

# Investigation into Row Spacing with Direct Seeded Canola and Wheat

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## Abstract

There are many benefits to increasing the row spacing on a seeder. Some of the benefits are better residue clearance, lower soil disturbance, lower power requirements and reduced machinery cost. Research on the agronomics of wider row spacings has shown mixed results but in most studies wider row spacing did not effect the yield, (Guy Lafond Agriculture & Agri-Food Canada). The majority of these studies were completed in Saskatchewan. A multi-year experiment was started in 1998 to determine the effect of using three row spacings and three seed rates on the emergence and yield of crops in Alberta. Results from 1998 with barley showed an increase in row spacing resulted in a decrease in barley yield at one site. The experiment was continued in 1999 with wheat and canola.

Row spacing affected the emergence of wheat and canola. An increase in row spacing resulted in a decrease of crop emergence. With wheat, differences in emergence between row spacings were significant at three of four sites. With canola, differences in emergence between row spacings were only significant at one site.

Seed rate affected the emergence of wheat and canola. An increase in seed rate resulted in an increase in wheat and canola emergence. Differences in emergence between seed rates were significant at three of four sites for both wheat and canola.

Row spacing affected the yield of wheat. An increase in row spacing resulted in a decrease in wheat yield. At all of the sites using the 20 cm (8 in) row spacing resulted in significantly higher wheat yield than the 30 cm (12 in) row spacing.

Row spacing affected the yield of canola. An increase in row spacing resulted in a decrease in canola yield. Using the 20 cm (8 in) row spacing resulted in significantly higher canola yields than the 25 and 30 cm (10 and 12 in) row spacings at one site and the 30 cm (12 in) row spacing at another site. Seed rate in general did not affect the yield of wheat and canola.

The experiment should be continued in the future to verify the results and further investigate the effect of row spacing and seed rate on crop emergence and yield.

## Introduction

There are many benefits to increasing the row spacing on a seeder. Some of the benefits are better residue clearance, lower soil disturbance, lower power requirements and reduced machinery cost. Research on the agronomics of wider row spacings has shown mixed results but in most studies wider row spacing did not effect the yield, (Guy Lafond, Agriculture & Agri-Food Canada). The majority of these studies were completed in Saskatchewan.

A multi-year experiment was started in 1998 to determine the effect of using three row spacings and three seed rates on the emergence and yield of crops in Alberta. Results from 1998 with barley showed an increase in row spacing resulted in a decrease in barley yield at one site. The experiment was continued in 1999 with wheat and canola.

## Experimental Procedure

Experimental sites for the project were a clay soil south of Lethbridge, a silty loam soil south of Blackie, a clay loam soil east of Provost and a loam soil west of Edmonton. Invigor 2153 canola and AC Barrie wheat were seeded into moist soil on May 6 at the Blackie site, May 18 at the Provost site, May 21 at the Lethbridge site and May 27 at the Edmonton site. The Lethbridge, Blackie and Edmonton sites were direct seeded. The Provost site was tilled prior to seeding. Fortress was applied at the Provost site. All of the other sites were sprayed with glyphosate prior to seeding. Phosphate ( $P_2O_5$ ) in the form of 11-51-0, was placed with the seed at a rate of 34 kg/ha (30 lb/ac). Nitrogen (N) in the form of Urea (46-0-0) was side banded at a rate of 67 kg/ha (60 lb/ac). The seed and fertilizer was placed with a Barton double shoot angle disc opener.

Crop emergence counts were taken on June 10 at the Blackie site, June 22 at the Lethbridge site, June 23 and July 15 at the Edmonton site and on June 24 at the Provost site. One count was taken for each row of every plot. The following post emergent chemicals were used: Prevail and Liberty at

Lethbridge, Achieve and Buctril M, on wheat and Muster Gold and Liberty on canola at Blackie, Refine Extra and Muster Gold at Provost, Achieve, Attain and Lontrel on wheat and Liberty on canola at Edmonton.

The crops were seeded later than normal at the Lethbridge and Edmonton sites due to wet weather. Growing conditions at the Lethbridge site were different from the other sites. The Lethbridge site was cool and dry. The other three sites were cool and wet.

