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Abstract

Fertility and opener experiments were developed to see how different soil openers placed anhydrous ammonia and urea with the seed. Crop injury and yield responses were measured. The fertility experiment included four double shoot soil openers placing 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen in the form of urea or anhydrous ammonia fertilizer. Barley, canola and wheat were seeded at nine sites across south, central and northern Alberta. The opener experiment was repeated at three sites. The opener experiment included 14 different double shoot soil openers placing urea and NH_3 fertilizer at 0, 56 and 168 kg/ha (0, 50 and 150 lb/ac) while seeding barley and canola.

In general, yields of wheat, barley and canola were lower when placing anhydrous ammonia with the seed compared to granular urea. However, statistical differences were not found between the urea and anhydrous ammonia on most sites. Reduced yields were attributed to the loss of anhydrous ammonia during and after seeding. Canola emergence tended to be lower when using anhydrous ammonia as compared to urea. However, results were not statistically significant at the 0.01 level. For the fertilizer rate factor, as the rate increased emergence tended to be reduced. As expected, yields increased with higher fertilizer rates. Results indicated some significant differences for the rate of fertilizer and type of openers in terms of yield and emergence depending on the site and soil conditions. Days to crop maturity were also effected by higher fertilizer rates, with high rates lengthening days to maturity. However, days to maturity were not effected consistently between sites.

Introduction

Many farmers on the Canadian prairies are changing from conventional farming to direct or one-pass seeding. One-pass seeding is placing fertilizer during seeding. Farmers have the choice of single shoot or double shoot system. Single shoot being the placement of seed and fertilizer through the same hose into a common furrow. A double shoot system uses two separate hoses to place seed and fertilizer in separate furrows of the seedbed. Even with a double shoot system, the major concern is how much of the required fertilizer can be applied without crop injury due to nitrogen burning. New improved double shoot openers on air seeders and air drills have greatly reduced this concern.

This project provides information on application of nitrogen in the form of anhydrous ammonia and granular urea with double shoot openers. Information on the movement of both anhydrous and nitrogen in the soil and the susceptibility of canola, barley and wheat injury will be reviewed.

Literature Review

Some information is available on the use of double shoot openers with granular fertilizer, but very little information is available on the use of double shoot openers with anhydrous ammonia. Interest in anhydrous ammonia is increasing because of it's low cost compared to other forms of fertilizer. Since high nitrogen concentrations can harm potential emerging seedlings, the effects and amount of placement of anhydrous ammonia with double shoot openers needs to be addressed.

Statement of Objectives

The experiment objectives were to outline how effective double shoot openers are in applying anhydrous a and granular urea fertilizer when seeding wheat, barley and canola. The following hypothesis were tested.

Hypothesis #1: The percentage of wheat, barley and canola damage caused by anhydrous ammonia is nc significantly different than damage caused by granular urea fertilizer when using double openers under direct seeding conditions.

Hypothesis #2: Double shoot openers can safely apply up to 100 percent of the required crop nitrogen ir of anhydrous ammonia or granular urea.

Hypothesis #3: Barley, canola and wheat damage caused by different types of double shoot openers (rel placements) because of anhydrous ammonia and granular urea is not significantly differ direct seeding conditions.

Hypothesis #4: The amount of anhydrous ammonia or granular fertilizer that is retained in the soil is no significantly different for double shoot openers under direct seeding conditions for whe canola.

The fertility experimental factors included opener type, fertilizer type, fertilizer rate and seed type. **Tabl** the levels of the factors used. The opener experiment used the same factors as the fertility experiment ex an emphasis on the openers. **Table 2** outlines the levels of the factors used in the opener experiment.

Table 1.

Factor	Level
Opener Type (4)	Barton No-Till Double Shoot Opener Bourgault Mid-Row Banding System Flexi-Coil LS Pair Row Double Shoot Knife Opener (Shallow Point) Flexi-Coil Side Band Double Shoot Knife Opener (Shallow Point)
Fertilizer Rate (4) kg - N/ha (lb - N/ac)	0 (Control) 56 (50) 112 (100) 168 (150)
Seed Type (2)	Barley or Wheat Canola
Fertilizer (2)	Anhydrous (82-0-0) Granular (46-0-0)
Soil Conditions (9)	Southern Alberta (3) Central Alberta (3) Northern Alberta (3)
Replications (4)	-

Table 2.

Factor	Level
Opener Type (14)	Barton No-Till Double Shoot Opener Bourgault Double Shoot Opener (Side Band) Bourgault Mid Row Banding System Flexi-Coil LS Pair Row Double Shoot Knife Opener (Shallow Point) Flexi-Coil Side Band Double Shoot Knife Opener (Shallow Point) Gen 200 T2 Seeding System (Side Band) Gen 200 T2x2 Seeding System (Pair Row) Key Ag Ventures Four Inch Chrome With Backswept Knife Key Ag Ventures Seven Inch Chrome With Backswept Knife Melranda Zero Till System (Side Band) Morris Pair Row Double Shoot Opener (Pair Row) Poirier Double Shoot Opener (Side Band) Sweep and Tube Sweep With Key Ag Ventures Backswept Knife
Fertilizer Rate (3) kg - N/ha (lb - N/ac)	0 (Control) 56 (50) 168 (150)
Seed Type (2)	Barley Canola
Fertilizer (2)	Anhydrous (82-0-0) Granular (46-0-0)
Soil Conditions (3)	Southern Alberta Central Alberta Northern Alberta
Replications (3)	-

Material and Methods

The materials and methods used were typical of direct seeding operations of Western Canada.

Seeding System

The seeding system was a John Deere 100 hp tractor pulling the AFMRC custom built 3 row, 8 shank, plot seeder. The seeder was equipped with John Deere heavy duty cultivator shanks. Different shanks were used in some cases to accommodate openers which did not meet ASAE standards. Row spacing for the seeder was 24.5 cm (10 in). Flexi-Coil 10.2 cm (4 in) rubber packers and 15.2 cm (6 in) radial tires were used for packing. The 15.2 cm (6 in) packers were used for paired row openers requiring larger packing widths. The seeder was operated at 6.7 km/h (4 mi/h). Travel speed was monitored using a radar gun mounted on the tractor. Seed and granular urea were metered from a Gandy seed box. Seed and granular rates were adjusted using Zeromax controllers. Ammonium Phosphate (11-51-0-0) fertilizer placed with the seed at 67.2 kg/ha (60 lb/ac) was metered through a Beline metering box. Anhydrous ammonia was electronically metered using a Raven anhydrous ammonia controller from a 300 gallon tank mounted on the seeder. A Continental vertical dam manifold was used to control distribution of the ammonia. Ammonia was

placed while seeding in approximately a 75/25 liquid/vapour form. Seed and fertilizer distribution and a rates were calibrated in the lab prior to seeding.

Seeding depth was determined in the field. Canola seeds were placed at 1.3 cm (0.5 in) or into moisture. Wheat were seeded at 2.5 cm (1 in) or into moisture.

Plant count samples of each plot were taken four to five weeks after seeding to determine effects of expe factors. Random samples of each plot row were taken and the average used as a representative sample o Plots were sprayed with the required herbicides to control weed growth. Yields were taken using Winte Hege plot combines. Crop moisture content was monitored at harvest to determine days to crop maturity

Soil type, pH, background nutrient levels and previous cropping history were determined prior to seedin water content, depth to water and seedbed temperature were also monitored.

Seed and fertilizer placement for the different openers and soil conditions tested were measured and out **Appendix 1.** Descriptions and drawings of the different openers used in the experiments are also outlin

Experimental Design

The experiments were split plot designs with a 2 x 4 factorial (opener x type) as the main plot in the fert experiment and a 2 x 13 factorial (opener x type) as the main plot in the opener experiment. The fertilit experiments had four and three complete replications for a total of 128 and 234 plots, respectively, per type. Plots were 2.43 x 9.14 m (8 x 30 ft) for the fertility sites and 2.43 x 7.62 m (8 x 25 ft) for the ope 12.2 m (40 ft) strip was left between each block of plots to allow for turning and starting of implements effects were controlled through plot randomization and border strips.

Table 3.

Source	Degrees of Freedom
Replication (R)	3
Main Plot	
Opener (A)	3
Type (B)	1
Opener x Type (AxB)	3
Error (Main Plot)	
AxR + BxR + AxBxR	21
Sub Plot	
Rates (C)	3
Rate x Opener (CxA)	9
Rate x Type (CxB)	3
Rate x Opener x Type (CxBxA)	9
Error (Sub Plot)	
RxC + AxCxR + BxCxR + AxBxCxR	72
TOTAL	**127**

Emergence, yield and days to crop maturity were analyzed using a split plot analysis with a 2 x 4 factorial and a 2 x 13 factorial as the main plots in fertility and opener experiments, respectively. The fixed effects of the analysis were the experimental factors as outlined in **Tables 1 and 2.** The four replications were considered random effects nested within the fixed analysis format and therefore applied to the error terms of the split plot analysis. **Table 3** outlines the error terms and degree of freedom on the split plot analysis. A Duncan's multiple range test was used to outline statistically significant differences occurring at the 0.01 and 0.05 levels.

Results and Discussion

Results were reviewed separately for each experiment site. **Table 4** outlines the factors and the experimental statistically significant differences in the emergence, yield and days to maturity measurements. In general, the opener factor tended to influence the emergence and yield results. Rate of fertilizer influenced yield and days to crop maturity, as expected. Type of fertilizer used was only significant at a few sites.

Table 4.

Factor (level)	Crop	Site
Emergence		
0.01 level		
Opener	Barley	Coaldale, Vermilion
Opener	Canola	Coaldale, Lethbridge, Strathmore
Opener	Wheat	Coaldale
0.05 level		
Opener	Canola	Calmar
Type	Canola	Irricana
Rate	Canola	Irricana
Yield		
0.01 level		
Opener	Barley	Burdett
Opener	Wheat	Burdett
Type	Barley	Lethbridge
Rate	Barley	Burdett, Coaldale, Irricana, Lethbridge, Neerland:
Rate	Canola	Calmar
Rate	Wheat	Burdett, Calmar, Lethbridge, Strathmore
0.05 level		
Opener	Barley	Neerlandia
Opener	Canola	Neerlandia, Strathmore
Opener	Wheat	Coaldale
Type	Barley	Neerlandia
Type	Canola	Neerlandia
Opener x Type	Wheat	Coaldale
Days to Maturity		
0.01 level		
Rate	Barley	Irricana, Olds
Rate	Canola	Irricana
Opener x Type	Wheat	Strathmore

Fertility Sites, Conditions and Results

Southern Alberta Fertility Sites

Three southern fertility experiment sites were set up near Lethbridge, Alberta. The openers were the Flexi-Coil side band and pair row stealth double shoot openers, a 30.5 cm (12 in) McKay sweep with fertilizer tubes and the Bourgault mid row banding system. All southern Alberta sites were irrigated.

Burdett

The Burdett site was a sandy loam soil. The field was sprayed with 1 L/ac Roundup on April 18, 1995. C and 20, 1995, Horizon canola, Manley barley and AC Reed soft wheat were seeded into canola stubble at lb/ac), 112 kg/ha (100 lb/ac) and 84 kg/ha (75 lb/ac), respectively. Soil water was at 0.64 cm (0.25 in) fr surface. Seeding depth for the Canola was 1.3 cm (0.5 in). Carbofuran was mixed with the canola at seec rate of 7.2 kg/ha (6.4 lbs/ac). Barley and soft wheat were pretreated with seed fungicide and seeded at a c cm (1 in). Phosphate was placed with the canola, barley and wheat at 67.2 kg/ha (60 lb/ac) in the form of Average soil water at seeding from the surface to 15.3 cm (6 in) was 24.1 percent (vol/vol). Average soil temperature at 5 cm (2 in) was 10.2°C. Wheat was harvested on August 29, 1995, 130 days after seeding was harvested on August 30, 1995, 131 days after seeding. Days to maturity were not recorded since the moisture at harvest was less than 10 percent. Herbicide spray drift and sclerotinia on the canola site may effected canola emergence results. Canola yield was not sampled due to weed and Sclerotinia problems.

Seeding Opener

The Flexi-Coil side band and paired row double shoot and Bourgault mid row band system were compare sweep and fertilizer tube.

Emergence: Barley, canola and wheat emergence counts showed no statistical difference (0.01 level) fo openers.

Yield: Wheat yield for the pair row opener was statistically lower (0.01 level) than the mid row banding yield. There was no difference between the yield of the pair row, side band or sweep openers at the 0.01 sweep and side band were also not statistically different from the mid row banding system. The analysis statistical difference (0.01 level) in barley yield due to the openers. However, Duncan's range tests did n difference.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley, canola and wheat emergence were not statistically effected (0.01 level) by the fertil used. However, anhydrous ammonia tended to cause lower emergence than the urea for both barley and Canola emergence was slightly higher with anhydrous ammonia as compared to urea.

Yield: Yields for the barley and wheat were not statistically effected by the type of fertilizer used.

Fertilizer Rate

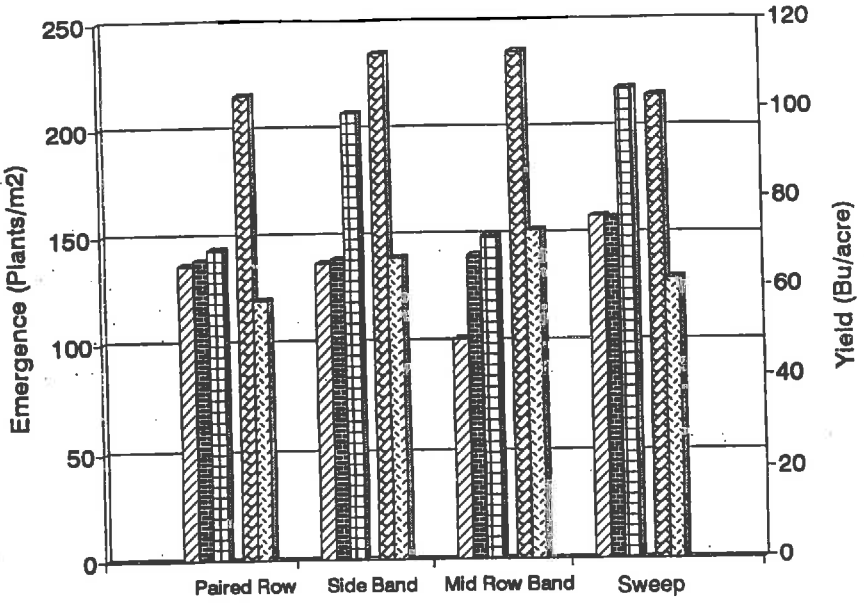
Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While emergence was generally reduced with higher rates of fertilizer, no statistical effect the 0.01 level for fertilizer rates.

Yield: Higher fertilizer rates increased yields of barley and wheat. For the barley, the control, 0 kg/ha a kg/ha (50 lb/ac) rates had statistically lower (0.01 level) yields than the 112 and 168 kg/ha (100 and 15(The 0 kg/ha rate was also statistically lower in yield than the 56 kg/ha (50 lb/ac) rate.

For the wheat, the control, 0 kg/ha had statistically lower (0.01 level) yields than the 56, 112 and 168 k and 150 lb/ac) rates. The 168 kg/ha (150 lb/ac) rate yield was also statistically higher (0.01 level) than (50 lb/ac) rate.

Seeding Opener



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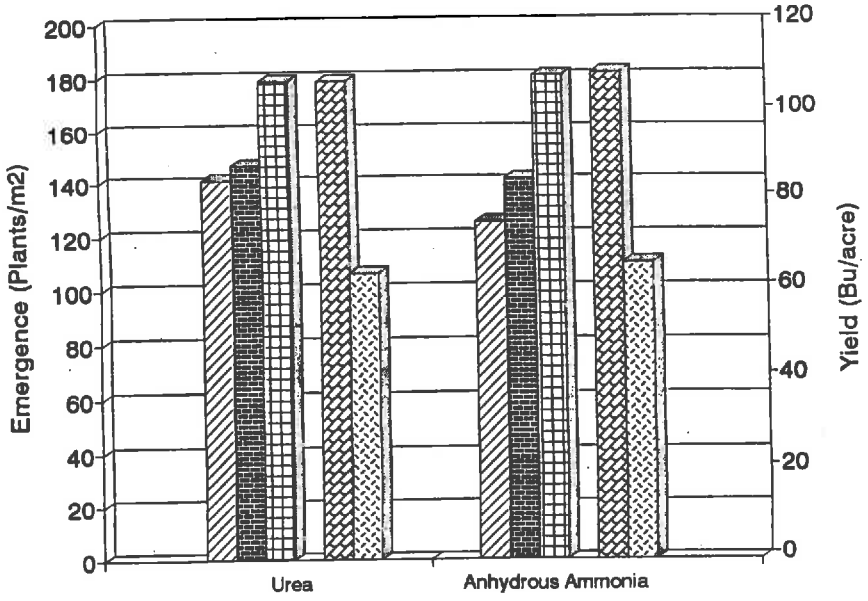

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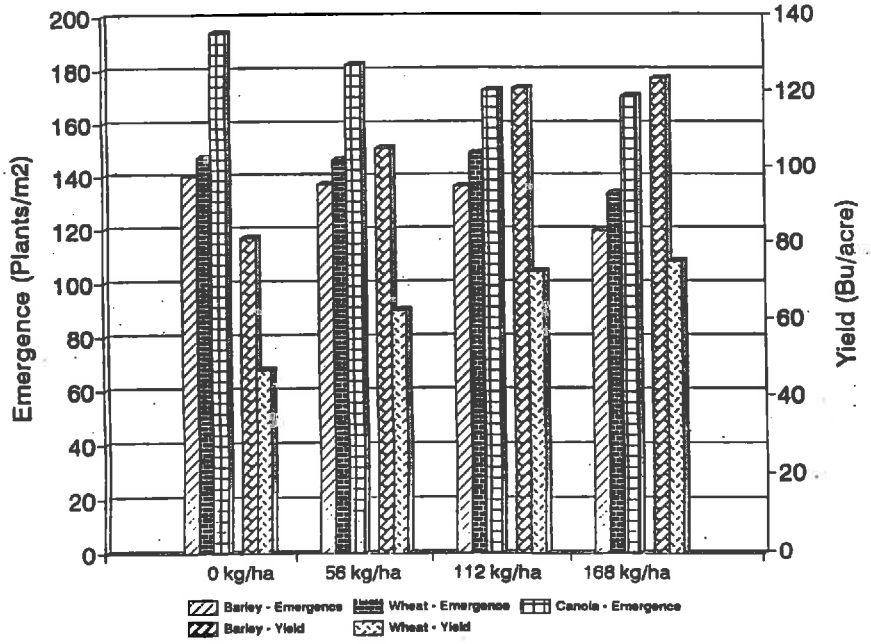


Coaldale

The Coaldale site was a clay soil. The field was sprayed with 1 L/ac Roundup on April 18, 1995. On April 1995, Horizon canola, Manley barley and AC Reed soft wheat were seeded into barley stubble at 9 kg/ha (8 112 kg/ha (100 lb/ac) and 84 kg/ha (75 lb/ac), respectively. The soil had water to the surface. Seeding depti Canola was 1.9 cm (0.75 in). Canola was mixed with 7.2 kg/ha (6.4 lb/ac) of Carbofuran. Barley and soft w were pretreated with seed fungicide and seeded at a depth of 2.5 cm (1 in). Phosphate was placed with the c barley and wheat at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Average soil water at seeding from the s 15.3 cm (6 in) was 31 percent (vol/vol). Average soil temperature at 5 cm (2 in) was 11°C. Wheat was harv September 9, 1995, 140 days after seeding. Canola and barley were harvested on September 11 and August 1995, 142 and 131 days after seeding. Days to maturity were not recorded since the crop had dried down pr harvest.

