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Investigation Into Row Spacing With Direct Seeded Barley, Canola And Wheat

2000 Results And Final Report

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ALBERTA CONSERVATION TILLAGE SOCIETY — 21 years of soil conservation

ABSTRACT

There are many benefits to increasing the row spacing on a seeder. Some of the benefits are better residue clearance, lower soil disturbance 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 and 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. The project was completed in 2000.

Row spacing affected the yield of barley and wheat. An increase in row spacing resulted in a decrease in barley and wheat yield. At all of the nine crop site years the differences in yield between the row spacings were significant.

Row spacing affected the yield of canola. An increase in row spacing resulted in a decrease in canola yield. At four of five crop site years the differences in yield between row spacings were significant. Yields were depressed due to hail at the fifth crop site year.

The results support Seed Bed Utilization (SBU). The more seed bed utilized the greater the potential of the crop. The Barton double shoot angle disc opener has a low seed bed utilization at wide row spacings. The experiment should be expanded to include row width. This will verify whether a wide row spacing with a wide row width will yield the same as a narrow row spacing with the same seed bed utilization.

INTRODUCTION

There are many benefits to increasing the row spacing on a seeder. Some of the benefits are better residue clearance, lower soil disturbance 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 and 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. The project was completed in 2000.

EXPERIMENTAL PROCEDURE

Experimental sites in 2000 for the project were a clay loam soil south of Lethbridge, a loam soil east of High River, a clay loam soil east of Provost and a loam soil west of Edmonton. Hyola 401 canola and AC Barrie wheat were seeded into moist soil on May 12th at the Lethbridge site, May 15th at the High River site, May 17th at the Edmonton site and May 18th at the Provost site. All sites were direct seeded and sprayed with glyphosate prior to seeding. Phosphate (P_2O_5) in the form of 11-31-0-20, 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 78 kg/ha (70 lb/ac). The seed and fertilizer was placed with a Barton double shoot angle disc opener (Figure 1).

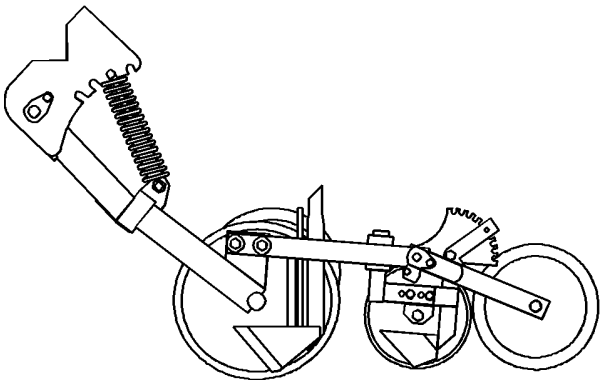

Figure 1. Barton double shoot angle disc opener.

Crop emergence counts were taken on June 23rd at the High River site, June 13th at the Edmonton site and on July 6th at the Provost site. One count was taken for each row of every plot. The following post emergent chemicals were used: Prevail at High River, Refine Extra and Muster Gold at Provost, Refine Extra and Lontrel and Poast Ultra at Edmonton.

The Lethbridge site was abandoned due to drought. The High River site was seeded into canola stubble. The volunteer canola grew vigorously so the canola plots were abandoned at High River. Growing conditions were dry at High River. The yields at Provost were depressed due to hail. Growing conditions at the Edmonton site were cool and wet.

Plot yields were obtained with a self-propelled plot harvester. All plots were harvested on the following dates: High River - September 11th, Provost wheat - September 13th, Provost canola October 19th and Edmonton - October 18th.

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 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 (7 5, 95 and 115 lb/ac).

The study used a randomized complete block design with 4 replications. Each site consisted of 36 plots. Plots were 2.43 x 15.24 m (8 x 30 ft). A 12.2 m (40 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.

TREATMENT	LEVEL
Seed Type (1)	Canola, Wheat
Seeding Rate (3)	Canola - 2.8, 5 and 7.3 kg/ha (2.5, 4.5 and 6.5 lb/ac) Wheat - 85, 105 and 130 kg/ha (75, 95 and 115 lb/ac)
Row Spacing (3)	20, 25 and 30 cm (8, 10 and 12 in)
Replications	4

Table 2: Outlines the experimental constants.

