i.e., K form - application rate) for all sites. Means were compared using Tukey's HSD test at 95% confidence interval. Within the same site, means followed by the same letter within a column do not significantly differ from each other.

Site: NARF (Melfort, SK)							
Treatment	Emergence (plants/m^2)	Days to flowering	CHI rating (0-5)	Ascochyta blight rating (0-9)	Days to maturity	Yield (kg/ha)	TKW (g)
UTC	42 A	46 A	0.3 A	1.8 A	119 A	2728 A	285 A
Granular - low	38 A	46 A	0.2 A	1.5 A	120 A	2821 A	283 A
Granular - mid	42 A	46 A	0.3 A	1.6 A	120 A	2754 A	278 A
Granular - high	35 A	46 A	0.2 A	1.6 A	121 A	2660 A	282 A
Foliar - low	44 A	46 A	0.3 A	1.4 A	121 A	2767 A	284 A
Foliar - mid	38 A	46 A	0.3 A	1.4 A	117 A	2718 A	285 A
Foliar - high	40 A	46 A	0.2 A	1.3 A	117 A	2771 A	277 A
Site: IHARF (Indian Head, SK)							
	Emergence (plants/m^2)	**Days to flowering**	**CHI rating (0-5)**	**Ascochyta blight rating (0-9)**	**Days to maturity**	**Yield (kg/ha)**	**TKW (g)**
UTC	36 A	56.5	0.0	1.2 A	116 A	4192 A	296 A
Granular - low	35 A	56.5	0.0	1.3 A	116 A	4065 A	292 A
Granular - mid	35 A	56.5	0.0	1.4 A	117 A	4202 A	293 A
Granular - high	34 A	56.5	0.0	1.2 A	117 A	4186 A	291 A
Foliar - low	34 A	56.5	0.0	1.3 A	117 A	4175 A	295 A
Foliar - mid	35 A	56.5	0.0	1.2 A	117 A	4092 A	293 A
Foliar - high	39 A	56.5	0.0	1.4 A	117 A	4057 A	297 A
Site: WCA (Swift Current, SK)							

	Emergence (plants/m²)	Days to flowering	CHI rating (0-5)	Ascochyta blight rating (0-9)	Days to maturity	Yield (kg/ha)	TKW (g)
UTC	37 A	47 A	1.9 A	0.0 A	114	3095 A	268 A
Granular - low	33 A	46 A	1.6 A	0.0 A	114	3188 A	259 A
Granular - mid	37 A	46 A	1.4 A	0.0 A	114	3238 A	259 A
Granular - high	35 A	47 A	1.5 A	0.1 A	113	3159 A	252 A
Foliar - low	38 A	47 A	1.4 A	0.0 A	116	3265 A	266 A
Foliar - mid	37 A	47 A	1.3 A	0.0 A	114	3188 A	260 A
Foliar - high	37 A	47 A	1.6 A	0.0 A	117	3318 A	261 A

Table A5. Means of agronomic parameters for two-way interaction between variety and treatment for the trial, 'Response of chickpea to granular and foliar applied Potassium' for all sites. Means were compared using Tukey's HSD test at 95% confidence interval. Within the same site, means followed by the same letter within a column do not significantly differ from each other.