Seeding Opener

The Flexi-Coil Stealth side band, pair row double shoot and Bourgault mid row bander system were compar the sweep and fertilizer tube.

Emergence: Canola and barley emergence for the sweep was statistically higher than the side band, pair rov mid row band system openers at the 0.01 level. The mid row bander had statistically lower wheat emergenc level) than the sweep, side band and pair row openers.

Yield: There was no difference between the canola or barley yield of the openers. Wheat yield was statistic higher (0.05 level) for the paired row opener compared to the side band and sweep openers. The opener x f type 2nd order interaction was also statistically significant at the 0.05 level. No trends were apparent.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley, canola and wheat emergence were not statistically effected (0.01 level) by the fertilize used. However, anhydrous ammonia caused lower emergence than the urea for the canola, barley and whea

Yield: Wheat, barley and canola yields were not statistically effected by the type of fertilizer used.

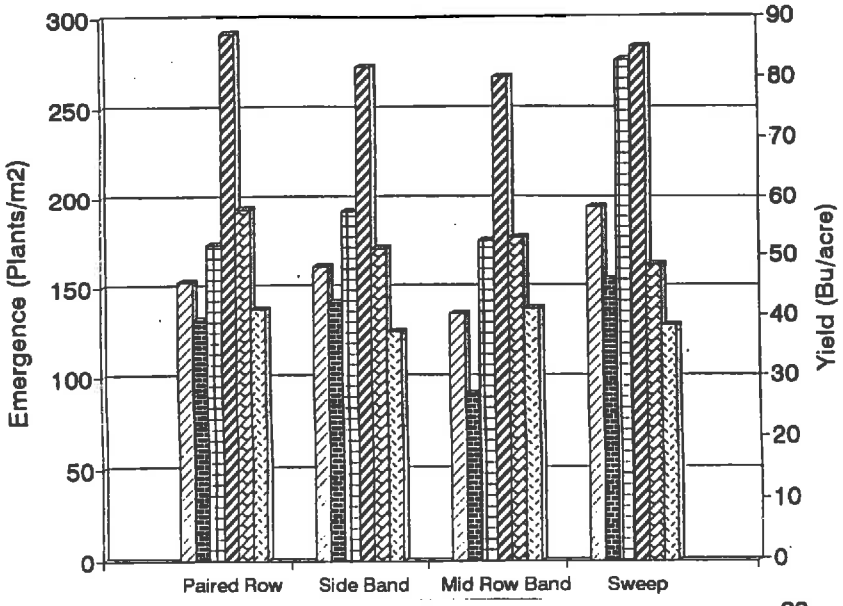
Fertilizer Rate

Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) actual nitrogen were compared.

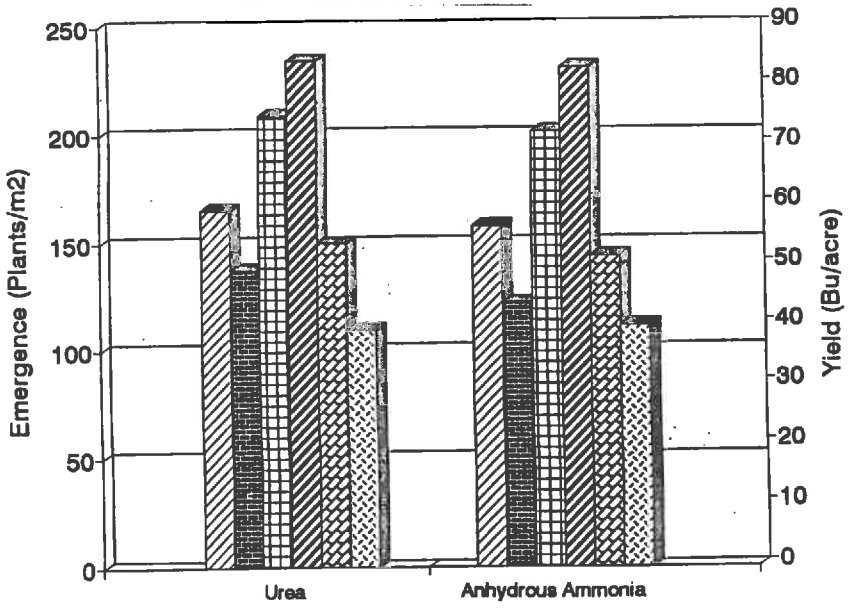
Emergence: While, emergence was generally reduced with higher rates of fertilizer, no statistical effect wa

Yield: Yields were not statistically effected by higher fertilizer rates for the wheat and canola. Barley yielc control (0 kg/ha) was statistically lower (0.05 level) than for the 56, 112 and 168 kg/ha (50, 100 and 150 lb

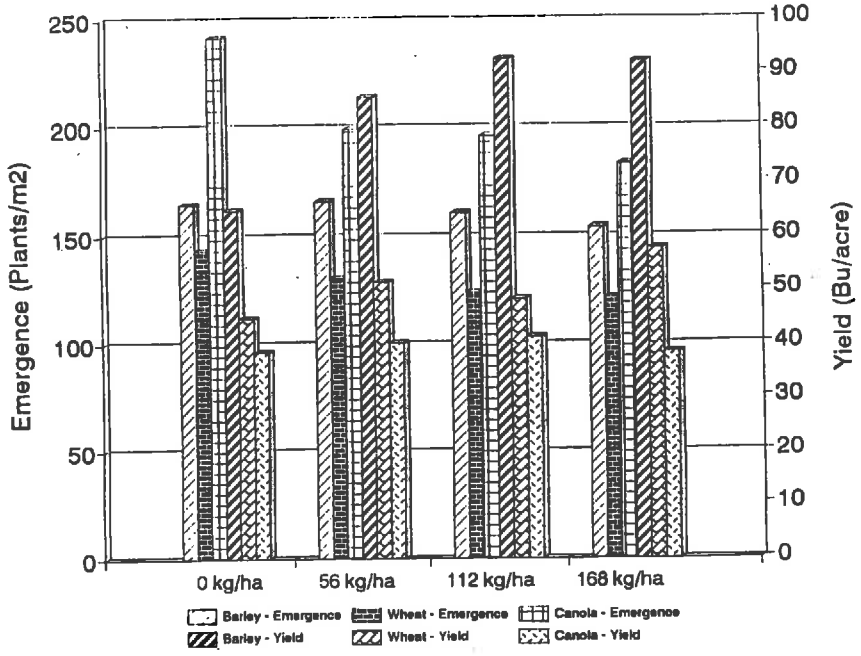
Seeding Opener



Fertilizer Type



Fertilizer Rate



Lethbridge

The Lethbridge site was a clay loam soil. The field was sprayed with 1 L/ac Roundup on April 18, 1995. C 22, 1995, Horizon canola, Manley barley and AC Reed soft wheat were seeded into barley stubble at 9 kg/h lb/ac), 112 kg/ha (100 lb/ac) and 84 kg/ha (75 lb/ac), respectively. The soil had water to the surface. Seedi for the Canola was 1.9 cm (0.75 in). Canola was mixed with 7.2 kg/ha (6.4 lb/ac) of Carbofuran. Barley ar wheat were pretreated with seed fungicide and seeded at a depth of 2.5 cm (1 in). Phosphate was placed wi canola, barley and wheat at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Average soil water at seeding fr surface to 15.3 cm (6 in) was 31.4 percent (vol/vol). Average soil temperature at 5 cm (2 in) was 7.4°C. W harvested on September 12, 1995, 142 days after seeding. Barley and canola were harvested on August 26 1995, 125 and 127 days after seeding. Days to maturity were not recorded since the crop had dried down p harvest.

Seeding Opener

The Flexi-Coil side band, pair row double shoot and Bourgault mid row bander system were compared wit and fertilizer tube.

Emergence: Barley and wheat emergence counts showed no statistical difference (0.01 level) for any of th Canola emergence for the sweep was statistically lower (0.01 level) than the mid row band system and the openers. The mid row banding system had statistically higher (0.01 level) emergence than the paired row There was no statistical difference between the emergence of the side band or pair row openers.

Yield: There was no statistical difference between the canola, barley or wheat yields of the openers.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley, canola and wheat emergence were not statistically effected by the fertilizer type used However, anhydrous ammonia caused lower emergence than the urea for the canola, barley and wheat.

Yield: Yields for the barley were statistically lower (0.01 level) for the anhydrous ammonia as compared Wheat and canola yields were not statistically effected by the type of fertilizer used.

Fertilizer Rate

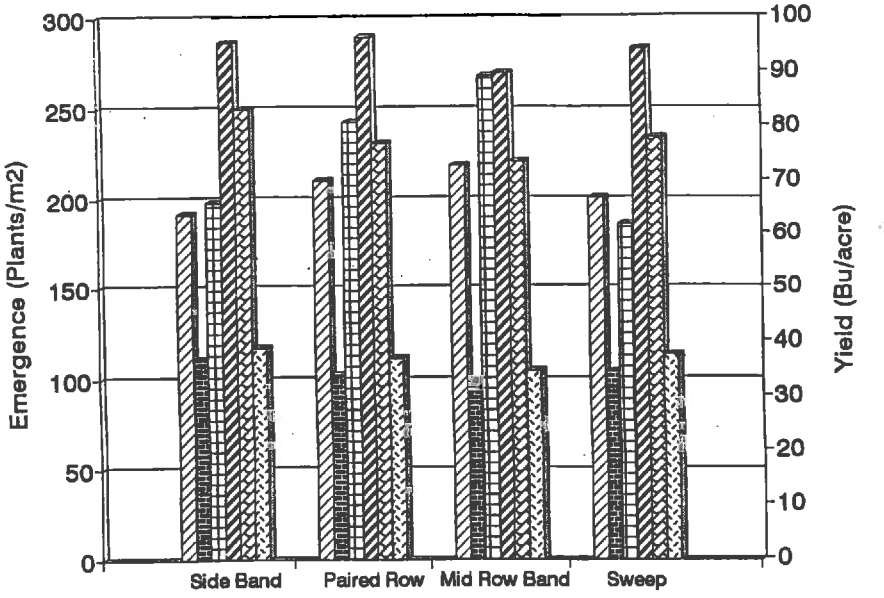
Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While, emergence was generally reduced with higher rates of fertilizer, no statistical effect w

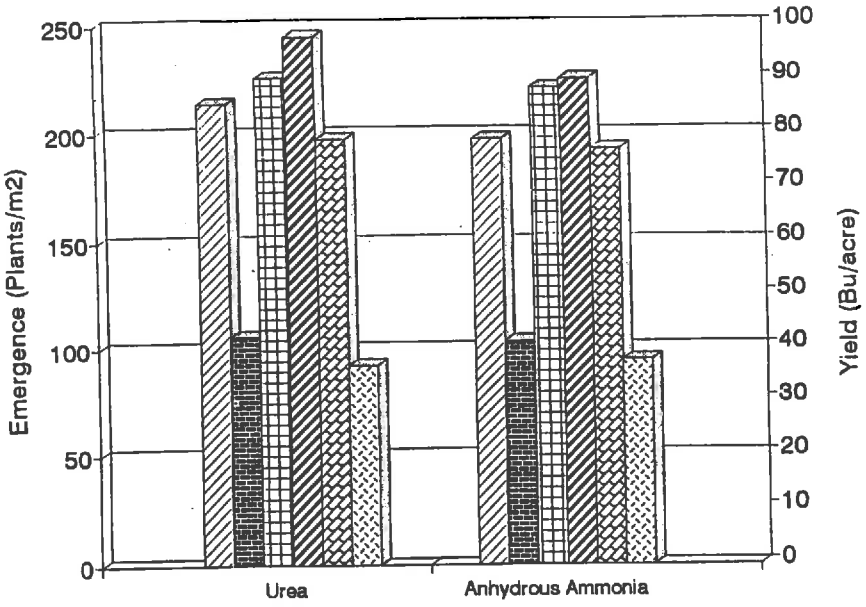
Yield: Higher fertilizer rates increased yields of barley and wheat. For the barley, the control, 0 kg/ha ha statistically lower (0.01 level) yields than the 56, 112 and 168 kg/ha (50, 100 and 150 lb/ac) rates.

Wheat yields for the control (0 kg/ha) were significantly less (0.01 level) than the yield for the 168 kg/ha rate.

Seeding Opener



Fertilizer Type



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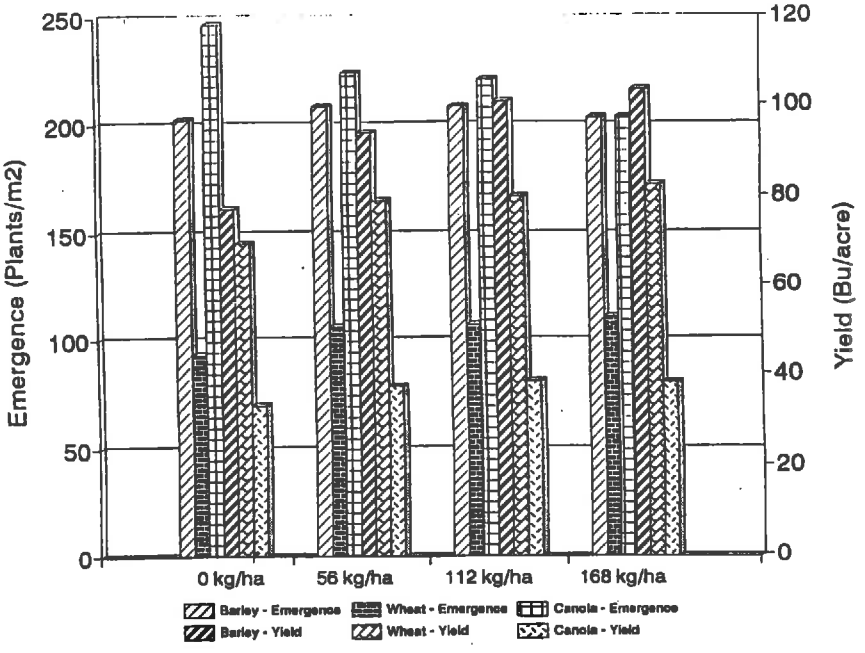


Central Alberta Fertility Sites

Three central Alberta sites were located near Calgary. The openers used at the central sites included the Flexi-Coil side pair row double shoot openers, Barton No-Till double shoot opener and a McKay sweep equipped with fertilizer tubes.

Irricana

The Irricana site was a sandy loam soil with no previous tillage of barley stubble. The field was sprayed with 1 L/ac Rc May 3, 1995. On May 4, 1995, Horizon canola and Manley barley were seeded into barley stubble at 9 kg/ha (8 lb/ac) . (100 lb/ac), respectively. Seeding depth for the canola was 1.3 cm (0.5 in). Canola was mixed with 7.2 kg/ha (6.4 lb/ac Carbofuran. Barley, pretreated with seed fungicide, was seeded at a depth of 2.5 cm (1 in). Phosphate was placed with and canola at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Average soil water at seeding from the surface to 15.3 cm 21.1 percent (vol/vol). Soil water was 0.64 cm (0.25 in) from the surface. Average soil temperature at 5 cm (2 in) was was harvested on September 1, 1995, 120 days after seeding. Barley was harvested on August 29, 1995, 118 days after

Seeding Opener

The Flexi-Coil side band and pair row openers and Barton opener were compared with the sweep and fertilizer tube.

Emergence: Barley emergence counts showed statistically lower emergence (0.01 level) counts for the Barton opener a the side band opener. The Barton opener also had significantly lower emergence (0.01 level) counts compared to the s seeding canola. Lower emergence with the Barton opener was attributed to the narrow banding of the phosphate and s have concentrated the phosphate or nitrogen to toxic levels in the seed row.

Yield: Barley yield results indicated that the sweep had significantly higher yield results (0.01 level) than the side banc Barton openers. No other yield difference was evident. The Barton opener caused a statistical increase (0.01 level) in t days to barley maturity as compared to the side band and paired row openers. The average days to maturity were 111. and 112.9 for the side band, paired row, sweep and Barton openers, respectively.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley emergence was not statistically effected by the fertilizer type used. However, anhydrous ammonia emergence than the urea.

Canola emergence was significantly lower for the anhydrous ammonia as compared to the urea at the 0.05 level.

Yield: Yields for the barley and canola were not statistically effected by the type of fertilizer used. However, barley a yields when using anhydrous ammonia tended to be lower than yields using urea.