CONSTANT	VARIABLE
Travel Speed	6.4 km/h (4 mph)
Tractor	63 kW (85 hp) tractor
Seeder	ATC plot seeder
Opener	Barton double shoot angle disc opener
Nitrogen (N) rate	78 kg/ha (70 lb/ac) of 46-0-0
Phosphate (P_2O_5) rate	34 kg/ha (30 lb/ac) of 10-31-0-20

RESULTS

An analysis of variance (ANOVA) was used to analyze the results. A Duncan's multiple range test was used to separate means that were significantly different.

Wheat mean plant counts for row spacing are presented in Figure 2. Differences in wheat emergence between row spacing were highly significant at the High River, Provost and Edmonton sites. At the High River site using the 20 cm (8 in) row spacing resulted in significantly higher emergence than the 25 and 30 cm (10 and 12 in) row spacings. At the Edmonton and Provost sites 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. Treatments with the same letter do not have significantly different means.

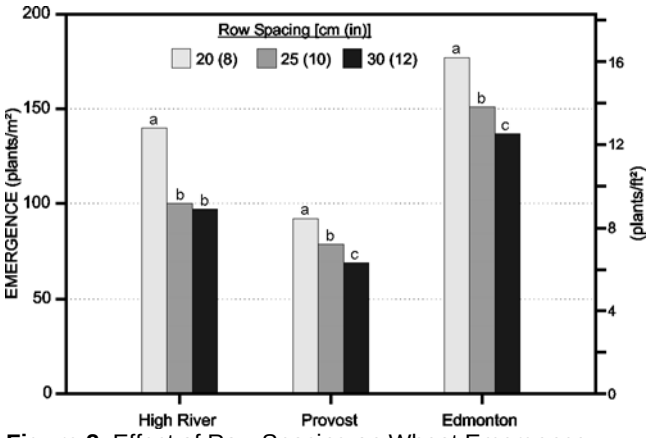

Figure 2. Effect of Row Spacing on Wheat Emergence.

Canola mean plant counts for row spacing are presented in Figure 3. Differences in canola emergence between the various row spacings were significant at the Provost site and not significant at the Edmonton site. At the Provost site using the 20 cm (8 in) row spacing resulted in significantly higher emergence than the 30 cm (12 in) row spacing.

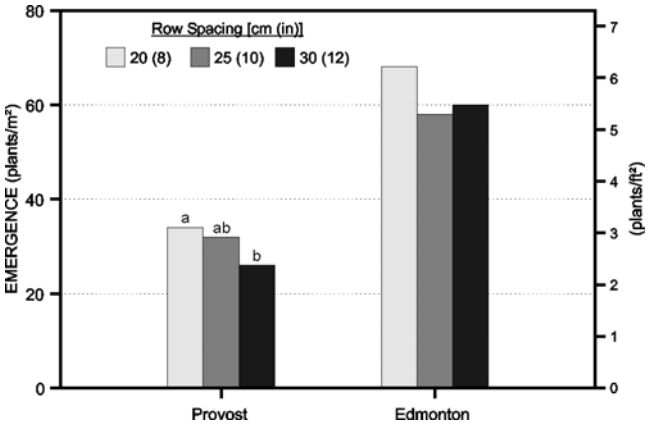

Figure 3. Effect of Row Spacing on Canola Emergence.

Wheat mean plant counts for seed rate are presented in Figure 4. Differences in wheat emergence between seed rates were highly significant at all sites. At the High River and Provost sites all three seed rates resulted in significantly different emergence with the high rate the highest and the low rate the lowest. At the Edmonton site using the high and medium rates resulted in significantly higher emergence than the low rate.

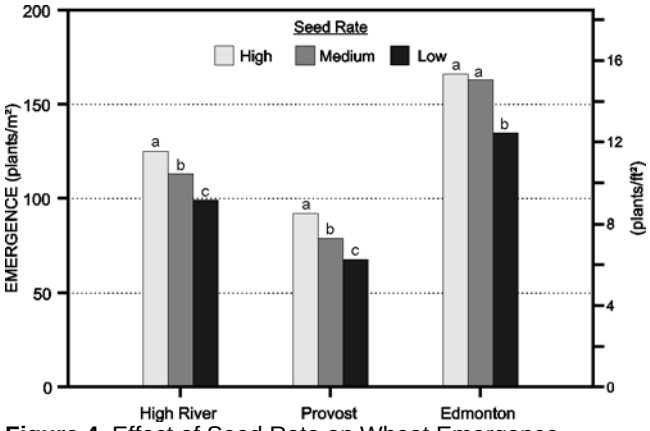

Figure 4. Effect of Seed Rate on Wheat Emergence.