Site: NARF (Melfort, SK)							
	Emergence (plants/m²)	Days to flowering	CHI rating (0-5)	Ascochyta blight rating (0-9)	Days to maturity	Yield (kg/ha)	TKW (g)
CDC Lancer UTC	43 A	48 A	0.2 A	1.9 A	129 A	3166 A	365 A
CDC Lancer Granular - low	39 A	48 A	0.1 A	1.5 A	131 A	3315 A	364 A
CDC Lancer Granular - mid	46 A	47 A	0.2 A	1.7 A	130 A	3119 A	351 A
CDC Lancer Granular - high	32 A	48 A	0.1 A	1.3 A	131 A	3020 A	356 A
CDC Lancer Foliar - low	44 A	47 A	0.3 A	1.3 A	130 A	3142 A	359 A
CDC Lancer Foliar - mid	38 A	48 A	0.2 A	1.0 A	123 ABC	3179 A	363 A
CDC Lancer Foliar - high	41 A	48 A	0.1 A	1.2 A	125 AB	3261 A	352 A
CDC Kala UTC	42 A	45 B	0.4 A	1.7 A	109 BC	2291 A	204 B
CDC Kala Granular - low	37 A	45 B	0.4 A	1.6 A	108 C	2327 A	203 B
CDC Kala Granular - mid	39 A	44 B	0.4 A	1.5 A	109 BC	2390 A	206 B
CDC Kala Granular - high	39 A	45 B	0.3 A	1.9 A	111 BC	2300 A	208 B
CDC Kala Foliar - low	44 A	45 B	0.4 A	1.5 A	111 BC	2393 A	208 B
CDC Kala Foliar - mid	37 A	45 B	0.4 A	1.8 A	111 BC	2256 A	207 B
CDC Kala Foliar - high	39 A	45 B	0.3 A	1.4 A	109 C	2281 A	201 B
Site: IHARF (Indian Head, SK)							
	Emergence (plants/m²)	Days to flowering	CHI rating (0-5)	Ascochyta blight rating (0-9)	Days to maturity	Yield (kg/ha)	TKW (g)
CDC Lancer UTC	37 A	56.5	0.0	1.3 A	116 A	4720 A	360 A
CDC Lancer Granular - low	36 A	56.5	0.0	1.3 A	116 A	4678 A	355 A
CDC Lancer Granular - mid	39 A	56.5	0.0	1.4 A	117 A	4865 A	356 A
CDC Lancer Granular - high	36 A	56.5	0.0	1.3 A	117 A	4788 A	356 A
CDC Lancer Foliar - low	39 A	56.5	0.0	1.2 A	117 A	4846 A	361 A
CDC Lancer Foliar - mid	39 A	56.5	0.0	1.1 A	117 A	4723 A	358 A
CDC Lancer Foliar - high	41 A	56.5	0.0	1.3 A	117 A	4659 A	361 A
CDC Kala UTC	34 A	56.5	0.0	1.1 A	117 A	3664 B	232 B
CDC Kala Granular - low	34 A	56.5	0.0	1.3 A	116 A	3453 B	229 B

CDC Kala Granular - mid	31 A	56.5	0.0	1.4 A	117 A	3540 B	229 B
CDC Kala Granular - high	33 A	56.5	0.0	1.2 A	117 A	3585 B	226 B
CDC Kala Foliar - low	30 A	56.5	0.0	1.3 A	117 A	3505 B	229 B
CDC Kala Foliar - mid	31 A	56.5	0.0	1.3 A	117 A	3461 B	229 B
CDC Kala Foliar - high	37 A	56.5	0.0	1.4 A	117 A	3456 B	234 B

Site: WCA (Swift Current, SK)