Plot yields were obtained with a self-propelled plot harvester. The Provost canola crop was not harvested due to chemical residue damage. All the plots were harvested on the following dates: Lethbridge - September 10, Blackie - September 23, Provost - September 30 and Edmonton - October 14.

Experimental factors included 3 row spacings and 3 seeding rates. The row spacings were 203, 254 and 305 mm (8, 10 and 12 in). The canola seeding rates were 2.8, 5.0 and 7.3 kg/ha (2.5, 4.5 and 6.5 lb/ac). The wheat seeding rates were 85, 105 and 130 kg/ha (75, 95 and 115 lb/ac).

The study used a randomized complete block design with 4 replications. Each crop site consisted of 36 plots. Plots were 2.43 x 15.24 m (8 x 30 ft). A 6.1 m (20 ft) strip was used between the ends of replication blocks. Border effects were controlled through winter crops on the sides of each plot.

**Table 1** outlines the levels of the treatments used in the experiment.

Treatment	Level
Seed Type (1)	Canola Wheat
Seeding Rate (3)	Canola 2.8, 5.0, 7.3 kg/ha (2.5, 4.5, 6.5 lb/ac) Wheat 85, 105, 130 kg/ha (75, 95, 115 lb ac)
Row Spacing (3)	20, 25, 30 cm (8, 10, 12 in)
Replications	4

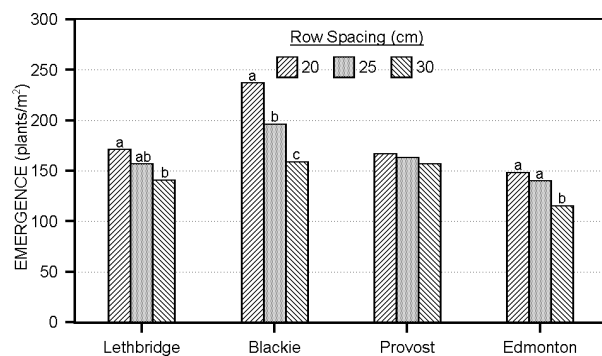
The following experimental constants were used for the experiment.

Travel Speed	6.4 km/h (4 mph)
Tractor	63 kW (85 hp) tractor
Seeder	AFMRC plot seeder
Opener	Barton double shoot angle disc opener
Nitrogen (N) rate	67 kg/ha (60 lb/ac) of 46-0-0
Phosphate (P <sub>2</sub> O <sub>5</sub> ) rate	34 kg/ha (30 lb/ac) of 11-51-0

## Results

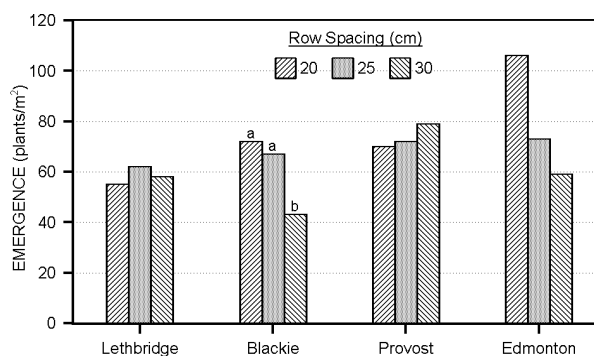
An analysis of variance (ANOVA) was used to analyse the results. A Duncan's multiple range test was used to separate means that were significantly different. Graph values are presented in Appendix I.

Wheat mean plant counts for row spacing are presented in **Figure 1**. Differences in wheat emergence between row spacing were highly significant at the Lethbridge, Blackie and Edmonton sites and not significant at the Provost site. At the Blackie site all three row spacings resulted in significantly different emergence with the 20 cm (8 in) the highest and the 30 cm (12 in) the lowest. At the Lethbridge site using the 20 cm (8 in) row spacing resulted in significantly higher emergence than the 30 cm (12 in) row spacing. At the Edmonton site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher emergence than the 30 cm (12 in) row spacing. **Treatments with the same letter do not have significantly different means.**



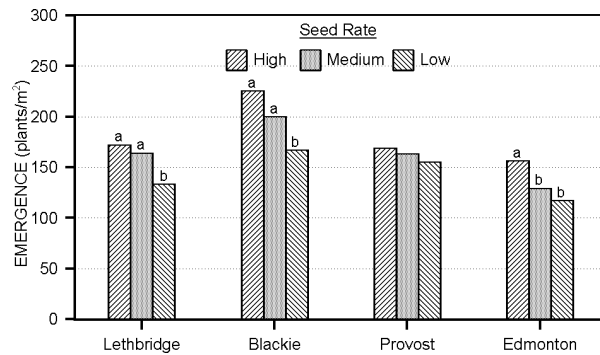
**Figure 1.** Effect of Row Spacing on Wheat Emergence.