Canola mean plant counts for seed rate are presented in Figure 5. Differences in canola emergence between seed rates were highly significant at all sites. At the Provost and Edmonton sites all three seed rates resulted in significantly different emergence with the high rate the highest and the low rate the lowest.

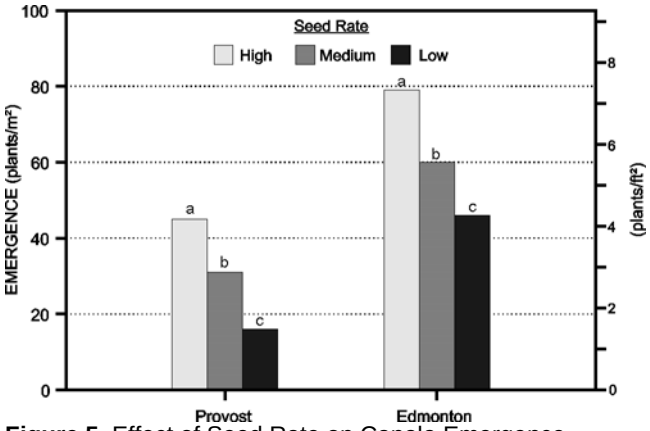

Figure 5. Effect of Seed Rate on Canola Emergence.

The analysis of variance for the plant count data at the Provost and Edmonton sites resulted in a first order interaction. Figure 6 shows the effect of seed rate and row spacing on wheat emergence at the Edmonton site. The trend was for higher emergence with high seed rates and narrow row spacing.

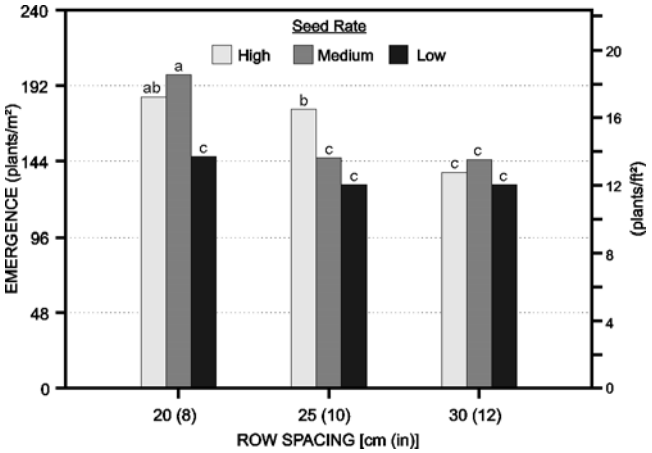

Figure 6. Effect of Seed Rate and Row Spacing on Wheat Emergence at Edmonton.

Figure 7 shows the effect of seed rate and row spacing on canola emergence at the Provost site. The trend was for increased emergence with increased seed rate and narrow row spacing.

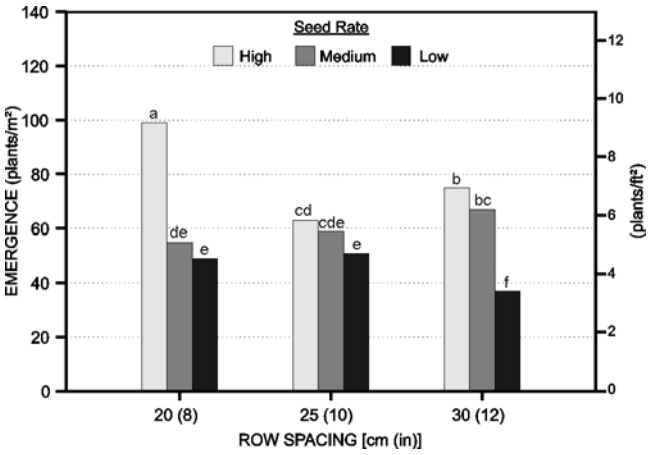

Figure 7. Effect of Seed Rate and Row spacing on Canola Emergence at Provost.

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

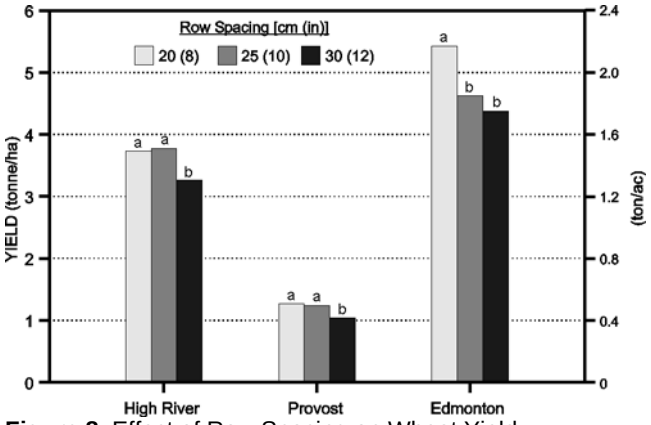

Figure 8. Effect of Row Spacing on Wheat Yield.