Fertilizer Rate

Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While, barley emergence was generally reduced with higher rates of fertilizer, no statistical effect was fo

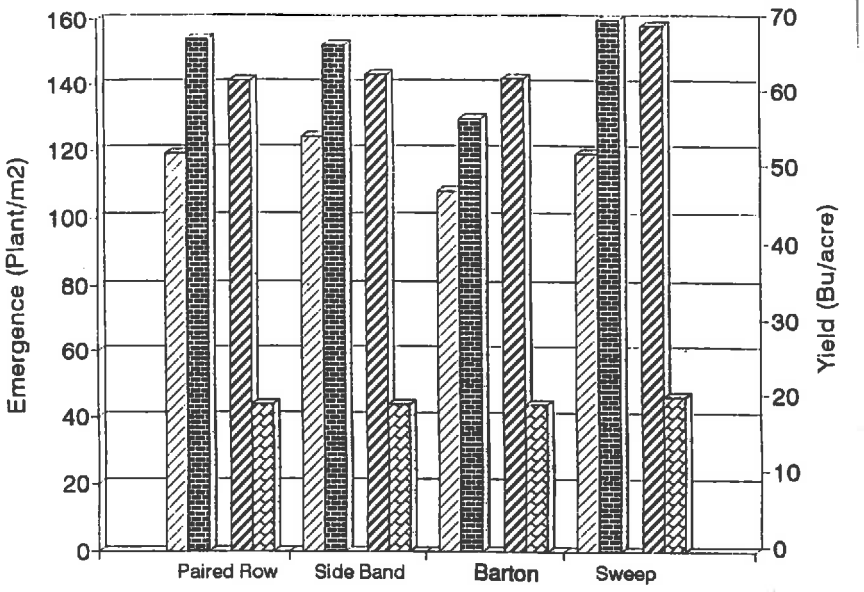
For canola emergence the 56 kg/ha (50 lb/ac) rate was significantly (0.05 level) higher than the 168 kg/ha (150 lb/ac)

Yield: Higher fertilizer rates increased yields of both canola and barley. For the barley yield, the control, 0 kg/ha had lower (0.01 level) yields than the 56, 112 and 168 kg/ha (50, 100 and 150 lb/ac) rates. In addition, the 56 kg/ha (50 lb statistically lower (0.01 level) barley yield than the 168 kg/ha (150 lbs/ac) rate.

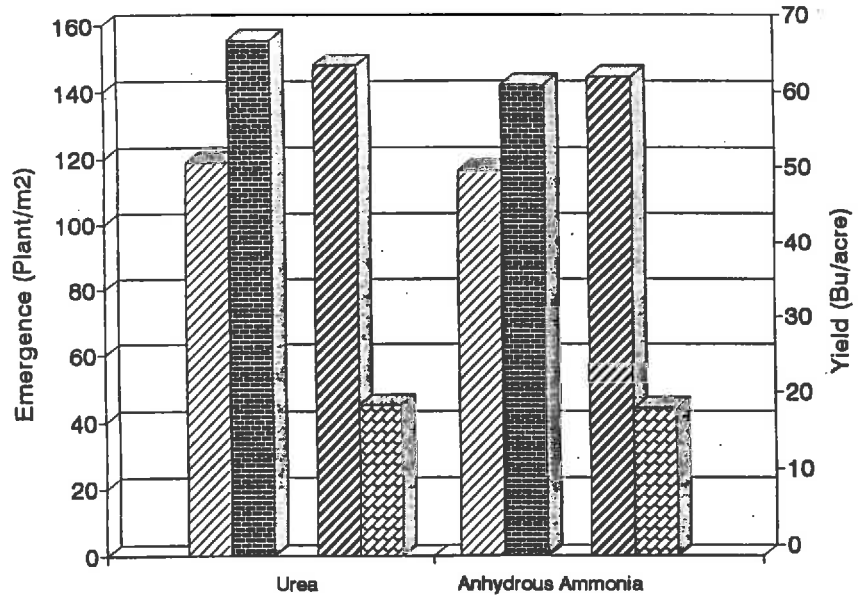
The 168 kg/ha (150 lb/ac) rate of nitrogen caused statistically higher (0.01 level) days to maturity for barley than the (or 50 lb/ac) rates. The 112 kg/ha (100 lb/ac) rate of nitrogen had statistically higher days to maturity than the 0 kg/ha average days to maturity were 113.6, 112.7, 111.3 and 110.6 days for the 168, 112, 56 and 0 kg/ha (150, 100, 50 and respectively.

While the canola days to maturity were outlined by the analysis as being significantly different at the 0.05 level, the D was not able to indicate why the difference occurred.

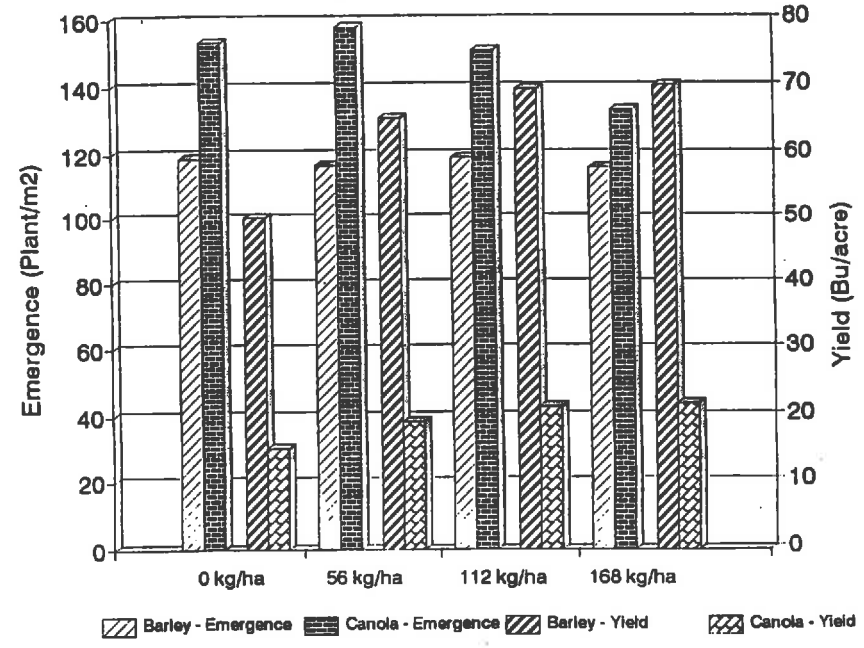
Seeding Opener



Fertilizer Type



Fertilizer Rate



Strathmore

The Strathmore site was a loam soil with no previous tillage. Canola and wheat were seeded on wheat and stubble, respectively. The sites were sprayed with 1 L/ac Roundup on May 2, 1995. On May 3, 1995, Hor canola and Roblin wheat were seeded. Canola and wheat were seeded at 9 kg/ha (8 lb/ac) and 100.8 kg/ha lb/ac), respectively. Seeding depth for the canola was 1.3 cm (0.5 in) with 7.2 kg/ha (6.4 lb/ac) of Carbofu Wheat, pretreated with seed fungicide, was seeded at a depth of 2.5 cm (1 in). Phosphate was placed with and canola at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Average soil water at seeding from the surfac cm (6 in) was 24.7 percent (vol/vol). Soil water was 1.25 cm (0.5 in) from the surface. Average soil temp 5 cm (2 in) was 6.3°C. Canola was harvested on September 1, 1995, 121 days after seeding. Wheat was h on September 22, 1995, 142 days after seeding.

Seeding Opener

The Flexi-Coil side band and pair row openers and Barton opener were compared with a sweep and fertili

Emergence: Wheat emergence was not effected by openers.

Canola emergence counts showed statistically lower emergence (0.01 level) counts for the Barton opener compared to the pair row, side band and sweep openers. Lower emergence with the Barton opener was at the narrow banding of the phosphate and seed which may have concentrated the phosphate or nitrogen to in the seed row.

Yield: Canola yield for the Barton opener was statistically higher (0.05 level) than the pair row opener. N yield differences were evident.

Wheat yield was not effected by soil opener.

Days to crop maturity was not statistically effected by the opener type. However, the opener x fertilizer t interaction was significant at the 0.05 level for the wheat crop days to maturity. No trends were apparent second order interaction.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Wheat and canola emergence were not statistically effected by the fertilizer type used. How anhydrous ammonia caused lower emergence than the urea for canola and higher emergence for wheat.

Yield: Yields for the wheat and canola were not statistically effected by the type of fertilizer used. Howe for anhydrous ammonia were lower than yields when using urea for both wheat and higher for canola. Da maturity was not statistically effected by the fertilizer type.

Fertilizer Rate

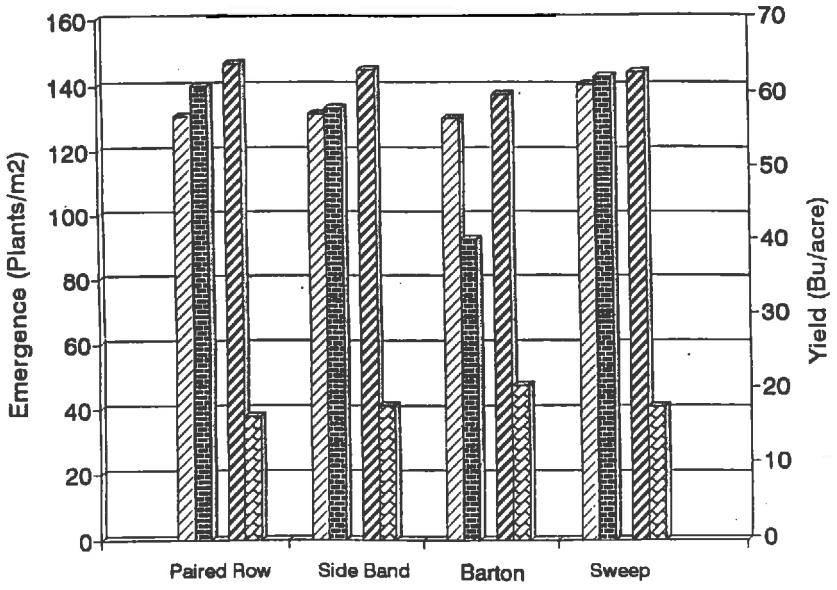
Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While, emergence was generally reduced with the high rate of fertilizer 168 kg/ha (150 lb/a statistical effect was found.

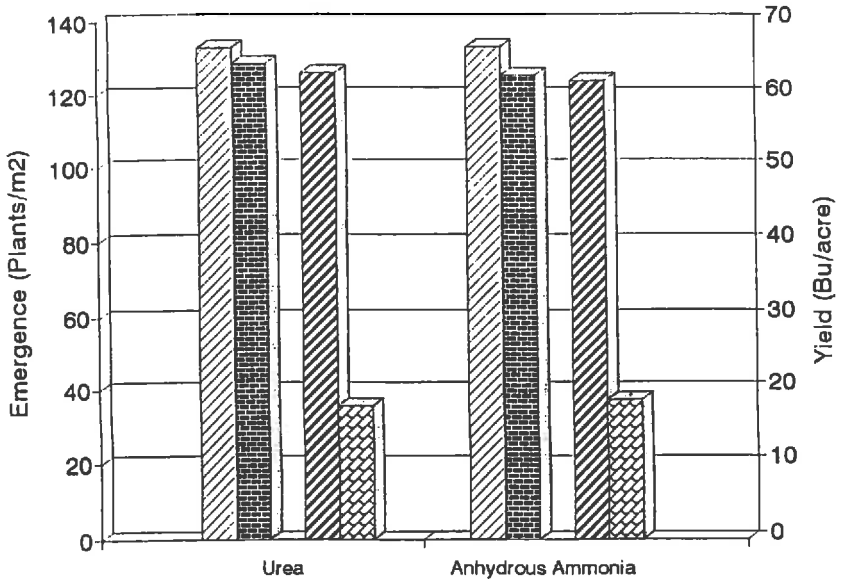
Yield: Canola yield was not statistically affected by fertilizer rate.

Higher fertilizer rates increased yields of both canola and wheat. However, only the control, 0 kg/ha had lower (0.01 level) wheat yields than the 56, 112 and 168 kg/ha (50, 100 and 150 lb/ac) rates for wheat. maturity were not statistically effected by fertilizer rate.

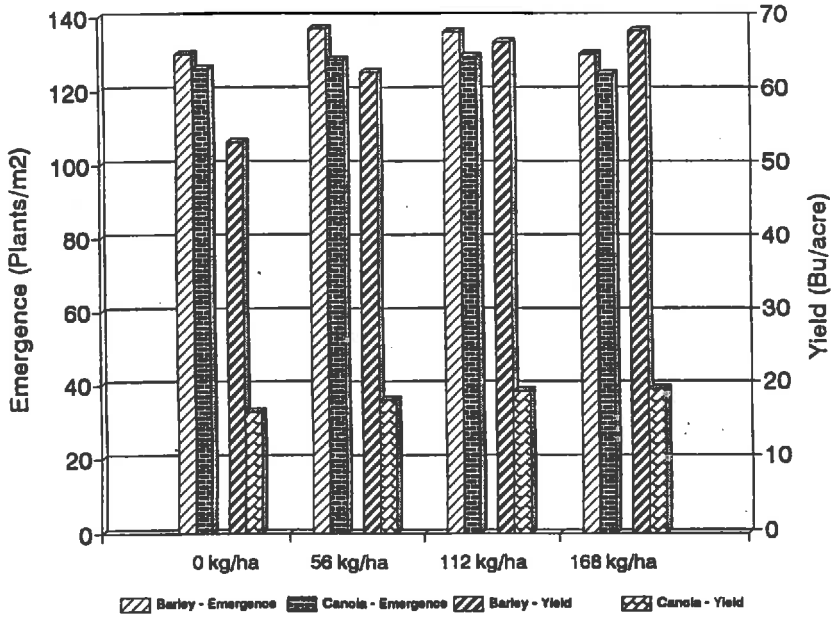
Seeding Opener



Fertilizer Type



Fertilizer Rate



Olds

The Olds barley site was a clay loam soil with no previous tillage of canola stubble. The Olds canola site v loam soil with one harrow operation of barley stubble. The barley site was sprayed with 1 L/ac Roundup (1995. On May 5, 1995, Manley barley was seeded at 112 kg/ha (100 lb/ac). Soil water was at the surface. Canola site was sprayed with 1 L/ac Roundup on May 21, 1995. On May 23, 1995, Horizon canola was s kg/ha (8 lb/ac). Seeding depth for the Canola was 1.3 cm (0.5 in). Canola was mixed with 7.2 kg/ha (6.4 Carbofuran. Barley, pretreated with seed fungicide, was seeded at a depth of 2.5 cm (1 in). Phosphate wa with both the barley and canola at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Average soil water at s the surface to 15.3 cm (6 in) was 30.1 and 37.3 percent (vol/vol) for the barley and canola sites, respectiv Average soil temperature at 5 cm (2 in) for the barley and canola sites was 3.8 and 5.3°C. Canola was har September 23, 1995, 123 days after seeding. Barley was harvested on September 23, 1995, 141 days afte Canola plant counts were not completed.

Seeding Opener

The Flexi-Coil side band and pair row openers and Barton opener were compared with the sweep and fer

Emergence: There was no statistical difference in emergence counts due to the different openers at the b

Yield: Barley yield results indicated no statistical difference in barley or canola yields. No yield trends v apparently due to the different openers. Days to maturity were not effected by the different openers for b canola.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley emergence was not statistically effected by the fertilizer type used. However, anhyd ammonia caused lower emergence than the urea.

Yield: Yields for the barley and canola were not statistically effected by the type of fertilizer used. Yiel anhydrous ammonia and urea were approximately the same for both barley and canola.

Days to maturity was not effected by fertilizer type.

Fertilizer Rate

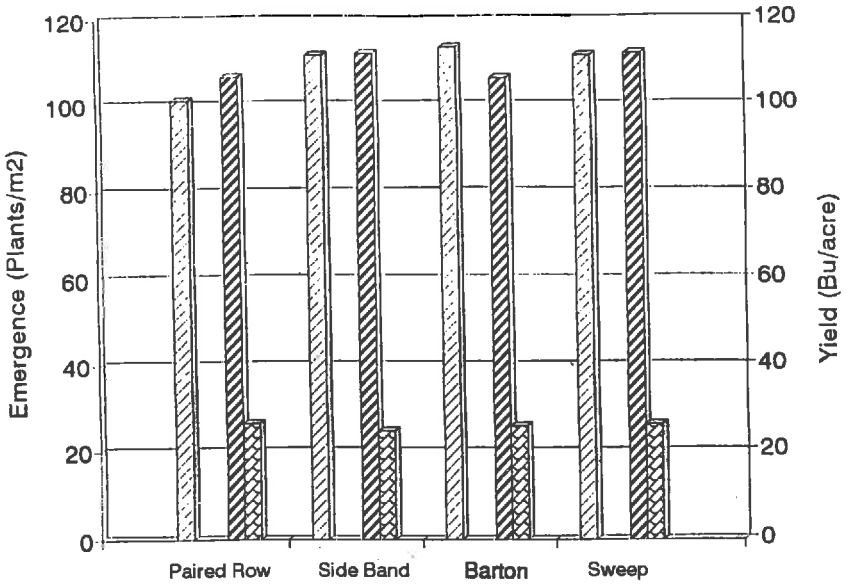
Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While, emergence was generally reduced with higher rates of fertilizer, no statistical effect

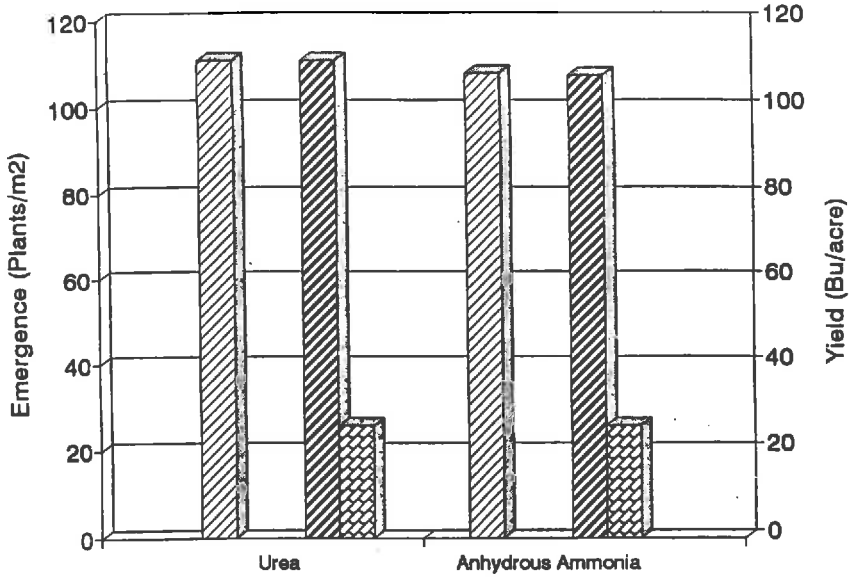
Yield: Higher fertilizer rates tended to increase yields of both canola and barley. However, only the cor had statistically lower (0.01 level) barley yields than the 56, 112 and 168 kg/ha (50, 100 and 150 lb/ac)

Days to barley maturity was statistically effected, at the 0.01 level, by fertilizer rate. The 168 kg/ha (15 nitrogen rate caused statistically longer days to maturity than the 0 and 56 kg/ha (0 and 50 lb/ac) rates. kg/ha (100 lb/ac) rate caused significantly (0.01 level) longer days to maturity than the control (0 kg/ha) to barley maturity were 136.3, 135.7, 134.6 and 133.8 for the 168, 112, 56 and 0 kg/ha (150, 100, 50 an rates, respectively.