Canola mean plant counts for row spacing are presented in **Figure 2**. Differences in canola emergence between the various seed rates were highly significant at the Blackie and Edmonton sites and not significant at the Lethbridge and Provost sites. At the Blackie site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher emergence than the 30 cm (12 in) row spacing. The comparison of means showed no significant difference in row spacings at the Edmonton site.



**Figure 2.** Effect of Row Spacing on Canola Emergence.

Wheat mean plant counts for seed rate are presented in **Figure 3**. Differences in wheat emergence between seed rates were highly significant at the Lethbridge, Blackie and Edmonton sites and not significant at the Provost site. At the Lethbridge and Blackie sites using the high and medium seed rates resulted in significantly higher emergence than the low seed rate. At the Edmonton site using the high seed rate resulted in significantly higher emergence than the medium and low seed rates.



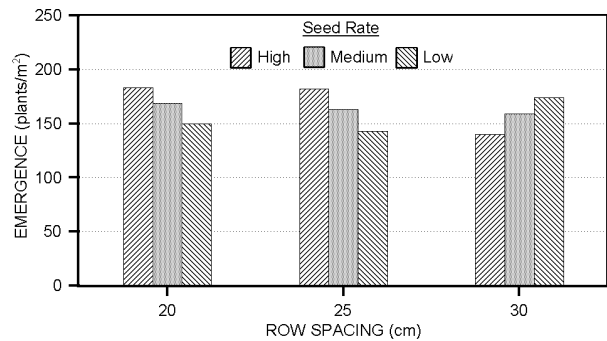
**Figure 3.** Effect of Seed Rate on Wheat Emergence.

Canola mean plant counts for seed rate are presented in **Figure 4**. Differences in canola emergence between row spacing were highly significant at the Lethbridge, Blackie and Provost sites and not significant at the Edmonton site. At the Blackie site all three seed rates resulted in significantly different emergence with the high seed rate the highest and the low seed rate the lowest. At the Lethbridge and Provost sites using the high and medium seed rates resulted in significantly higher emergence than the low seed rate.



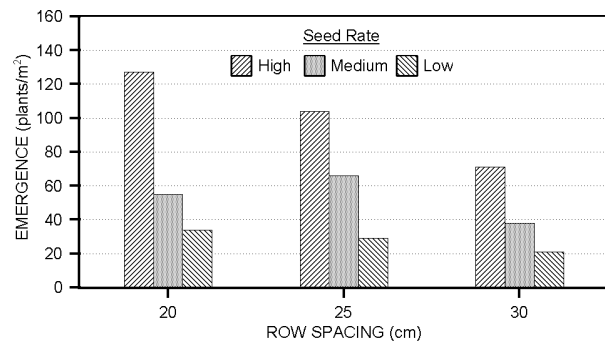
**Figure 4.** Effect of Seed Rate on Canola Emergence .

The analysis of variance for the plant count data at the Provost and Blackie sites resulted in a first order interaction. **Figure 5** shows the effect of seed rate and row spacing on wheat emergence at the Provost site. An increase in seed rate resulted in an increase in emergence at all row spacings except the 30 cm (12 in) row spacing where the emergence decreased.



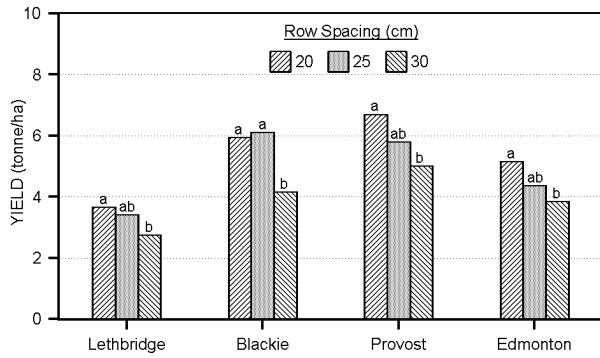
**Figure 5.** Effect of Seed Rate and Row Spacing on Wheat Emergence at Provost.