Mean canola yields for row spacing are presented in Figure 9. Differences in canola yield between the row spacings were not significant at the Provost site and highly significant at the Edmonton site. At the Edmonton site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher canola yield than the 30 cm (12 in) row spacing.

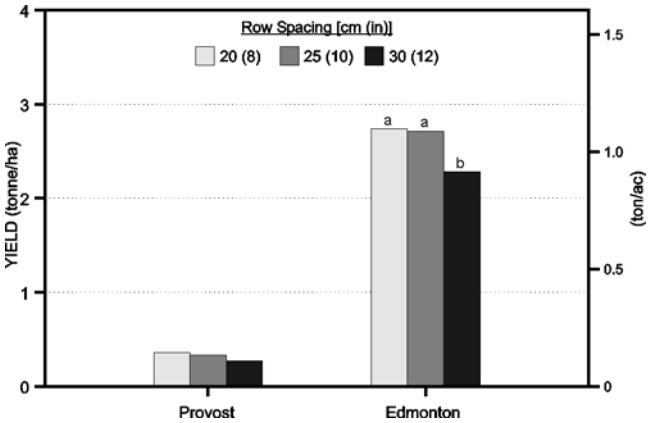

Figure 9. Effect of Row Spacing on Canola Yield.

Mean wheat yields for seed rate are presented in Figure 10. Differences in wheat yield between seed rates were not significant at all the sites.

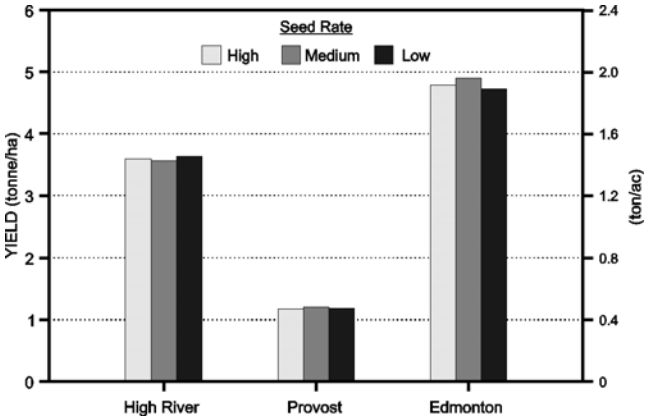

Figure 10. Effect of seed rate on wheat yield.

Mean canola yields for seed rate are presented in Figure 11. Differences in canola yield between seed rates were highly significant at the Edmonton site and not significant at the Provost site. At the Edmonton site using the high and medium seed rates resulted in significantly higher canola yield than the low seed rate.

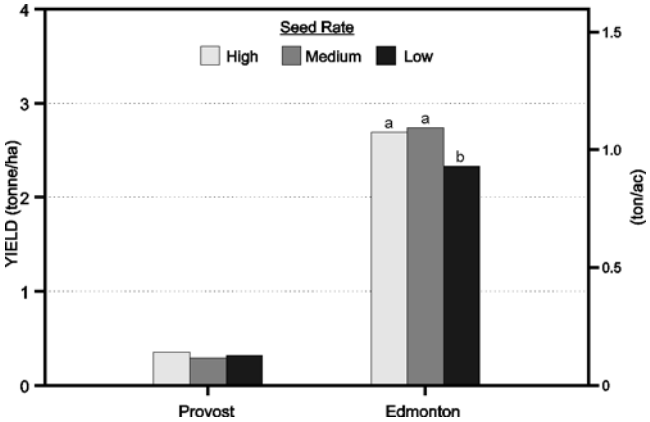

Figure 11: Effect of Seed Rate on wheat Yield.

The seed moisture for wheat was too dry at all the sites at harvest to calculate days to maturity. The density was measured by the harvester at all the sites. An analysis was completed for the wheat at the High River and Edmonton sites. Mean densities for row spacing are presented in Figure 12. Differences in density for row spacing were highly significant at the High River site. At the High River site using the 25 cm (10 in) row spacing resulted in significantly higher wheat density than the 20 and 30 cm (8 and 12 in) row spacings.