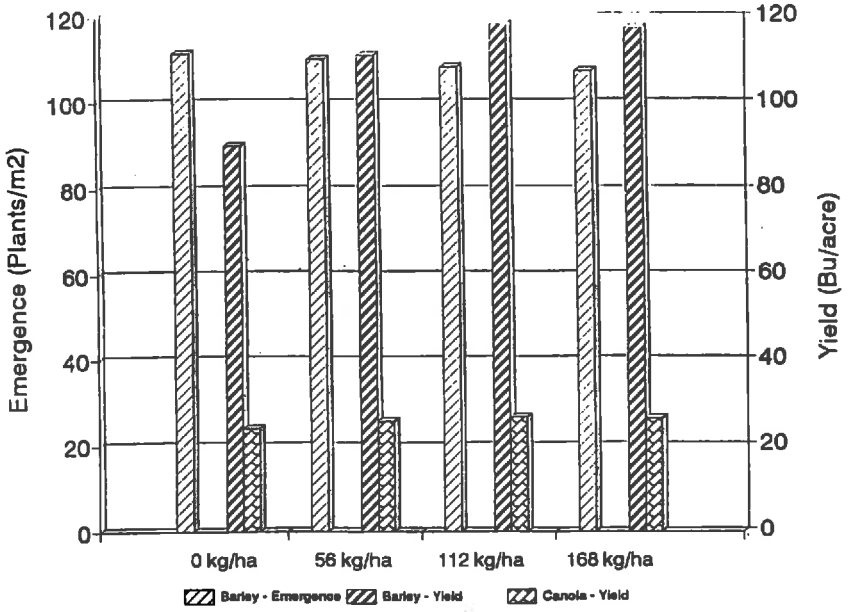
Seeding Opener



Fertilizer Type



Fertilizer Rate



Northern Alberta Fertility Sites

The fertility site was replicated at three sites near Edmonton, Alberta. The openers used included the Flex band and paired row openers, Barton opener and a McKay sweep equipped with fertilizer tubes.

Calmar

The Calmar site was a loam soil which had been worked black prior to seeding. Canola and wheat were s the site which contained barley the year before. The site was sprayed with 1 L/ac Roundup on May 10, 1 May 12, 1995, Horizon canola and Roblin wheat were seeded. Canola and wheat were seeded at 9 kg/ha and 100.8 kg/ha (90 lb/ac), respectively. Seeding depth for the canola was 1.3 cm (0.5 in). The canola wa with 7.2 kg/ha (6.4 lb/ac) of Carbofuran. Wheat, pretreated with seed fungicide, was seeded at a depth of in). Phosphate was placed with the wheat and canola at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. A water at seeding from the surface to 15.3 cm (6 in) was 24.8 percent (vol/vol). Soil water was 1.9 cm (0.' the surface. Average soil temperature at 5 cm (2 in) was 13°C. Both the wheat and canola were harveste September 25, 1995, 136 days after seeding. Wheat plant counts were not completed.

Seeding Opener

The Flexi-Coil side band and pair row openers and Barton opener were compared with the sweep and fer

Emergence: Canola emergence counts showed a statistically lower count for the Barton opener as comp sweep and paired row openers at the 0.05 level.

Yield: No yield difference was evident due to the different openers. Days to crop maturity was not statis effected by the opener type.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Canola emergence was not statistically effected by the fertilizer type used. However, anhyd ammonia caused higher emergence than the urea for the canola.

Yield: Yields for the wheat and canola were not statistically effected by the type of fertilizer used. Days maturity was not statistically effected by the fertilizer type.

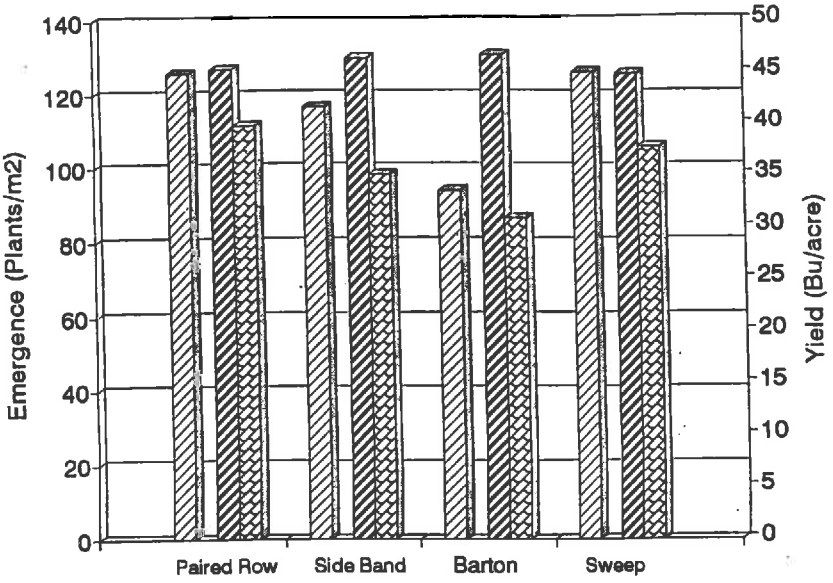
Fertilizer Rate

Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

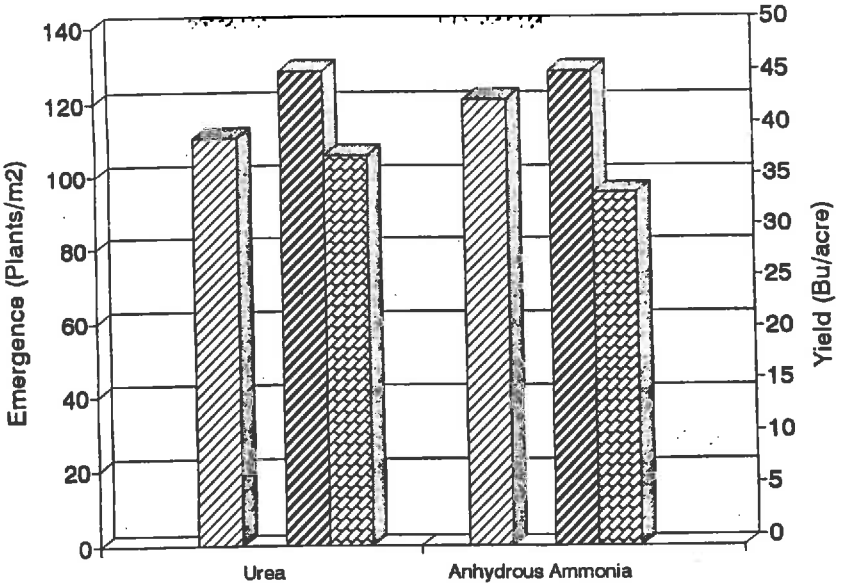
Emergence: While, canola emergence was generally reduced as the fertilizer rate increased, no statistica found.

Yield: Higher fertilizer rates increased yields of both canola and wheat. However, only the control, 0 k statistically lower (0.01 level) wheat and canola yields than the 56, 112 and 168 kg/ha (50, 100 and 150 Days to maturity were not statistically effected by fertilizer rate.

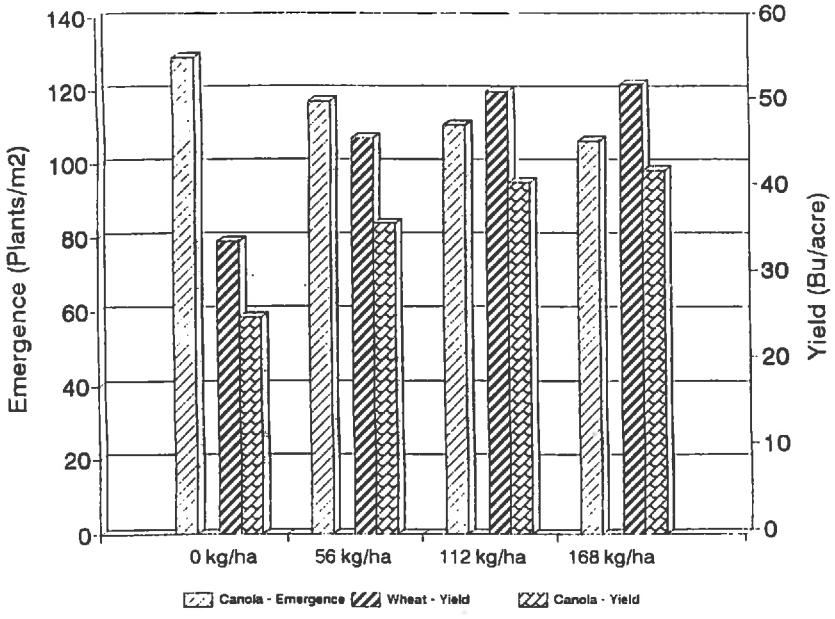
Seeding Opener



Fertilizer Type



Fertilizer Rate



Neerlandia

The Neerlandia site was a silty loam soil with malt barley as the previous crop. The site was tilled prior The field was sprayed with 1 L/ac Roundup on May 10, 1995. On May 13, 1995, Horizon canola and M were seeded at 9 kg/ha (8 lb/ac) and 112 kg/ha (100 lb/ac), respectively. Seeding depth for the canola w (0.75 in). The canola was mixed with 7.2 kg/ha (6.4 lb/ac) of Carbofuran. Barley, pretreated with seed was seeded at a depth of 2.5 cm (1 in). Phosphate was placed with the barley and canola at 67.2 kg/ha (the form of 11-51-0-0. Average soil water at seeding from the surface to 15.3 cm (6 in) was 19.6 percen Soil water was 1.9 cm (0.75 in) from the surface. Average soil temperature at 5 cm (2 in) was 12°C. Ca harvested on September 28, 1995, 138 days after seeding. Barley was harvested on August 27, 1995, 13 seeding. Days to maturity were not recorded. In addition, hail on the site may have effected the canola

Seeding Opener

The Flexi-Coil Stealth side band and pair row openers and Barton opener were compared with a sweep a tube.

Emergence: Barley and canola emergence counts showed no statistical difference in emergence counts openers.

Yield: The Barton opener had statistically lower (0.05 level) barley yields than the sweep and the side b No barley yield difference was found between the pair row and Barton openers. The canola yields were higher (0.05 level) for the sweep as compared to the Barton and side band openers.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experimen

Emergence: Barley and canola emergence was not statistically effected by the fertilizer type used. Ho anhydrous ammonia caused higher emergence than the urea for both barley and canola.

Yield: Barley and canola yields using urea were statistically higher (0.05 level) than when using anhydr ammonia. The yield difference was attributed to the ammonia losses at seeding.

Fertilizer Rate

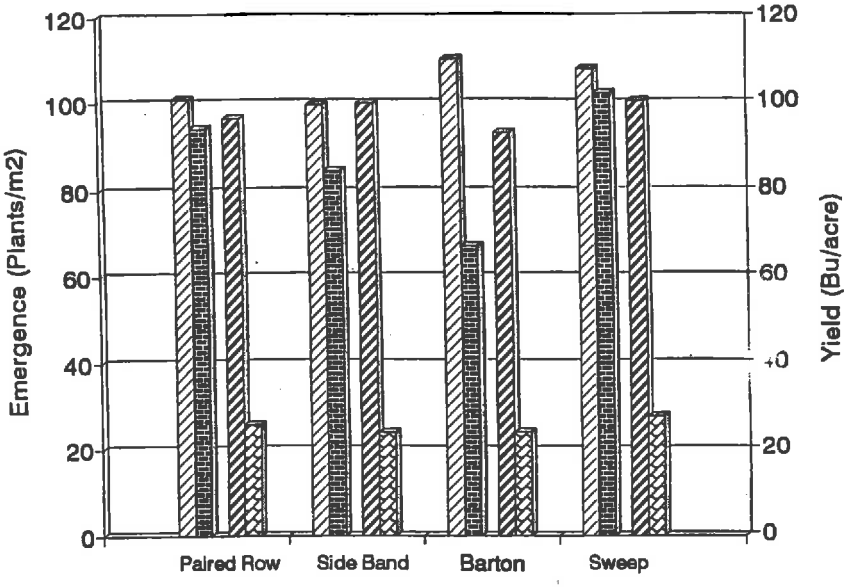
Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

Emergence: While, emergence was generally reduced with higher rates of fertilizer, no statistical effec

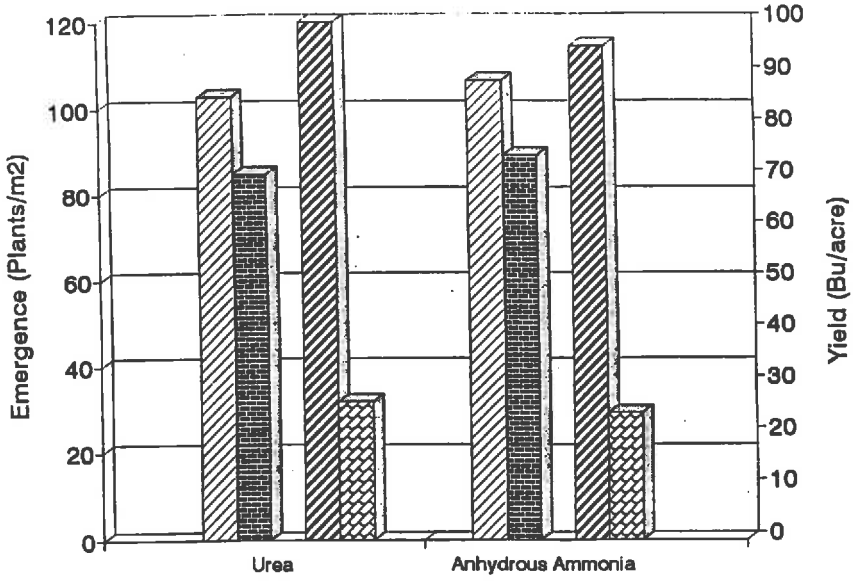
Yield: Higher fertilizer rates increased yields of the barley. The control, 0 kg/ha and the 56 kg/ha (50 l had statistically lower (0.01 level) yields than the 112, 168 kg/ha (100, 150 lb/ac) rates. The 0 kg/ha ra statistically lower in yield than the 56 kg/ha (50 lb/ac) rate.

Canola yield was not effected as much by fertilizer rates. This may have been due to hail on the crop ea year.

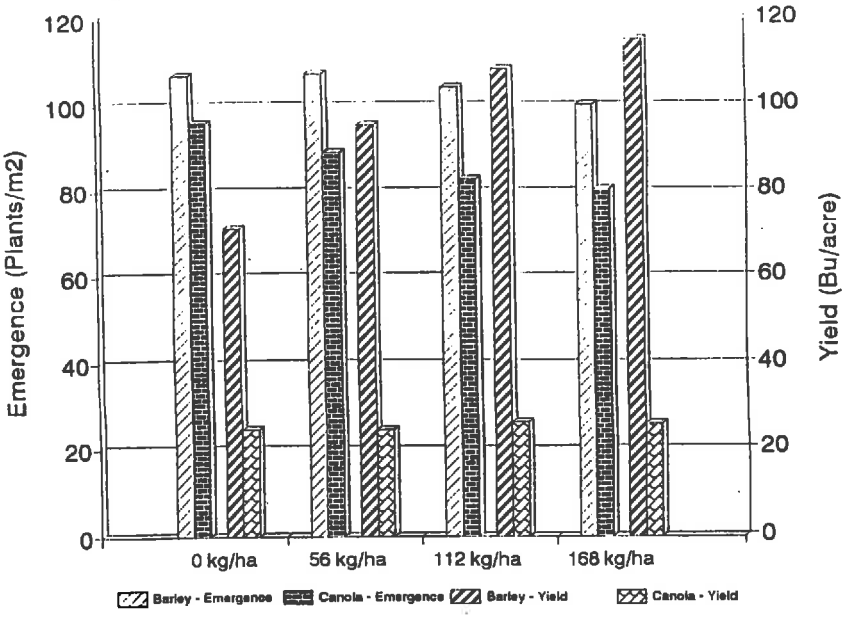
Seeding Opener



Fertilizer Type



Fertilizer Rate



Vermilion

The Vermilion site was clay loam soil with well wheat and green feed as the previous crop. The field was t to seeding. The field was sprayed with 1 L/ac Roundup on May 10, 1995. On May 11, 1995, Roblin whea Manley barley were seeded at 100.8 kg/ha (90 lb/ac) and 112 kg/ha (100 lb/ac), respectively. Soil water w cm (0.75 in). Wheat and barley, pretreated with seed fungicide, were seeded at a depth of 2.5 cm (1.0 in). Phosphate was placed with the wheat and barley at 67.2 kg/ha (60 lb/ac) in the form of 11-51-0-0. Averag water at seeding from the surface to 15.3 cm (6 in) was 25 percent (vol/vol). Average soil temperature at 5 was 15.2°C. Wheat and barley were harvested on September 6, 1995, 118 days after seeding.