**Figure 6** shows the effect of seed rate and row spacing on canola emergence at the Blackie site. An increase in seed rate resulted in an increase in canola emergence at all row spacings. The increase in canola emergence was highest at the 20 cm (8 in) row spacing.



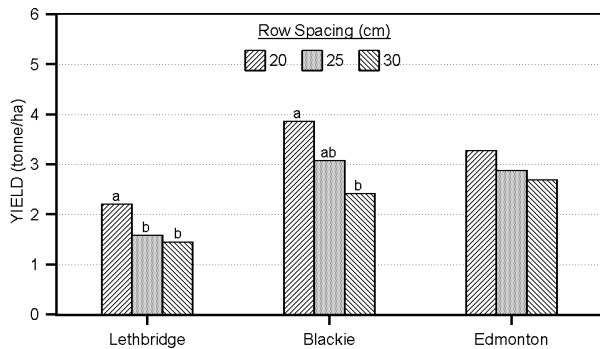
**Figure 6.** Effect of Seed Rate and Row spacing on Canola Emergence at Blackie.

Mean wheat yields for row spacing are presented in **Figure 7**. Differences in wheat yield between the row spacings were highly significant at all sites. At the Lethbridge, Provost and Edmonton sites using the 20 cm (8 in) row spacing resulted in significantly higher wheat yield than the 30 cm (12 in) row spacing. At the Blackie site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher wheat yield than the 30 cm (12 in) row spacing.



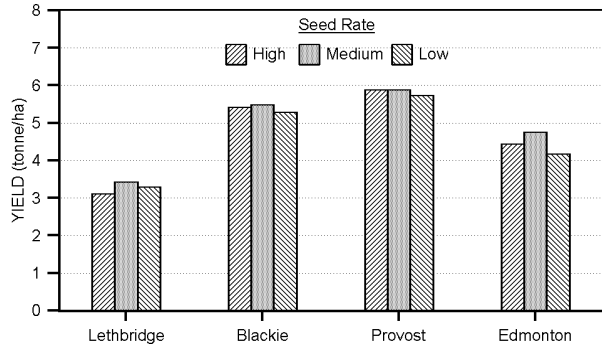
**Figure 7.** Effect of Row Spacing on Wheat Yield.

Mean canola yields for row spacing are presented in **Figure 8**. Differences in canola yield between the row spacings were highly significant at the Lethbridge and Blackie sites and significant at the Edmonton site. At the Lethbridge site using the 20 cm (8 in) row spacing resulted in significantly higher canola yields than the 25 and 30 cm (10 and 12 in) row spacings. At the Blackie site using the 20 cm (8 in) row spacing resulted in significantly higher canola yield than the 30 cm (12 in) row spacing. The comparison of means showed no significant differences at the Edmonton site.



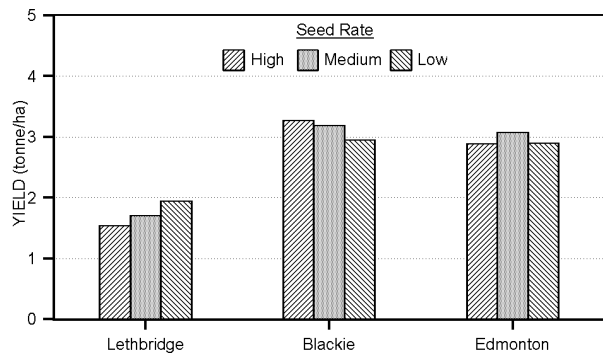
**Figure 8.** Effect of Row Spacing on Canola Yield.

Mean wheat yields for seed rate are presented in **Figure 9**. Differences in wheat yield between seed rates were not significant at all the sites.