	Emergence (plants/m^2)	Days to flowering	CHI rating (0-5)	Ascochyta blight rating (0-9)	Days to maturity	Yield (kg/ha)	TKW (g)
CDC Lancer UTC	42 AB	47 A	1.8 A	0.0 A	112	3377 A	345 A
CDC Lancer Granular - low	37 ABCDE	47 A	1.3 A	0.0 A	112	3374 A	330 A
CDC Lancer Granular - mid	41 ABC	46 A	1.5 A	0.0 A	112	3300 A	326 A
CDC Lancer Granular - high	41 ABCD	45 A	1.8 A	0.3 A	112	3373 A	324 A
CDC Lancer Foliar - low	42 AB	47 A	1.5 A	0.0 A	113	3383 A	347 A
CDC Lancer Foliar - mid	42 AB	47 A	1.3 A	0.0 A	112	3318 A	324 A
CDC Lancer Foliar - high	43 A	47 A	1.8 A	0.0 A	114	3404 A	332 A
CDC Kala UTC	31 DE	47 A	2.0 A	0.0 A	116	2813 A	190 B
CDC Kala Granular - low	30 E	46 A	2.0 A	0.0 A	116	3002 A	188 B
CDC Kala Granular - mid	33 BCDE	47 A	1.3 A	0.0 A	116	3176 A	192 B
CDC Kala Granular - high	29 E	49 A	1.3 A	0.0 A	114	2944 A	180 B
CDC Kala Foliar - low	33 BCDE	48 A	1.3 A	0.0 A	119	3148 A	186 B
CDC Kala Foliar - mid	32 CDE	47 A	1.3 A	0.0 A	116	3058 A	196 B
CDC Kala Foliar - high	30 E	47 A	1.5 A	0.0 A	119	3233 A	190 B

Table A6. Means of chickpea tissue K post foliar application grouped by application rate. Means were compared using Tukey's HSD test at 95% confidence interval. Within the same site, means followed by the same letter within a column do not significantly differ from each other.

Site: NARF (Melfort, SK)

Rate of application of foliar K	% Tissue K post foliar application
UTC	1.62 A
Low rate	1.68 A
Mid rate	1.65 A
High rate	1.66 A

Site: IHARF (Indian Head, SK)

Rate of application of foliar K	% Tissue K post foliar application
UTC	1.56 A
Low rate	1.54 A
Mid rate	1.52 A
High rate	1.55 A

Site: WCA (Swift Current, SK)

Rate of application of foliar K	% Tissue K post foliar application
UTC	1.37 A

Low rate	1.42 A
Mid rate	1.53 A
High rate	1.48 A

Table A7. Means of two-way interaction of variety x application rate for chickpea tissue K post foliar application. Means were compared using Tukey's HSD test at 95% confidence interval. Within the same site, means followed by the same letter within a column do not significantly differ from each other.

Site: NARF (Melfort, SK)	
Variety x Rate of application of foliar K	**% Tissue K post foliar application**
CDC Lancer - UTC	1.79 ABC
CDC Lancer - Low rate	1.82 AB
CDC Lancer - Mid rate	1.90 A
CDC Lancer - High rate	1.88 AB
CDC Kala - UTC	1.45 D
CDC Kala - Low rate	1.55 BCD
CDC Kala - Mid rate	1.41 D
CDC Kala - High rate	1.45 CD
Site: IHARF (Indian Head, SK)	
Variety x Rate of application of foliar K	**% Tissue K post foliar application**
CDC Lancer - UTC	1.67 A
CDC Lancer - Low rate	1.62 A
CDC Lancer - Mid rate	1.67 A
CDC Lancer - High rate	1.69 A
CDC Kala - UTC	1.45 A
CDC Kala - Low rate	1.46 A
CDC Kala - Mid rate	1.37 A
CDC Kala - High rate	1.42 A
Site: WCA (Swift Current, SK)	
Variety x Rate of application of foliar K	**% Tissue K post foliar application**
CDC Lancer - UTC	1.30 A
CDC Lancer - Low rate	1.44 A
CDC Lancer - Mid rate	1.40 A
CDC Lancer - High rate	1.41 A
CDC Kala - UTC	1.44 A
CDC Kala - Low rate	1.40 A
CDC Kala - Mid rate	1.66 A
CDC Kala - High rate	1.54 A

A8. Disease rating guide for Chickpea Health Issue (from Dr. Michelle Hubbard)

Survey rating scale (0-5) based percent plant area affected (PAA) by symptoms of chickpea health issue:

0	none	no symptoms

1	low	<10% Plant Area Affected (PAA) / new growth wilted, some leaf tip chlorosis
2	moderate	10 to 30% PAA chlorotic/necrotic
3	high	30 to 60% PAA chlorotic/necrotic
4	very high	60 to 90% PAA chlorotic/necrotic
5	dead	Plants dying to dead / >90% PAA necrosis