Seeding Opener

The Flexi-Coil side band and pair row openers and Barton opener were compared with the sweep and ferti

Emergence: Barley emergence counts showed statistically lower emergence (0.01 level) counts for the sw compared to the side band, Barton and pair row openers.

Wheat emergence was not statistically effected by the opener.

Yield: No yield or crop maturity differences were evident because of openers.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley and wheat emergence were not statistically effected by the fertilizer type used.

Yield: Yields for the barley and wheat were not statistically effected by the type of fertilizer used. Howe for anhydrous ammonia tends to be lower than yields when using urea for both wheat and barley. No diff crop maturity because of fertilizer type were evident.

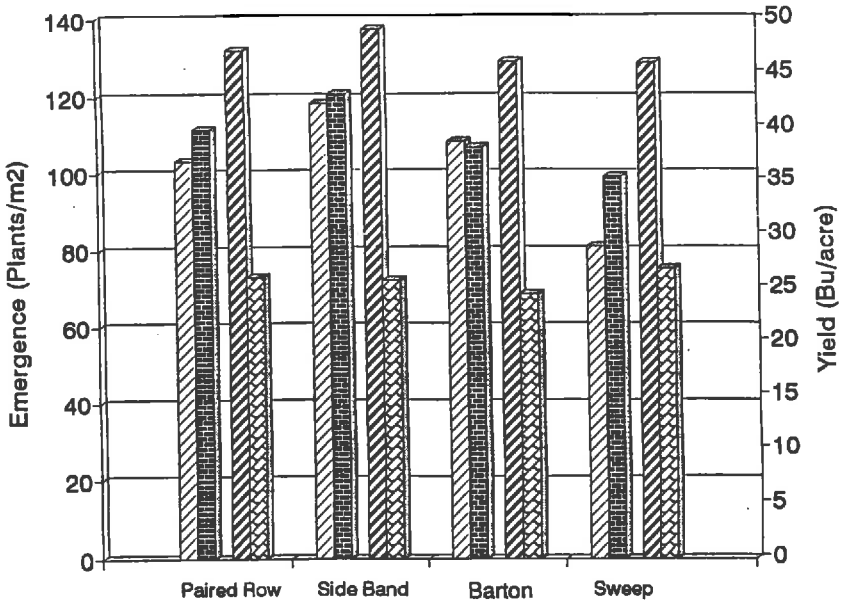
Fertilizer Rate

Four rates, 0, 56, 112 and 168 kg/ha (0, 50, 100 and 150 lb/ac) of actual nitrogen were compared.

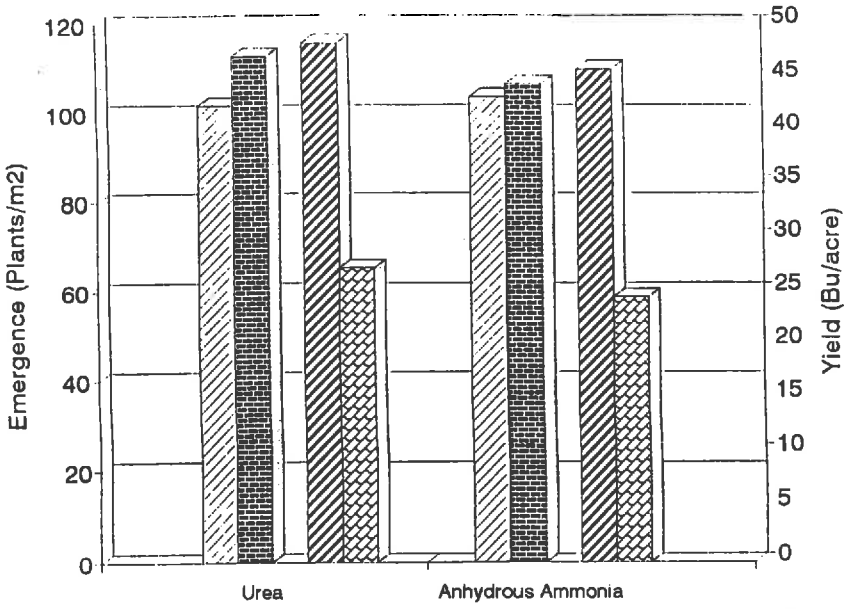
Emergence: While, emergence was generally reduced with higher rates of fertilizer, no statistical effect v

Yield: Higher fertilizer rates increased yields of both wheat and barley. However, there were no statistica different yields with the varying fertilizer rates. Crop maturity was not effected by varying fertilizer rate

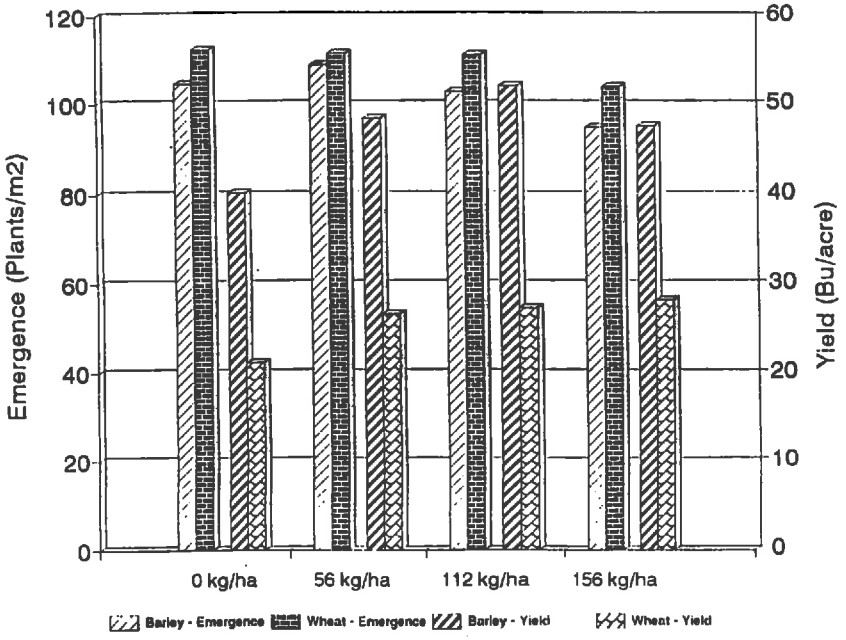
Seeding Opener



Fertilizer Type



Fertilizer Rate



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Opener Sites, Conditions and Results

Results were reviewed separately for each opener site. **Table 5** outlines the factors which caused statistically significant differences in the emergence and yield measurements. In general, the opener factor tended to influence the emergence and yield results. Rate of fertilizer influenced yield, as expected. Type of fertilizer used was only significant at a one sites for barley yield.

Table 5.

Factor (level)	Crop	Site
Emergence		
0.01 level		
Opener	Barley	Camrose, Grande Prairie
Opener	Canola	Camrose
Rate	Canola	Barons
Yield		
0.01 level		
Opener	Barley	Barons
Rate	Barley	Barons
Rate	Canola	Barons, Camrose
Type	Barley	Barons
0.05 level		
Opener	Barley	Camrose
Rate	Barley	Grande Prairie

Barons

The Barons site was a clay loam soil with no previous tillage of wheat stubble. On April 24, 27 and 28, 199. canola and Manley barley were seeded at 9 kg/ha (8 lb/ac) and 112 kg/ha (100 lb/ac). The canola was seede kg/ha (6.4 lb/ac) of carbofuran. The barley was treated with a fungicide. Soil water was to the surface. See the canola was 13 mm (0.5 in). Seeding depth for the barley was 24 mm (1 in). Phosphate was placed with canola at 67 kg/ha (60 lb/ac) in the form of 11-51-0-0 fertilizer. Average soil water at seeding from the surf (6 in) was 27.1 percent (vol/vol). Average soil temperate at 50 mm (2 in) was 6.2°C (43.2°F). Canola was h September 13, 1995, 137 days after seeding. Barley was harvested on September 12, 1995, 137 days after s to maturity was not recorded since the crop had dried down prior to harvest.

Seeding Opener

The following openers were used at the Barons site:

- Bourgault Double Shoot Opener
- Bourgault Mid Row Banding System
- Flexi-Coil LS Pair Row Double Shoot Knife Opener
- Flexi-Coil Side Band Double Shoot Knife Opener
- Gen 200 T2 Seeding System
- Gen 200 T2x2 Seeding System
- Key Ag Ventures Four Inch Chrome With Backswept Knife
- Key Ag Ventures Seven Inch Chrome With Backswept Knife
- Melranda Zero Till System
- Morris Pair Row Double Shoot Opener
- Poirier Double Shoot Opener
- Sweep and Tube
- Sweep With Key Ag Ventures Backswept Knife

Emergence: Barley and canola emergence were not statistically effected by the seeding opener used.

Yield: The barley yield results indicated that the Gen 200 T2x2 had significantly higher yield results (0.01 Sweep and Tube, Melranda, Flexi-Coil side band and Poirier openers. No other barley yield differences an openers were significant.

Canola yield was not statistically effected by the opener used.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley and canola emergence were not statistically effected by the fertilizer type used. Howe ammonia caused lower emergence than the urea for canola. Barley emergence did not change with fertilize

Yield: The yield of canola was not statistically effected by the type of fertilizer used. The yield of barley v higher (0.01 level) with urea than with anhydrous ammonia fertilizer. The canola yield was slightly lower ammonia fertilizer.

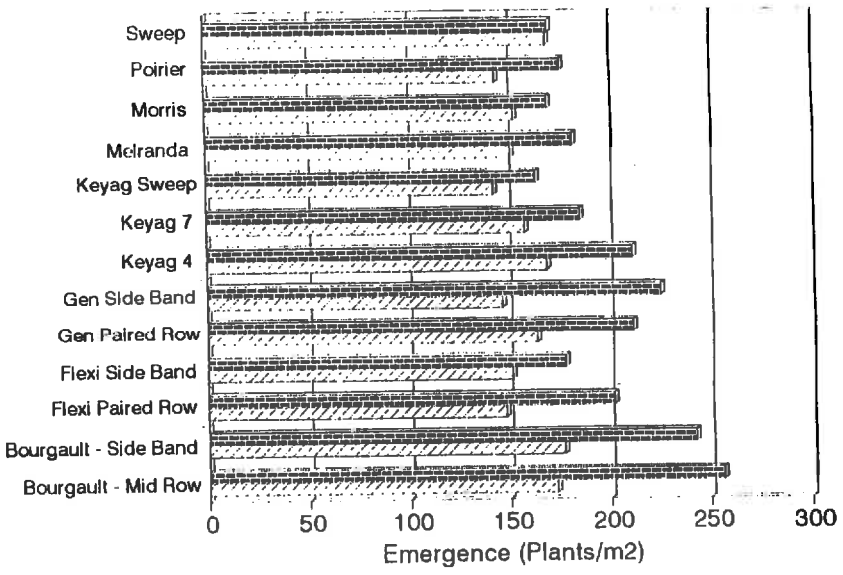
Fertilizer Rate

Nitrogen fertilizer rates of 0, 56 and 168 kg/ha (0, 50 and 150 lb/ac) were compared.

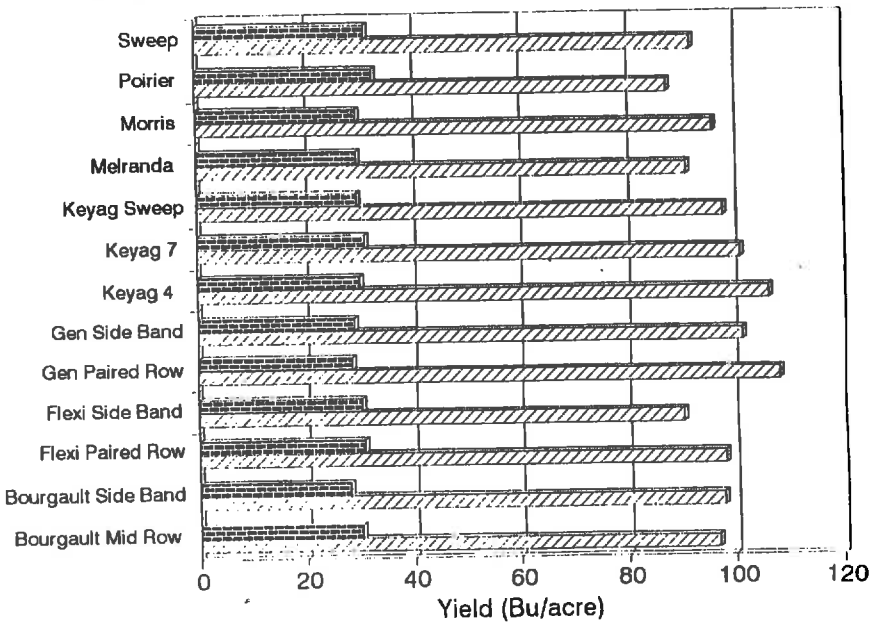
Emergence: The emergence of canola for the 56 and 168 kg/ha (50 and 150 lb/ac) fertilizer rates were sig (0.01 level) than the control or 0 kg/ha fertilizer rate. This indicates that the anhydrous ammonia is contac canola seeds and causing damage. The emergence of barley was not effected by the fertilizer rate.

Yield: Higher fertilizer rates significantly increased yields of both canola and barley. The yields resulted rates were significantly different (0.01 level) for both canola and barley.

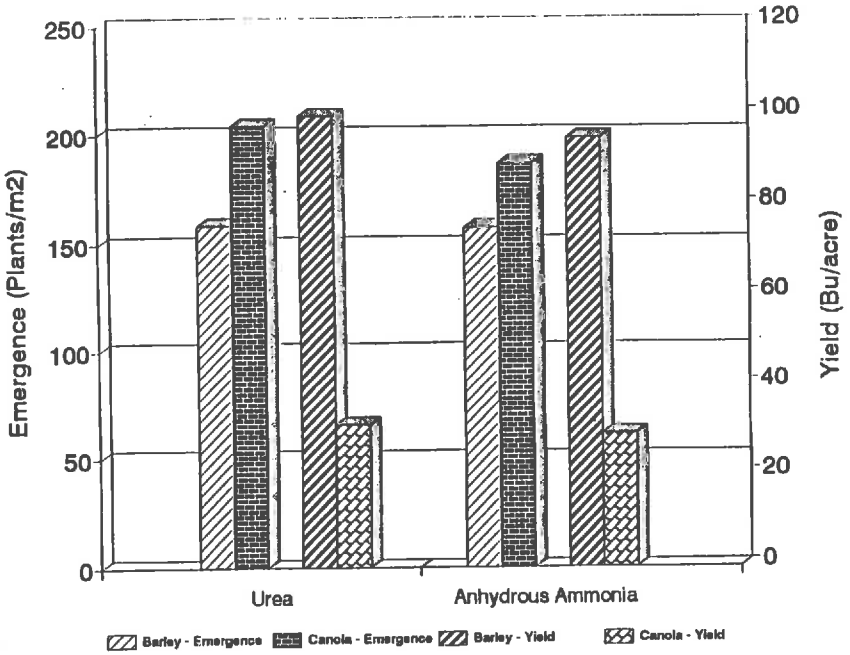
Seeding Opener Emergence



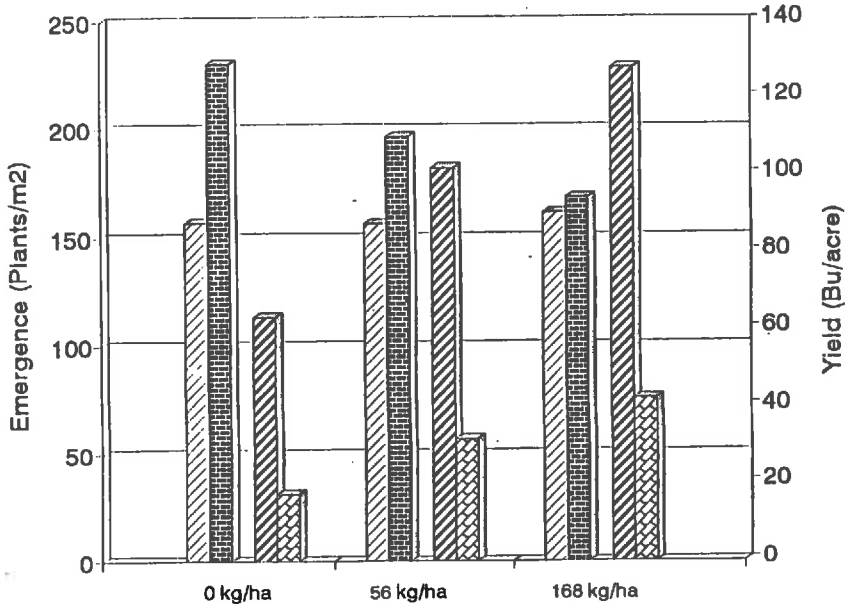
Seeding Opener Yield



Fertilizer Type



Fertilizer Rate



Camrose

The Camrose site was a clay loam soil with no previous tillage of wheat stubble. The field was sprayed w or Roundup prior to seeding. On May 9 and 10, 1995, Horizon canola and Manley barley were seeded at lb/ac) and 112 kg/ha (100 lb/ac). The canola was seeded with 7.2 kg/ha (6.4 lb/ac) of carbofuran. The ba treated with a fungicide. Soil water was to the surface. Seeding depth for the canola was 13 mm (0.5 in). depth for the barley was 25 mm (1 in). Phosphate was placed with the barley and canola at 67 kg/ha (60 l form of 11-51-0-0 fertilizer. Average soil water at seeding from the surface to 153 mm (6 in) was 34.6 pe (vol/vol). Average soil temperature at 50 mm (2 in) was 10.3°C (50.5°F). Canola was harvested Septemb 1995, 126 days after seeding. Barley was harvested on September 15, 1995, 128 days after seeding. Day maturity was not recorded since the crop had dried down prior to harvest.