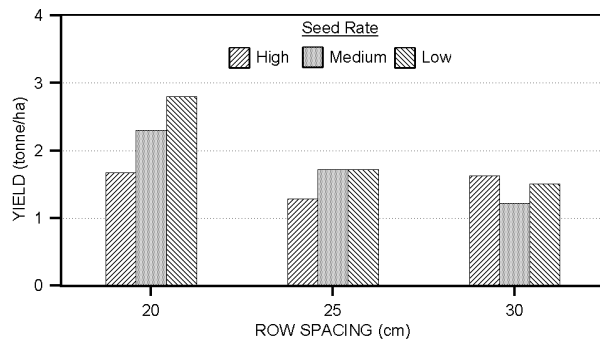
**Figure 9.** Effect of Seed Rate on Wheat Yield.

Mean canola yields for seed rate are presented in **Figure 10**. Differences in canola yield between seed rates were significant at the Lethbridge site and not significant at the Blackie and Edmonton sites. The comparison of means showed no significant differences at the Lethbridge site.



**Figure 10.** Effect of Seed Rate on Canola Yield.

The analysis of variance for the canola yield at the Lethbridge site resulted in a first order interaction. **Figure 11** shows the effect of seed rate and row spacing on canola yield at the Lethbridge site. An increase in seed rate resulted in a decrease in canola yield at the 20 cm (8 in) spacing.



**Figure 11.** Effect of Seed Rate and Row Spacing on Canola Yield at Lethbridge.

The seed moisture for wheat at Edmonton was too dry at harvest to calculate days to maturity. Days to maturity were calculated and analysed for wheat at the other sites. Differences in days to maturity for row spacing and seed rates were not significant except at the Provost site where differences in days to maturity between row spacings were highly significant. The comparison of means showed no significant differences.

## Discussion and Conclusions

Row spacing affected the emergence of wheat. An increase in row spacing resulted in a decrease of wheat emergence. At three of four sites the differences in emergence between the row spacings were significant.

Row spacing affected the emergence of canola. The trend was an increase in row spacing resulted in a decrease of canola emergence. Differences in emergence between the row spacings were only significant at one site.

Seed rate affected the emergence of wheat and canola. An increase in seed rate resulted in an increase in wheat and canola emergence. Differences in emergence between seed rates were significant at three of four sites for both wheat and canola.

The interaction between row spacing and seed rate at the Blackie canola site showed the same trends. An increase in seed rate resulted in an increase in emergence. The interaction between row spacing and seed rate at the Provost wheat site showed the same trend except at the 30 cm (12 in) spacing where an increase in seed rate resulted in a decrease in wheat emergence.

Row spacing affected the yield of wheat. An increase in row spacing resulted in a decrease in wheat yield. At three of the sites using the 20 cm (8 in) row spacing resulted in significantly higher wheat yield than the 30 cm (12 in) row spacing. At the other site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher wheat yield than the 30 cm (12 in) row spacing.

Row spacing affected the yield of canola. An increase in row spacing resulted in a decrease in canola yield. At the Lethbridge site using the 20 cm (8 in) row spacing resulted in significantly higher canola yields than the 25 and 30 cm (10 and 12 in) row spacings. At the Blackie site using the 20 cm (8 in) row spacing resulted in significantly higher canola yield than the 30 cm (12 in) row spacing.

Seed rate in general did not affect the yield of wheat and canola. The one exception was the Lethbridge canola where the interaction between row spacing and seed rate showed a trend of increasing yield with decreasing seed rate at the 20 cm (8 in) row spacing.

The experiment should be continued in the future to verify the results and further investigate the effect of row spacing and seed rate on crop emergence and yield.

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## Appendix 1: Values for Graphs

Figure 1: Effect of row Spacing on Wheat Emergence.

Spacing		Lethbridge			Blackie			Provost		Edmonton		
cm	in	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference
20	8	171	15.9	a	237	22.0	a	167	15.5	148	13.7	a
25	10	157	14.6	ab	196	18.2	b	163	15.1	140	13.0	a
30	12	141	13.1	b	159	14.8	c	157	14.6	115	10.7	b

Figure 2: Effect of Row Spacing on Canola Emergence.

Spacing		Lethbridge			Blackie			Provost		Edmonton	
cm	in	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	
20	8	55	5.1	72	6.7	a	70	6.5	106	9.8	
25	10	62	5.8	67	6.2	a	72	6.7	73	6.8	
30	12	58	5.4	43	4.0	b	79	7.3	59	5.5	

Figure 3: Effect of Seed Rate on Wheat Emergence.