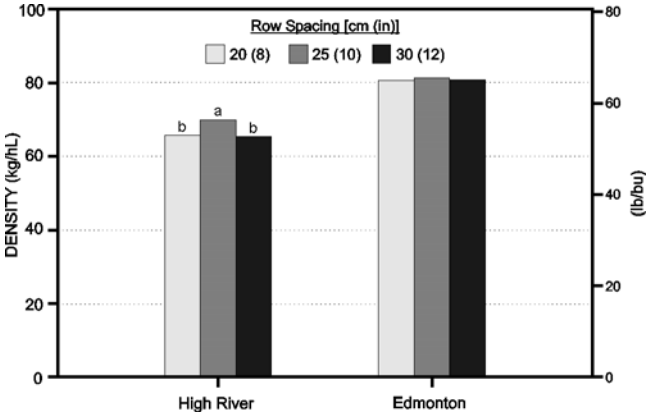

Figure 12: Effect of Seed Rate on Canola Yield.

Mean densities for seed rate are presented in Figure 13. Differences in density for seed rate were significant at the Edmonton site. At the Edmonton site using the 20 and 25 cm (8 and 10 in) row spacings resulted in significantly higher wheat density than the 30 cm (12 in) row spacing.

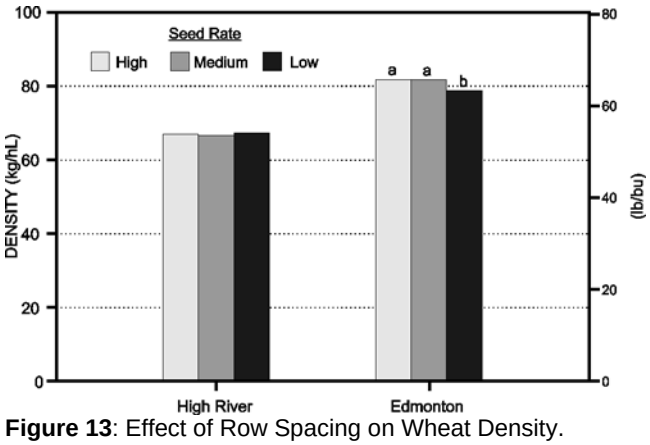

Figure 13: Effect of Row Spacing on Wheat Density.

DISCUSSION AND CONCLUSIONS

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

Row spacing affected the emergence of canola. An increase in row spacing resulted in a decrease of canola emergence. The differences were 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 all the 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 three sites the differences in yield between the row spacings were significant. At one site using the 20 cm (8 in) row spacing resulted in significantly higher wheat yield than the 25 and 30 cm (10 and 12 in) row spacing. At the other two sites 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. The differences were significant at one site.

Seed rate did not affect the yield of wheat. Seed rate affected the yield of canola. An increase in seed rate resulted in an increase in canola yield at one site.

DISCUSSION AND CONCLUSIONS FOR THREE YEAR PROJECT

Row spacing affected the emergence of barley and wheat. An increase in row spacing resulted in a decrease of barley and wheat emergence. At 9 of 10 crop site years the differences in emergence between the row spacings were significant. At the wider row spacings less seed bed was utilized. This crowding of the seeds probably caused the reduced plant emergence.

Row spacing affected the emergence of canola but the differences were only significant at 3 of 6 crop site years. The trend was an increase in row spacing resulted in a decrease of canola emergence. Row spacing probably did not affect canola emergence as much as wheat emergence because canola is a smaller seed.

Seed rate affected the emergence of barley, wheat and canola. An increase in seed rate resulted in an increase in barley, wheat and canola emergence. At 12 of 16 crop site years the differences in emergence between seed rates were significant.

Row spacing affected the yield of barley and wheat. An increase in row spacing resulted in a decrease in barley and wheat yield. At all 9 crop site years the differences in yield between the row spacings were significant.

Row spacing affected the yield of canola. An increase in row spacing resulted in a decrease in canola yield. At 4 of 5 crop site years the differences between row spacings were significant. At the crop site year where differences were not significant, the yields were depressed hail.

Seed rate in general did not affect the yield of barley, wheat and canola. Differences in yield between seed rates were significant at 3 of the 14 crop site years. No consistent trends were apparent among the 3 crop site years.

The results support Seed Bed Utilization (SBU). The more seed bed utilized the greater the potential of the crop. The Barton double shoot angle disc opener has a low seed bed utilization at wide row spacings.