Seeding Opener

The following openers were used at the Camrose site:

- Barton No-Till Double Shoot Opener
- Bourgault Double Shoot Opener
- Bourgault Mid Row Banding System
- Flexi-Coil LS Pair Row Double Shoot Knife Opener
- Flexi-Coil Side Band Double Shoot Knife Opener
- Gen 200 T2 Seeding System
- Gen 200 T2x2 Seeding System
- Key Ag Ventures Four Inch Chrome With Backswept Knife
- Key Ag Ventures Seven Inch Chrome With Backswept Knife
- Melranda Zero Till System
- Morris Pair Row Double Shoot Opener
- Poirier Double Shoot Opener
- Sweep and Tube
- Sweep With Key Ag Ventures Backswept Knife

Emergence: The barley and canola emergence was statistically effected (0.01 level) by the seeding opener used. The following table outlines the significant differences among the various openers. Openers with the same letter do not have significantly different average emergence. The emergence of the Morris opener in canola was not measured because a higher seeding rate was used.

Canola Emergence		
Bourgault Mid-Row	a	←highest emergence
Barton	ab	
Key Ag 7 inch	abc	
Key Ag 4 inch	bcd	
Bourgault Double Shoot	bcde	
Flexi-Coil Side Band	bcde	
Seep and Tube	bcde	
Key Ag Sweep	bcde	
Gen 200 T2	cde	
Gen 200 T2x2	cde	
Melranda	de	
Flexi-Coil Pair Row	e	
Poirier	e	←lowest emergence

Barley Emergence		
Flexi-Coil Side Band	a	←highest emergence
Flexi-Coil Pair Row	ab	
Key Ag 7 inch	ab	
Gen 200 T2	ab	
Melranda	abc	
Bourgault Double Shoot	abc	
Key Ag 4 inch	abc	
Gen 200 T2x2	abc	
Bourgault Mid Row	abc	
Key Ag Sweep	abc	
Poirier	abc	
Sweep and Tube	abc	
Morris	bc	
Barton	c	←lowest emergence

No trends are evident from the emergence data as to which openers result in better emergence. For instance, the Barton opener ranged high in canola emergence and low in barley emergence.

Yield: Canola yield was not statistically effected by the seeding opener used. Barley yields were significan different among openers at the 0.05 level. The following table outlines the significant differences among th openers. Openers with the same letter do not have significantly different average yield.

Barley Yield		
Bourgault Double Shoot	a	←highest
Bourgault Mid Row	yield	
Morris	ab	
Melranda	bc	
Barton	abc	
Key Ag 7 inch	abcd	
Key Ag 4 inch	abcde	
Key Ag Sweep	abcde	
Gen 200 T2x2	abcde	
Gen 200 T2	abcde	
Flexi-Coil Pair Row	bcde	
Poirier	bcde	
Flexi-Coil Side Band	cde	
Sweep and Tube	de	
	e	←lowest yield

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley and canola emergence were not statistically effected by the fertilizer type used.

Yield: The yield of barley and canola were not statistically effected by the type of fertilizer used.

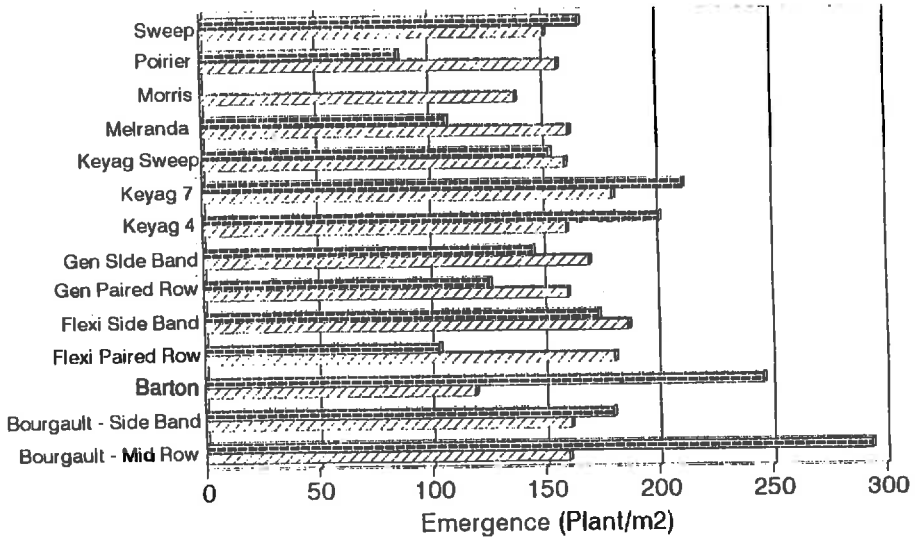
Fertilizer Rate

Nitrogen fertilizer rates of 0, 56 and 168 kg/ha (0, 50 and 150 lb/ac) were compared.

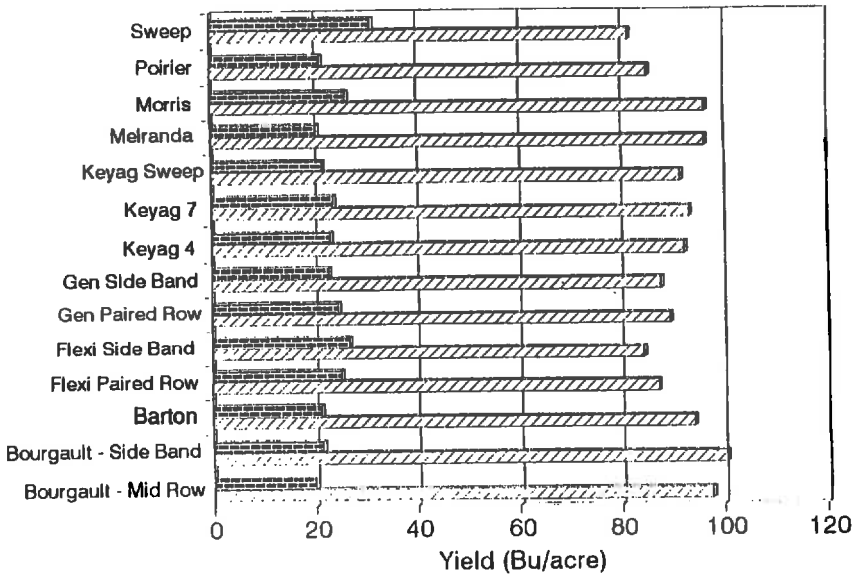
Emergence: The emergence of barley and canola was not statistically effected by the rate of nitrogen fert However, the emergence slightly decreased for every increase in fertilizer rate with barley and canola.

Yield: Higher nitrogen fertilizer rates increased yields of both barley and canola. However, only the yiel canola were significantly different (0.01 level). The yields resulting from the 0 and 56 kg/ha (50 lb/ac) fe rates were significantly lower than the 168 kg/ha (150 lb/ac) fertilizer rate.

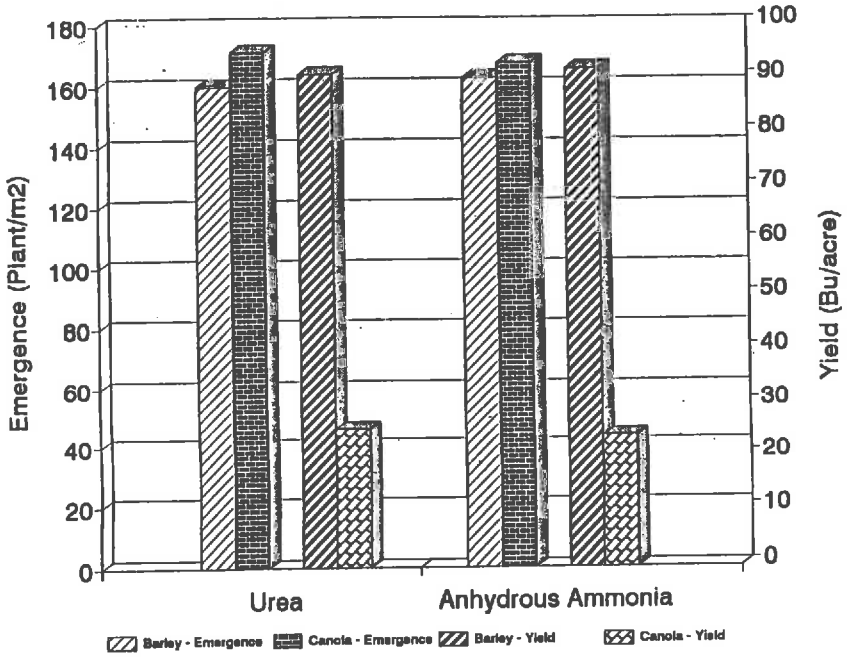
Seeding Opener Emergence



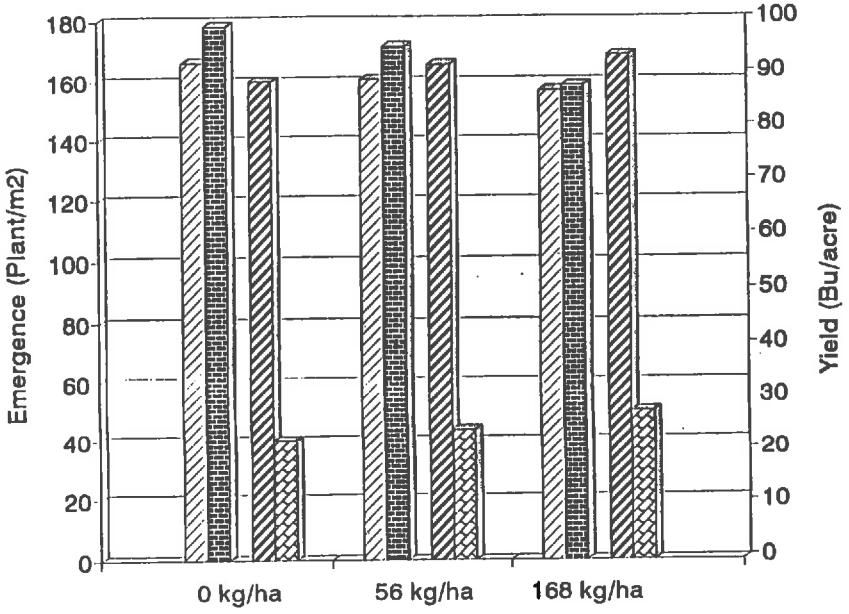
Seeding Opener Yield



Fertilizer Type



Fertilizer Rate



Grande Prairie

The Grande Prairie site was a clay loam soil with no previous tillage of wheat stubble. On May 17, 1995, Manley barley w 112 kg/ha (100 lb/ac). The barley was treated with a fungicide prior to seeding. Soil water was to the surface. Seeding de canola was 13 mm (0.5 in). Seeding depth for the barley was 25 mm (1 in). Phosphate was placed with the barley at 67 kg in the form of 11-51-0-0 fertilizer. Barley was harvested on September 16, 1996, 121 days after seeding. The canola was the soil water and temperature were not measured due to a sudden change in weather conditions. The field was sprayed wi Roundup on May 20, 1995. Days to maturity were not recorded since the crop had dried down prior to harvest.

Seeding Opener

The following openers were used at the Grande Prairie site:

- Bourgault Double Shoot Opener
- Bourgault Mid Row Banding System
- Flexi-Coil LS Pair Row Double Shoot Knife Opener
- Flexi-Coil Side Band Double Shoot Knife Opener
- Gen 200 T2 Seeding System
- Gen 200 T2x2 Seeding System
- Key Ag Ventures Four Inch Chrome With Backswept Knife
- Key Ag Ventures Seven Inch Chrome With Backswept Knife
- Melranda Zero Till System
- Morris Pair Row Double Shoot Opener
- Poirier Double Shoot Opener
- Sweep and Tube
- Sweep With Key Ag Ventures Backswept Knife

Emergence: The barley emergence was statistically effected (0.01 level) by the seeding opener used. The following table significant differences among the various openers. Openers with the same letter do not have significantly different averag

Barley Emergence		
Morris	a	←highest emergence
Bourgault Double Shoot	ab	
Melranda	abc	
Sweep and Tube	abc	
Key Ag Sweep	abcd	
Flexi-Coil Pair Row	abcd	
Flexi-Coil Side Band	abcd	
Poirier	bcde	
Bourgault Mid Row	cdef	
Key Ag 7 inch	def	
Gen 200 T2x2	ef	
Key Ag 4 inch	ef	
Gen 200 T2	f	←lowest emergence

Yield: Barley yield was not statistically effected by the seeding opener used.

Fertilizer Type

Urea (46-0-0) and Anhydrous Ammonia (82-0-0) were the nitrogen sources compared in the experiment.

Emergence: Barley emergence was not statistically effected by the fertilizer type used.

Yield: Barley yield was not statistically effected by the fertilizer type used.

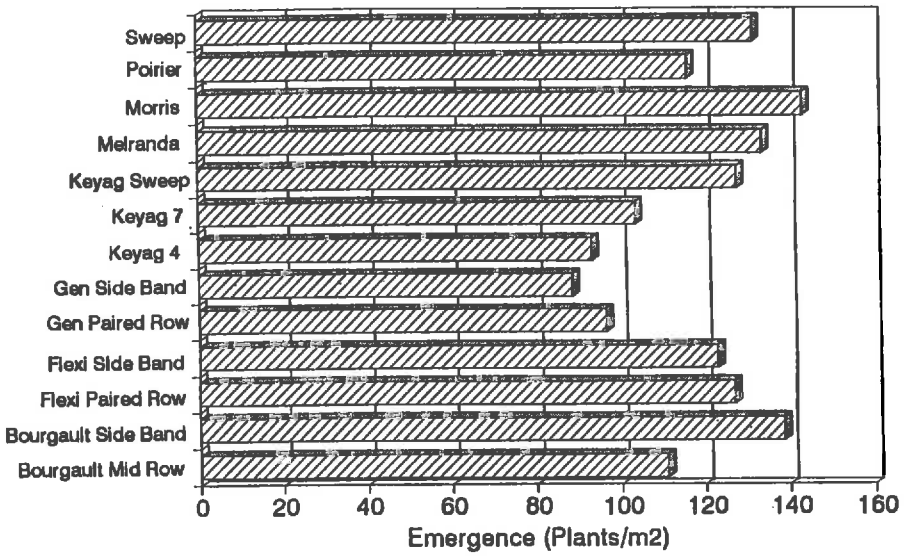
Fertilizer Rate

Nitrogen fertilizer rates of 0, 56 and 168 kg/ha (0, 50 and 150 lb/ac) were compared.

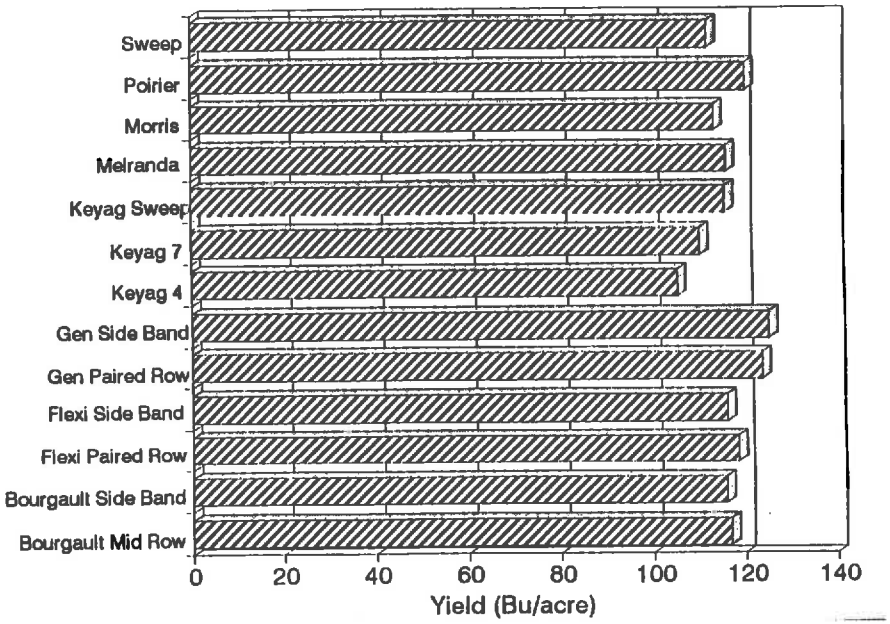
Emergence: Barley emergence was not statistically effected by the rate of fertilizer

Yield: Barley yield was statistically effected by the rate of fertilizer at the 0.05 level. The yield at the 56 and 168 kg/ha (lb/ac) rates were significantly higher than the yield at the 0 kg/ha or control rate.