Pictures of Chickpea Health Issue

Emerging Chickpea Health Issue, Leaf Tip Chlorosis (Photo: Teagan Parkin, 2022)

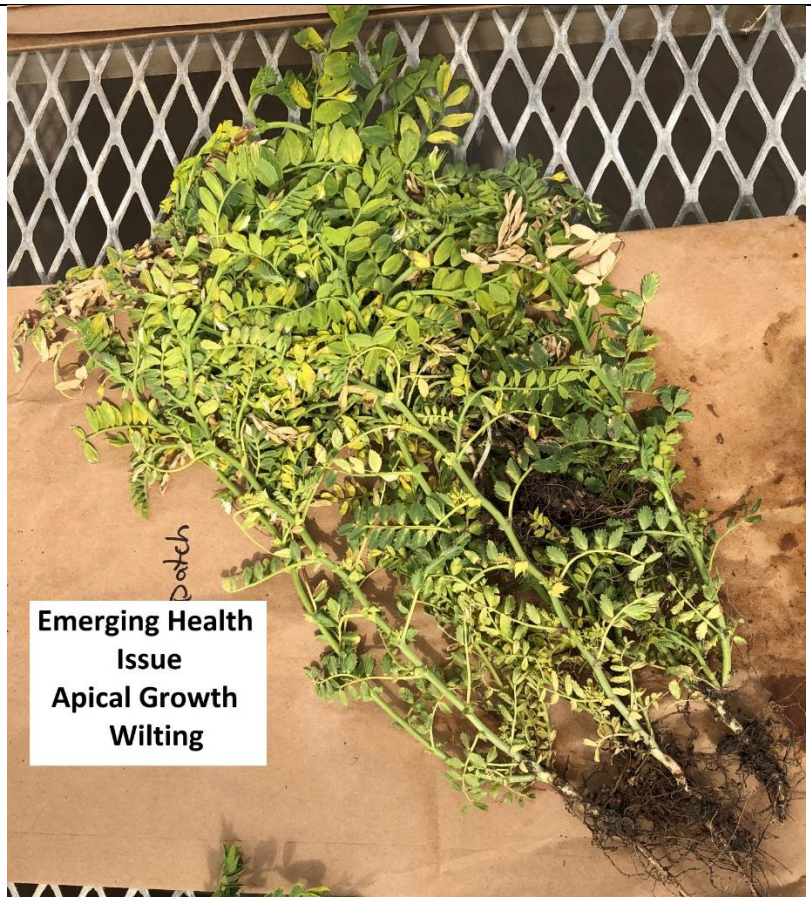

Photo: Teagan Parkin, 2022

A9. Disease rating guide for ***Ascochyta rabiei*** Disease severity

Use 0-9 rating scale. Example images in Figure A9.1

- **0** no symptoms;
- **1** few, very small (<2 mm^2) lesions on leaves and stems, <2% plant area affected (PAA);
- **2** very small (<2 mm^2) lesions, 2-5 % PAA;
- **3** many small lesions (<2 to 5 mm^2), 5 to 10% PAA;
- **4** many small lesions, few large (>5 mm^2) lesions, 10 to 25% PAA;
- **5** many large lesions, 25 to 50% PAA;
- **6** lesions coalescing, 50 to 75% PAA,
- **7** lesions coalescing with stem girdling, 75 to 90% PAA;
- **8** stem girdling or breakage, >90% PAA;
- **9** plants dead