The experiment should be expanded to include row width. This will verify whether a wide row spacing with a wide row width will yield the same as a narrow row spacing with the same seed bed utilization.

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Appendix 1. Values for graphs

Figure 2. Effect of row spacing on wheat Emergence

Spacing		High River			Provost			Edmonton		
cm	in	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
20	8	140	13.0	a	92	8.6	a	177	16.4	a
25	10	100	9.3	b	79	7.3	b	151	14.0	b
30	12	97	9.0	b	69	6.4	c	137	12.7	c

Figure 3. Effect of Row spacing on Canola Emergence

Spacing		Provost			Edmonton		
cm	in	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
20	8	34	3.2	a	68	6.3	a
25	10	32	3.0	ab	58	5.4	a
30	12	26	2.4	b	60	5.6	a

Figure 4. Effect of Seed Rate on Wheat Emergence

Seed Rate	High River			Provost			Edmonton		
	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
High	125	11.6	a	92	8.6	a	166	15.4	a
Medium	113	10.5	b	79	7.3	b	163	15.1	a
Low	99	9.2	c	68	6.3	c	135	12.5	b

Figure 5. Effect of Seed Rate on Canola Emergence

Seed Rate	Provost			Edmonton		
	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
High	45	4.2	a	79	7.3	a
Medium	31	2.9	b	60	5.6	b
Low	16	1.5	c	46	4.3	c

Figure 6. Effect of Seed Rate and Row Spacing on Wheat Emergence at Edmonton

Spacing		Seed Rate								
		Low			Medium			High		
cm	in	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
20	8	147	13.7	c	199	18.5	a	185	17.2	ab
25	10	129	12.0	c	146	13.6	c	177	16.4	b
30	12	129	12.0	c	145	13.5	c	137	12.7	c

Figure 7. Effect of Seed Rate and Row Spacing on Canola Emergence at Provost

Spacing		Seed Rate								
		Low			Medium			High		
cm	in	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter	plants/m^2	plants/ft^2	SD Letter
20	8	49	4.6	e	55	5.1	de	99	9.2	a
25	10	51	4.7	e	59	5.5	cde	63	5.9	cd
30	12	37	3.4	f	67	6.2	bc	75	7.0	b

Figure 8. Effect of Row Spacing on Wheat Yield

Spacing		High River			Provost			Edmonton		
cm	in	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter
20	8	3.73	1.49	a	1.27	0.51	a	5.42	2.16	a
25	10	3.77	1.50	a	1.24	0.49	a	4.62	1.84	b
30	12	3.26	1.30	b	1.04	0.41	b	4.38	1.75	b

Figure 9. Effect of Row Spacing on Canola Yield

Spacing		Provost			Edmonton		
cm	in	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter
20	8	0.36	0.14	a	2.74	1.09	a
25	10	0.33	0.13	a	2.71	1.08	a
30	12	0.27	0.11	a	2.28	0.91	b

Figure 10. Effect of Seed Rate on Wheat Yield

Seed Rate	High River			Provost			Edmonton		
	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter
High	3.59	1.43	a	1.17	0.47	a	4.79	1.91	a
Medium	3.56	1.42	a	1.20	0.48	a	4.90	1.95	a
Low	3.64	1.45	a	1.18	0.47	a	4.73	1.88	a

Figure 11. Effect of Seed rate on Canola Yield

Seed Rate	Provost			Edmonton		
	tonne/ha	ton/ac	SD Letter	tonne/ha	ton/ac	SD Letter
High	0.35	0.14	a	2.69	1.07	a
Medium	0.29	0.12	a	2.74	1.09	a
Low	0.32	0.13	a	2.33	0.93	b

Figure 12. Effect of Row Spacing on Wheat Density

Spacing		High River			Edmonton		
cm	in	kg/hL	lb/bu	SD Letter	kg/hL	lb/bu	SD Letter
20	8	65.5	52.5	b	80.4	64.5	a
25	10	69.8	56.0	a	81.1	65.0	a
30	12	65.2	52.3	b	80.6	64.6	a

Figure 13. Effect of Seed Rate on Wheat

Seed Rate	High River			Edmonton		
	kg/hL	lb/bu	SD Letter	kg/hL	lb/bu	SD Letter
High	66.8	53.6	a	81.7	65.5	a
Medium	66.5	53.3	a	81.7	65.5	a
Low	67.2	53.9	a	78.7	63.1	b

**** SD Letter = Significantly Different Letter**