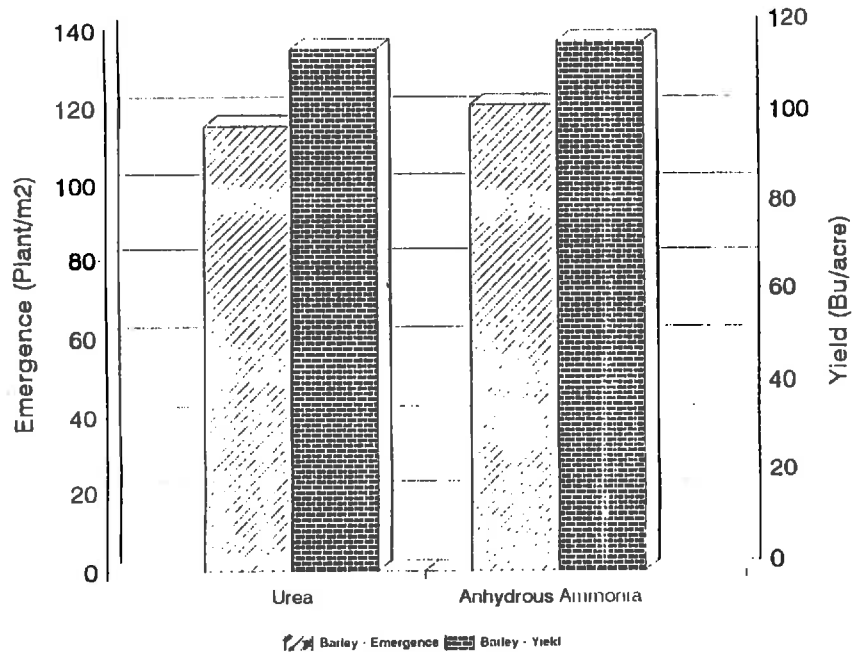
Seeding Opener Emergence



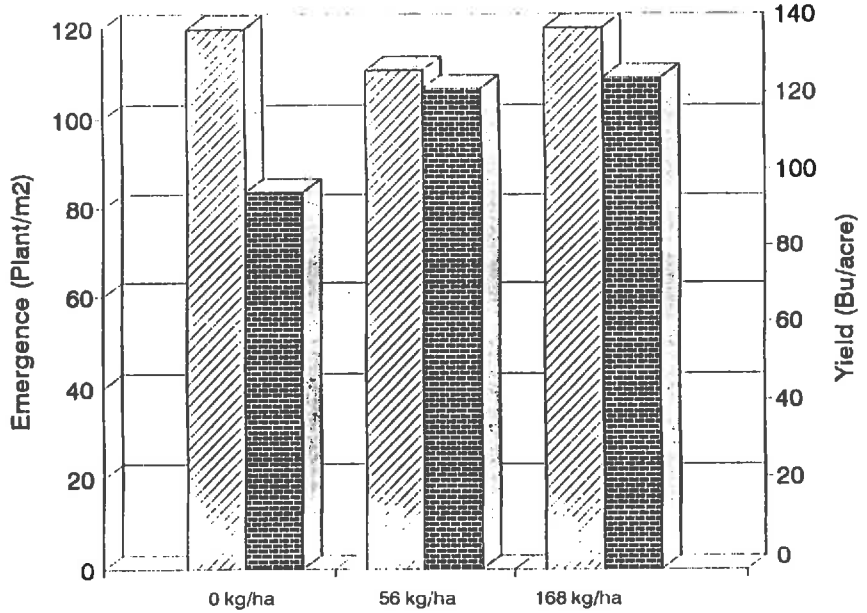
Seeding Opener Yield



Fertilizer Type



Fertilizer Rate



Anhydrous Ammonia Loss Tests

Preliminary testing of anhydrous ammonia loss at the opener was completed in a well worked moist soil ne: Vegreville, Alberta. A sampling hood was constructed which enclosed the airspace on either side of the op to a point 1.85 metres (6 ft) behind the opener. Air was allowed to enter the sampling hood through a 30.5 cm (12 x 6 in) opening in front of the opener. The air passed through the sample box and into a 7.6 cm (3 : sample tube equipped with a fan. The purpose of the fan was to maintain air flow through the box and com for pressure reduction losses. A roller at the end of the sample box sealed the rear of the box to the ground insured all the air moved through the sample tube. A vacuum pump sampled the air flow at the end of the s tube. The air flow over the opener and 1.85 m behind the opener was sampled for ammonia concentrations bubbling the air through impingers filled with hydrochloric acid. The impingers were then sampled using a chromatagraph for ammonium chloride concentrations and ammonia loss was determined. Based on the re insignificant amount (<0.01 percent) of ammonia was lost for the openers tested at the point of injection. I anhydrous ammonia loss testing should be completed to determine the amount of ammonia lost over time f variety of openers.

Conclusions

In most conditions tested, barley, wheat and canola emergence, as a measure of seedling injury, when usin anhydrous ammonia was not significantly different than emergence when using granular urea. In addition. varying placement of seed and fertilizer resulting from the different openers tests, did not effect emergenc yield in most cases.

All the double shoot openers tested, safely applied up to 168 kg/ha (150 lb/ac) of actual nitrogen in the for anhydrous ammonia or granular urea fertilizer for wheat, barley and canola. In general, as fertilizer rate in emergence decreased and final yield increased. One site out of 12 showed significantly lower barley emer the 168 kg/ha (150 lb/ac) rate. In addition, days to crop maturity increased with increased levels of nitrog in the crop.

Barley, canola and wheat damage caused by anhydrous ammonia and granular urea fertilizer with differen fertilizer relative placements were not significantly different under direct seeding conditions. For the oper the type of opener significantly effected the emergence of canola and barley at three of the five crop/sites. significant differences between the openers did not show any trends between different types of openers. T opener significantly effected the yield of canola and barley at two of the five crop/sites. The significant di: between the openers did not show any trends between different types of openers.

Based on the results, an insignificant amount (<0.01 percent) of ammonia was lost for the openers tested a of injection. Further anhydrous ammonia loss testing should be completed to determine the amount of am over time for a variety of openers.

Appendices

Appendix 1

Seed and Anhydrous Ammonia/Urea Placement Using Double Shoot Openers

Report

Project RL0295
November, 1995

Seed and Anhydrous Ammonia/Urea Placement Using Double Shoot Openers

Prepared by:

Alberta Farm Machinery Research Centre

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Project Manager

Alberta Farm Machinery Research Centre

Project Cooperators

Alberta Barley Commission
Alberta Canola Producers Commission
County of Forty Mile
County of Lethbridge
Flexi-Coil
Saskatchewan Canola Development Commission
Soil and Crop Management Branch, AAFRD
Sherrit Fertilizers Inc.
Western Cooperative Fertilizer Limited

Project Support and Funding

BASF
Bourgault Industries
CASEA (Canada-Alberta Environmentally Sustainable Agriculture Agreement)
County of Camrose
County of Grande Prairie
Dupont Canada
Gen Manufacturing Ltd.
Key Ag Ventures
Melranda
Monsanto Canada Inc.
Morris Industries Ltd.

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INTRODUCTION

The seed placement data for this report was obtained during the spring of 1995, as part of the study "Effectiveness of Double Shoot Openers for Applying Anhydrous Ammonia and Urea While Seeding." Twelve sites across Alberta were seeded and data was collected at each site. Only three sites, Vermilion, Calmar and Neerlandia were tilled before seeding. Please see APPENDIX, TABLES 1 and 2, for site information and openers used at individual sites.

PURPOSE

The purpose of this study is to provide manufacturers and farmers with more information on the placement of seed and fertilizer with double shoot openers, when placing urea or anhydrous ammonia.

PROCEDURE

Two seeding runs were made with each opener and seed type. One run was made with urea as the fertilizer, and the other with anhydrous ammonia. Each run consisted of sets of plots with varying fertilizer rates. The fertilizer rates were either 0, 50, 100 or 150 lb/ac, (0, 56, 112 or 168 kg/ha) of actual nitrogen. Two seed placement measurements were made on each run. Both measurements were taken in different locations of the same plot. Seed placements were taken on one of the 150 lb/ac (168 kg/ha) plots because the higher application rate made locating the fertilizer easier.

The seed and urea were located by carefully removing the soil covering the seed and fertilizer bands. The anhydrous ammonia band was located by making a cut across the plot with a shovel, applying Phenolphthalein powder to the face of the cut and then wetting the powder. Phenolphthalein is a dye indicator which is normally white in colour but turns pink in the presence of anhydrous ammonia or pH above 8.5.

All depth measurements were taken using the bottom of the furrow made by the packer as a reference. Relative position of the seed and fertilizer bands was measured from centre to centre of the bands (FIGURE 1). Mixing was considered to have occurred if seeds and fertilizer bands were found in the same band, or if the seed and fertilizer bands were in contact. Measurements were considered significantly different if the measurement was greater than 0.125 in (3.175 mm).

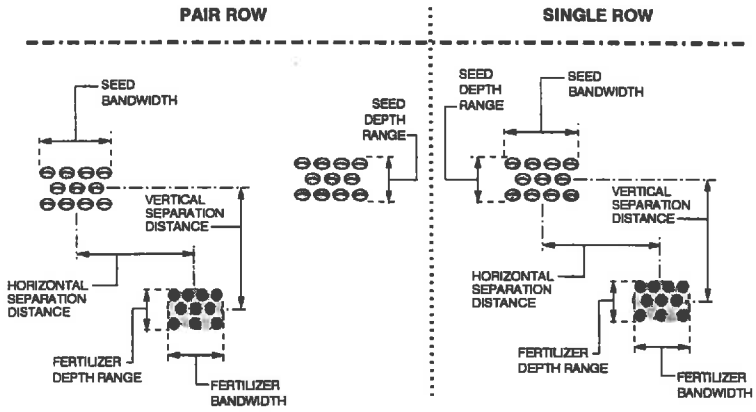
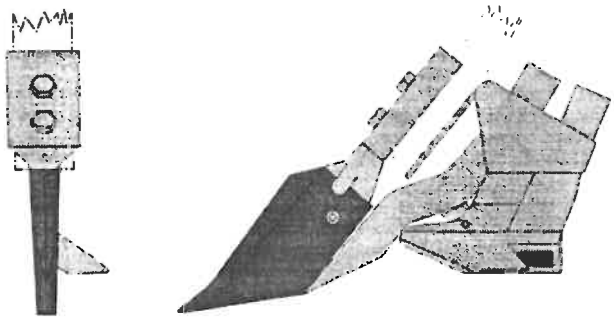


Figure 1. Explanation of figures in the following reports.
(Cloud: Anhydrous Ammonia, Solid Dots: Urea)

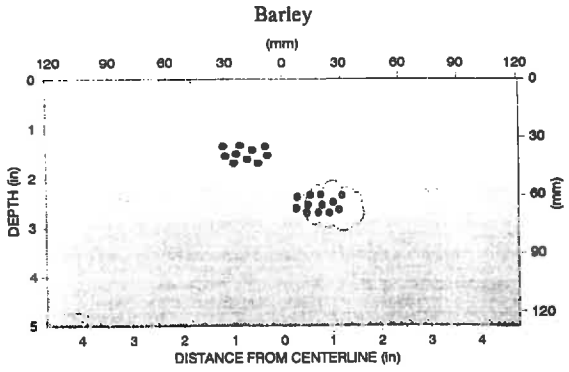
RESULTS

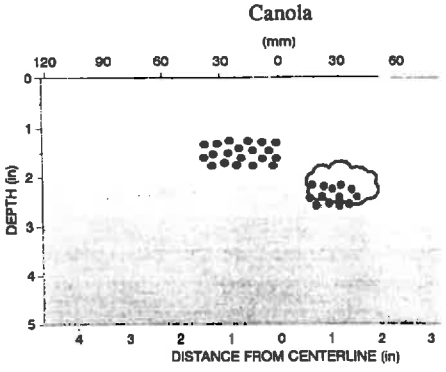
Bourgault Double Shoot Opener



The Bourgault places single seed and fertili
The fertilizer was placed behind the front p
the opener. Seed is placed off to the side
the fertilizer.

Canola was placed in bands 0.56 in (14.3
and 0.16 in (4 mm) thicker than the barley
anhydrous ammonia fertilizer band was 0.2
(7.1 mm) wider and 0.44 in (11.1 mm) th
the urea band. Canola was placed with 0.
(7.4 mm) more horizontal separation and C
(7.4 mm) less vertical separation from the
than the barley. There was 0.25 in (6.4 mm) more horizontal separation with anhydrous ammonia tha
There was no difference in vertical seed and fertilizer separation between the fertilizer types. Canola a
anhydrous ammonia mixing occurred twice at Barons.

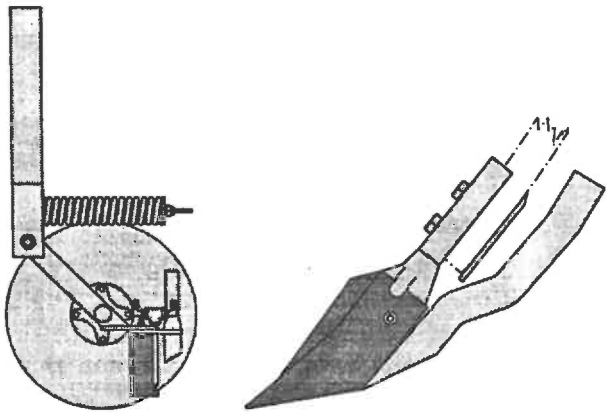




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.44	11.2	0.59	15.0
AA* band thickness	1.00	25.4	0.88	22.4
Urea band thickness	0.48	12.2	0.52	13.2
Seed band width	1.01	25.7	1.57	39.9
AA* band width	1.19	30.2	1.42	36.1
Urea band width	1.02	25.9	1.02	25.9
Horizontal separation	1.64	41.7	1.02	25.9
Vertical separation	1.93	49.0	0.73	18.5

*AA: Anhydrous Ammonia

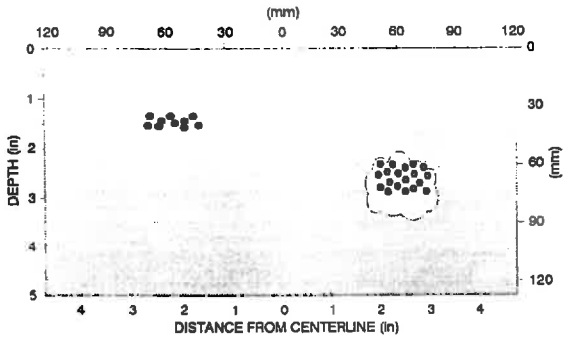
Bourgault Mid-Row Banding System



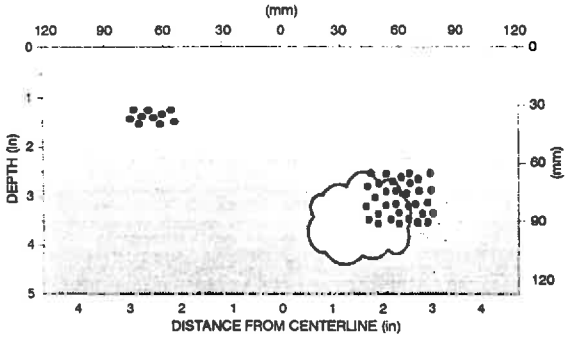
The seed was placed by a single shoot opener. Fertilizer was placed by a coulter. The coulter placed the fertilizer in between the seed rows with tubes placed along the side of the coulter.

Canola was placed in 0.22 in (5.6 mm) wider bands than the barley. There was no significant difference in seed band thickness between the two seed types. The coulter placed the anhydrous ammonia in bands 0.48 in (12.2 mm) wider and 0.72 in (18.3 mm) thicker than the urea bands. The barley had 0.68 in (17.3 mm) more horizontal separation but 0.55 in (13.9 mm) less vertical separation from the fertilizer than the canola. There was 0.98 in (24.8 mm) more horizontal separation and 0.36 in (9.0 mm) less vertical separation between the seed and urea than with anhydrous ammonia. There was no mixing of seed and fertilizer.

Barley



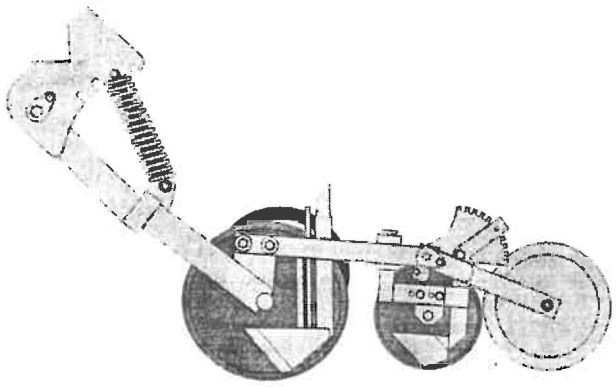
Canola



SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.32	8.1	0.38	9.7
AA* band thickness	1.38	35.1	1.86	47.2
Urea band thickness	0.67	17.0	1.13	28.7
Seed band width	1.14	29.0	1.00	25.4
AA* band width	1.45	36.8	2.03	51.6
Urea band width	1.09	27.7	1.43	36.3
Horizontal separation	4.63	117.6	4.52	114.8
Vertical separation	1.23	31.2	1.78	45.2

*AA: Anhydrous Ammonia

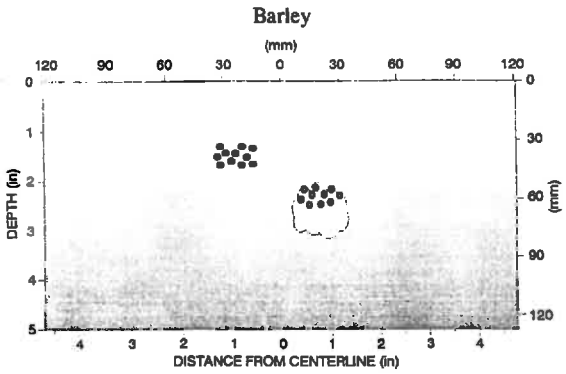
Barton No-Till Double Shoot Opener

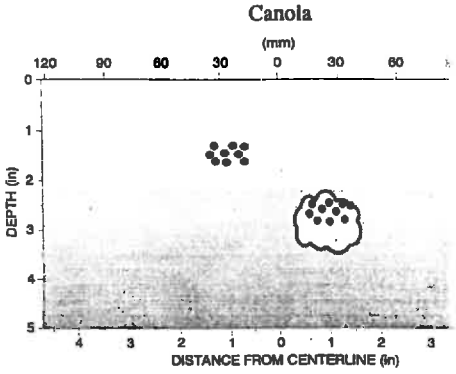


The prototype disk is a double shoot versio
Barton disk design. The fertilizer band is pl
the front disk. A single seed row is placed
back disk. The disks cut the soil at opposite

The prototype disk had very little variation
and fertilizer bands between the seed types.

Anhydrous ammonia fertilizer bands were
inches, (8.5 mm) wider and 0.72 inches, (1
thicker than the urea bands. There was 0.2
(6.4 mm) more vertical separation and 0.1
(3.9 mm) less horizontal separation measur
between the seed and anhydrous ammonia
one case, at Camrose, the anhydrous ammonia was mixed with the barley seeds.