Seed Rate	Lethbridge			Blackie			Provost		Edmonton		
	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference
High	172	16.0	a	225	20.9	a	169	15.7	156	14.5	a
Medium	164	15.2	a	200	18.6	a	163	15.1	129	12.0	b
Low	133	12.4	b	167	15.5	b	155	14.4	117	10.9	b

Figure 4: Effect of Seed Rate on Canola Emergence.

Seed Rate	Lethbridge			Blackie			Provost			Edmonton	
	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	Significant Difference	plants/m <sup>2</sup>	plants/ft <sup>2</sup>
High	71	6.6	a	101	9.4	a	90	8.4	a	80	7.4
Medium	61	5.7	a	53	4.9	b	80	7.4	a	76	7.1
Low	44	4.1	b	28	2.6	c	51	4.7	b	81	7.5

Figure 5: Effect of Seed Rate and Row Spacing on Wheat Emergence at Provost.

Spacing		Seed Rate					
cm	in	Low		Medium		High	
		plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>
20	8	150	13.9	169	15.7	183	17.0
25	10	143	13.3	163	15.1	182	16.9
30	12	174	16.2	159	14.8	140	13.0

Figure 6: Effect of Seed Rate and Row Spacing on Canola Emergence at Blackie.

Spacing		Seed Rate					
cm	in	Low		Medium		High	
		plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>	plants/m <sup>2</sup>	plants/ft <sup>2</sup>
20	8	34	3.2	55	5.1	127	11.8
25	10	29	2.7	66	6.1	104	9.7
30	12	21	2.0	38	3.5	71	6.6



Figure 7: Effect of Row Spacing on Wheat Yield.

Spacing		Lethbridge			Blackie			Provost			Edmonton		
cm	in	tonne/ha	ton/ac	Significant Difference	tonne/ha	ton/ac	Significant Difference	tonne/ha	ton/ac	Significant Difference	tonne/ha	ton/ac	Significant Difference
20	8	3.66	1.46	a	5.93	2.36	a	6.69	2.66	a	5.15	2.05	a
25	10	3.41	1.36	ab	6.09	2.43	a	5.79	2.31	ab	4.36	4.74	ab
30	12	2.74	1.09	b	4.15	1.65	b	5.00	1.99	b	3.83	1.53	b

Figure 8: Effect of Row spacing on Canola Yield.

Spacing		Lethbridge			Blackie			Edmonton	
cm	in	tonne/ha	ton/ac	Significant Difference	tonne/ha	ton/ac	Significant Difference	tonne/ha	ton/ac
20	8	2.20	0.88	a	3.86	1.54	a	3.28	1.31
25	10	1.58	0.63	b	3.07	1.22	ab	2.87	1.14
30	12	1.45	0.58	b	2.41	0.96	b	2.69	1.07

Figure 9: Effect of Seed Rate on Wheat Yield.

Seed Rate	Lethbridge		Blackie		Provost		Edmonton	
	tonne/ha	ton/ac	tonne/ha	ton/ac	tonne/ha	ton/ac	tonne/ha	ton/ac
High	3.10	1.23	5.41	2.15	5.87	2.34	4.44	1.77
Medium	3.42	1.36	5.47	2.18	5.88	2.34	4.75	1.89
Low	3.28	1.31	5.28	2.10	5.73	2.28	4.16	1.66

Figure 10: Effect of Seed Rate In Canola Yield.

Seed Rate	Lethbridge		Blackie		Edmonton	
	tonne/ha	ton/ac	tonne/ha	ton/ac	tonne/ha	ton/ac
High	1.53	0.61	3.27	1.30	2.88	1.15
Medium	1.70	0.68	3.19	1.27	3.07	1.22
Low	1.94	0.77	2.95	1.17	2.89	1.15

Figure 11: Effect of Seed Rate and Row Spacing on Canola Yield at Lethbridge.

Spacing		Seed Rate					
cm	in	Low		Medium		High	
		tonne/ha	ton/ac	tonne/ha	ton/ac	tonne/ha	ton/ac
20	8	2.80	1.12	2.30	0.92	1.67	0.67
25	10	1.72	0.69	1.72	0.69	1.29	0.51
30	12	1.51	0.60	1.22	0.49	1.63	0.65