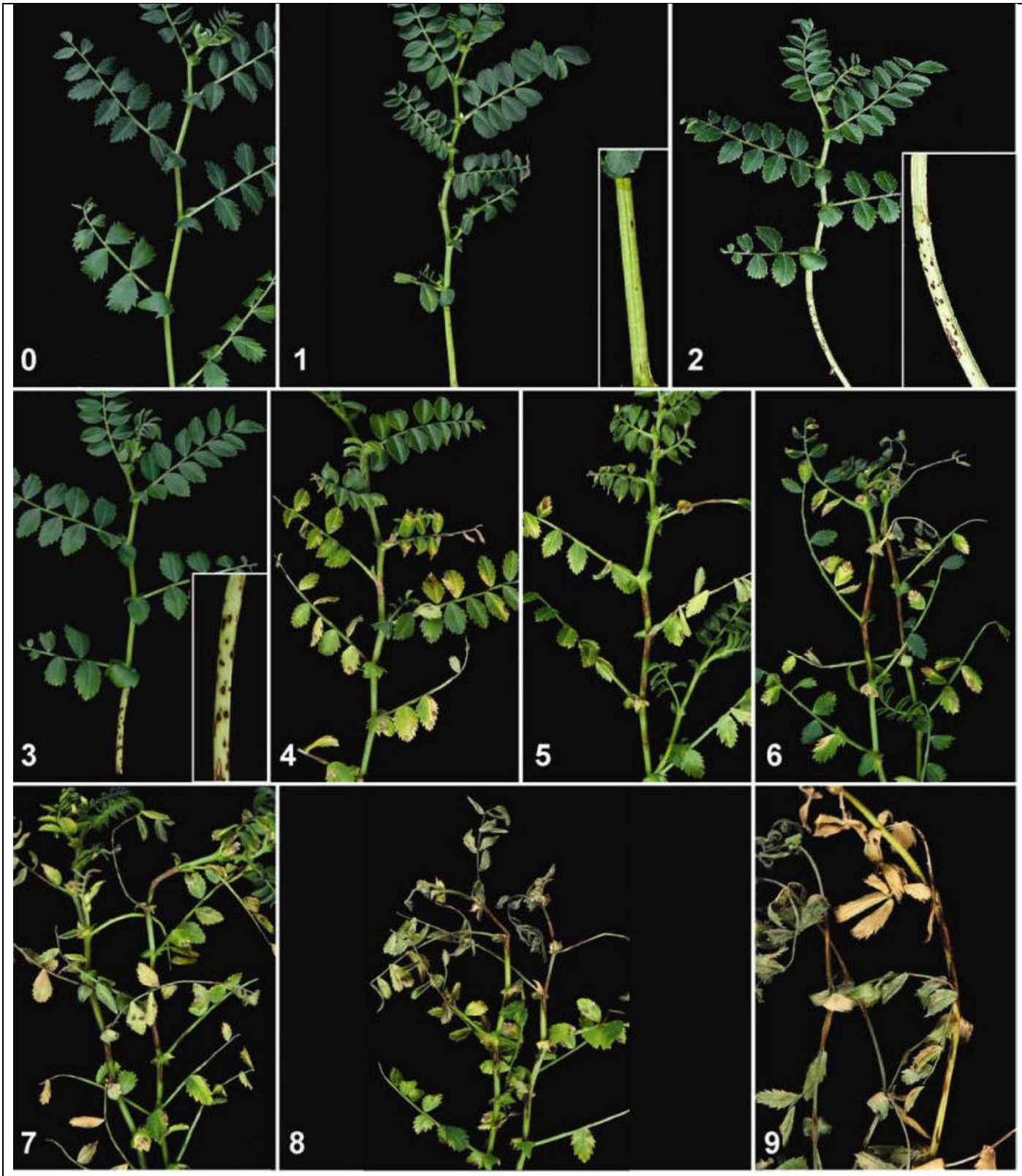

Figure A9.1. Rating scale example images for *Ascochyta rabiei*, reproduced from Chongo et al. (2004) Genetic Diversity of *Ascochyta rabiei* in Canada. Plant Disease. 88: 4-10.

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