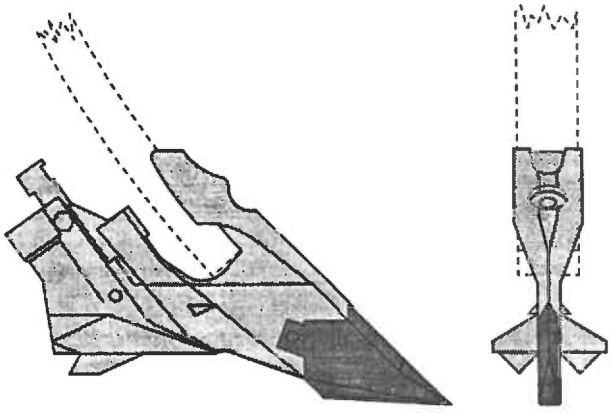




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.46	11.7	0.42	10.7
AA* band thickness	1.13	28.7	1.23	31.2
Urea band thickness	0.43	10.9	0.48	12.2
Seed band width	0.86	21.8	0.83	21.1
AA* band width	1.12	28.4	1.29	32.8
Urea band width	0.86	21.8	0.89	22.6
Horizontal separation	1.71	43.4	2.14	54.4
Vertical separation	0.95	24.1	1.27	32.3

*AA: Anhydrous Ammonia

Flexi-Coil HS Pair Row Double Shoot Knife Opener

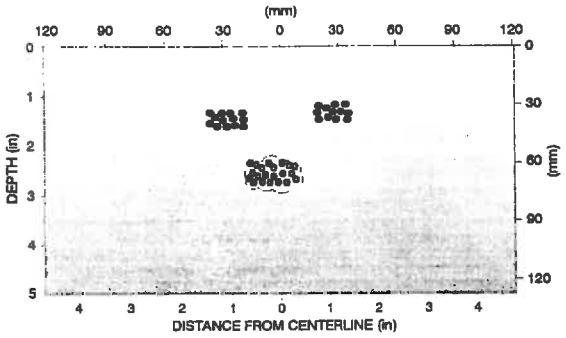


The Flexi-Coil paired row opener is designed to place the seed into two bands with a fertilizer band in between and below the seed bands. The fertilizer was applied behind the front point of the opener. The seeds are placed by a splitter located at the back of the opener.

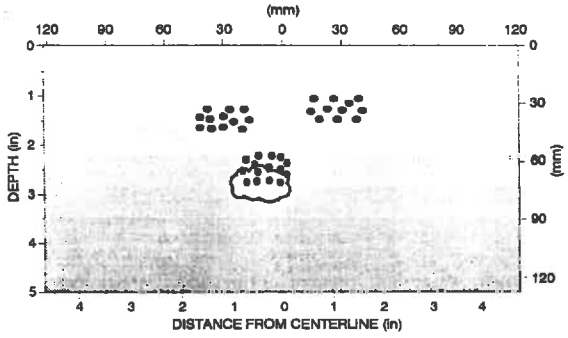
The seeds were not always placed in a paired row. Single seed bands occurred at Coaldale, Vermilion, Calmar and Neerlandia when seeding barley. When seeding canola, single bands were found at Lethbridge, Irricana, Olds, Barons, Camrose and Calmar. On average, the canola seed bands were 0.31 in (7.9 mm) wider than the barley seed bands. There was no difference in seed band thickness between the two seed types.

The anhydrous ammonia fertilizer bands were 0.19 in (4.9 mm) wider and 0.28 in (7.1 mm) thicker than the urea fertilizer bands. Barley had 0.28 in (7.1 mm) more horizontal separation from the fertilizer than the barley had. There was no significant difference in vertical separation between the seed types and the fertilizer. Anhydrous ammonia had 0.17 in (4.3 mm) more vertical separation between the seed and fertilizer than urea. The horizontal separation between the two fertilizer types and the seeds was not significantly different. There were two cases where seed and fertilizer were able to mix. Mixing occurred at Strathmore and at Camrose when placing canola and anhydrous ammonia.

Barley



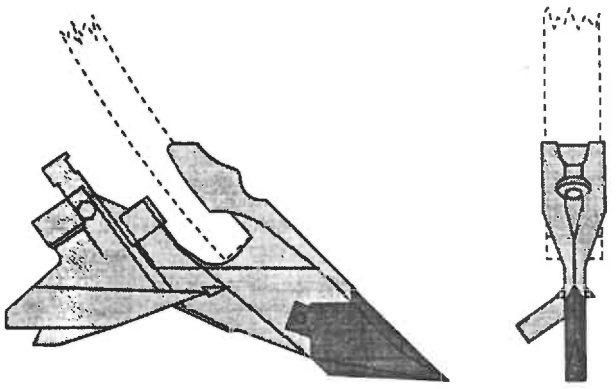
Canola



SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.39	9.9	0.48	12.2
AA* band thickness	0.74	18.8	0.64	16.3
Urea band thickness	0.51	13.0	0.97	24.6
Seed band width	0.80	20.3	1.12	28.4
AA* band width	1.18	30.0	1.22	31.0
Urea band width	1.03	26.2	0.97	24.6
Seed band separation	2.15	54.6	2.21	56.1
Horizontal separation	0.94	23.9	0.73	18.5
Vertical separation	1.10	27.9	1.17	29.7

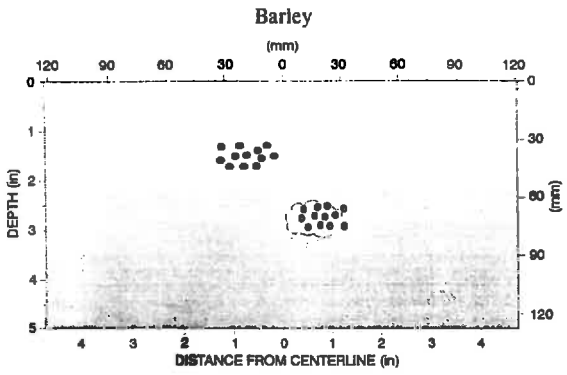
*AA: Anhydrous Ammonia

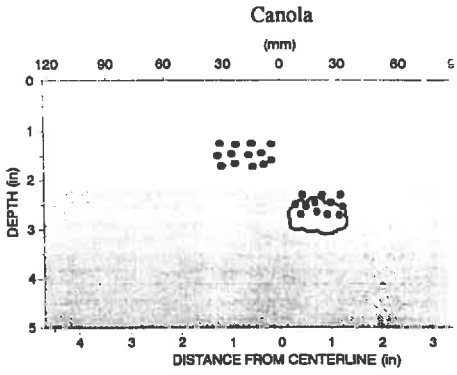
Flexi-Coil Side Band Double Shoot Knife Opener



The Flexi-Coil side band opener places the
the side of the opener, while the fertilizer is
beside and below the seed. The fertilizer tu
located behind the front point of the opener
seed tube is behind the fertilizer tube.

The Flexi-Coil side band opener had very l
variation in band widths and thicknesses be
seed types. The barley, wheat and canola l
widths had no significant difference in varia
anhydrous ammonia bands were 0.18 in (4.
wider and 0.25 in (6.5 mm) thicker than th
bands. There was no significant difference
horizontal separation between seed and fert
the seed types. There was 0.14 in (3.5 mm) more vertical separation between the seed and fertilizer b
wheat and barley than for canola. There was no significant difference between the horizontal seed and
separation for the fertilizer types. There was 0.15 in (3.8 mm) more vertical separation with anhydrou
ammonia than with the urea fertilizer. At Barons, there was one case of canola and anhydrous ammon
mixed.

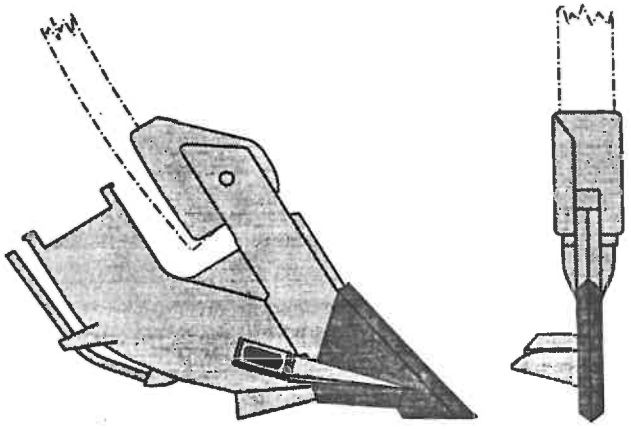




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.51	13.0	0.56	14.2
AA* band thickness	0.84	21.3	0.72	18.3
Urea band thickness	0.54	13.7	0.51	13.0
Seed band width	1.22	31.0	1.21	30.7
AA* band width	1.23	31.2	1.12	28.4
Urea band width	0.97	24.6	1.03	26.2
Horizontal separation	1.43	36.3	1.26	32.0
Vertical separation	1.48	37.6	1.12	28.4

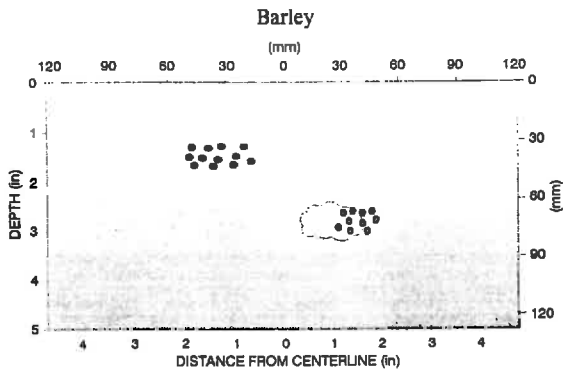
*AA: Anhydrous Ammonia

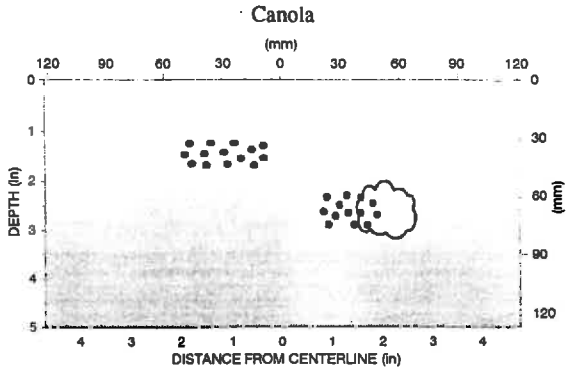
Gen 200 T2 Seeding System



The Gen 200 T2 places the seed in a single band to the side and above the fertilizer. The seed tube runs behind the point of the opener. The seed is directed to the side and behind a wing on the side of the opener. Granular fertilizer is placed behind the front point. Anhydrous ammonia is placed by a tube located behind the granular fertilizer opening.

The canola seed bands were 0.34 in (8.6 mm) wider than the barley seed bands. There was no significant differences in seed band thickness between the two seed types. The opener placed anhydrous ammonia in a band 0.21 in (5.4 mm) wider and 0.37 in (9.3 mm) thicker than the urea. There was very little difference in seed and fertilizer separation between the seed and fertilizer types. There was no mixing of seed and fertilizer observed.

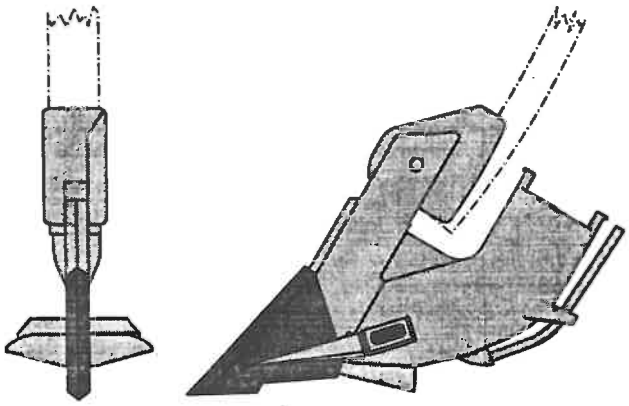




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.49	12.4	0.53	13.5
AA* band thickness	0.79	20.1	1.16	29.5
Urea band thickness	0.50	12.7	0.72	18.3
Seed band width	1.37	34.8	1.70	43.2
AA* band width	1.27	32.3	1.16	29.5
Urea band width	0.88	22.4	1.13	28.7
Horizontal separation	2.51	63.8	2.84	72.1
Vertical separation	1.33	33.8	1.13	28.7

*AA: Anhydrous Ammonia

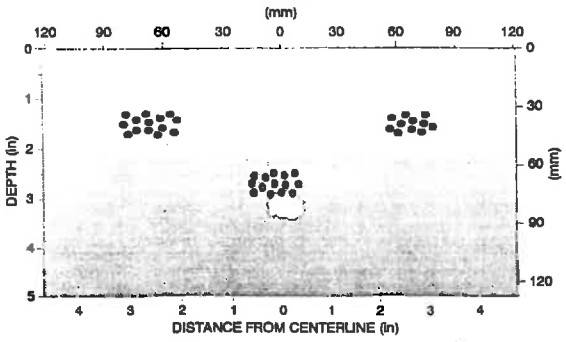
Gen 200 T2X2 Seeding System



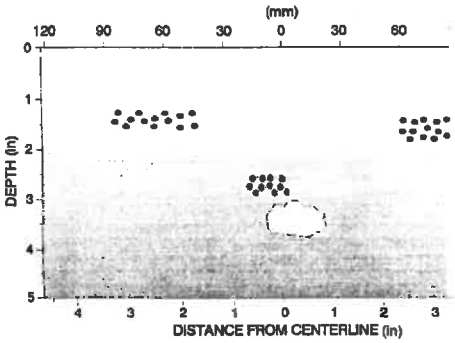
The Gen 200 T2X2 is similar to the Gen 20 except the seed is placed in paired rows. T placed behind wings on both sides of the op fertilizer is placed in between and below the

The canola band was 0.27 in (6.9 mm) wid the barley seed band. There was no signifi difference in seed band thickness between t seed types. Anhydrous ammonia was place bands 0.18 in (4.5 mm) thicker than the ur difference in fertilizer band widths was insi Anhydrous ammonia had 0.39 in (9.8 mm) horizontal and 0.55 in (13.9 mm) more sep average than did the urea. There were no mixing between the seed and fertilizer.

Barley



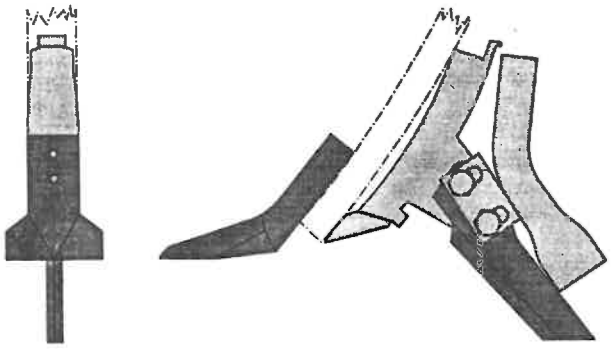
Canola



SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.50	12.7	0.42	10.7
AA* band thickness	0.58	14.7	0.72	18.3
Urea band thickness	0.54	13.7	0.41	10.4
Seed band width	1.08	27.4	1.35	34.3
AA* band width	0.75	19.1	1.16	29.5
Urea band width	1.04	26.4	0.84	21.3
Horizontal seed band separation	5.24	133.1	5.34	135.6
Horizontal separation	2.58	65.5	2.50	63.5
Vertical separation	1.41	35.8	1.39	35.3

*AA: Anhydrous Ammonia

Key Ag Ventures Four Inch Chrome With Backswept Knife

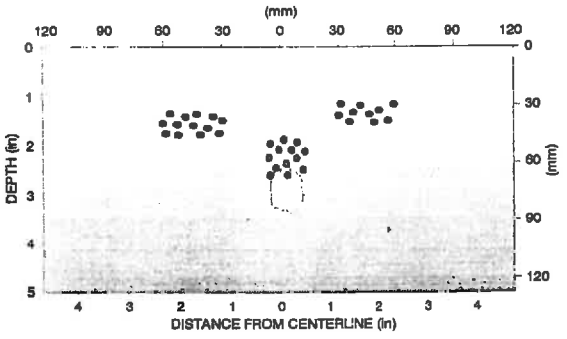


The Key Ag Ventures Four Inch Chrome with Backswept Knife opener used a four inch wide chrome tip with a seed splitter to place the seed, and a backswept knife to place the fertilizer. The opener placed the seed the fertilizer in between and below the seed.

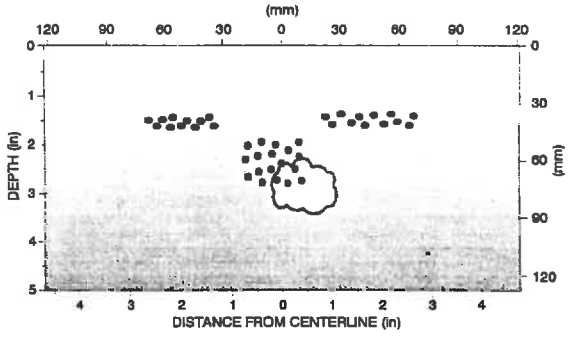
Seed was placed across the width of the opener as either one or two bands. At the Barons site, both seed types were placed into single bands. At Camrose and Grande Prairie both single and paired rows were observed. When placed in a single band the canola was in 0.32 in (8.2 mm) wider bands than the barley. There was no significant difference found in the band thicknesses between the seed types. When in a paired row, the canola was 0.38 in (9.7 mm) wider and 0.18 in (4.5 mm) thinner than the barley. When placed in a single band, the barley had 0.5 in (12.7 mm) more horizontal separation and 0.77 in (19.5 mm) less vertical separation from the fertilizer than the canola. When placed in a paired row the canola had 0.69 in (17.5 mm) more horizontal and 0.38 in (9.5 mm) less vertical separation from the fertilizer than the barley.

When the seeds were placed in a single band the anhydrous ammonia bands were 0.34 in (8.7 mm) wider and 0.47 in (11.9 mm) thicker than the urea bands. When urea was applied, there was 0.50 in (12.7 mm) more horizontal and 0.53 in (13.5 mm) more vertical separation between seed and fertilizer with anhydrous ammonia. When the seed was in paired rows, there was no significant difference in fertilizer band width. The anhydrous ammonia bands had 0.16 in (4.1 mm) more thickness, as well as 0.27 in (6.9 mm) more horizontal and 0.47 in (12 mm) more vertical separation than urea. Mixing occurred at Camrose between barley and anhydrous ammonia and at Grande Prairie between canola and urea.

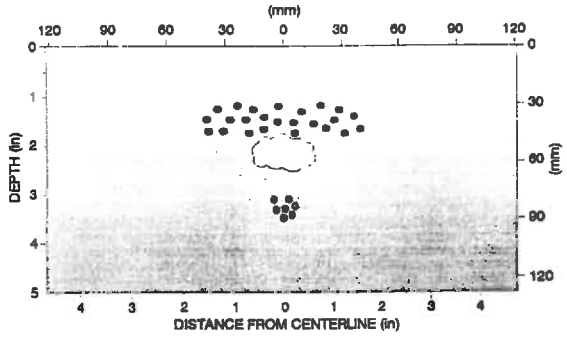
Barley (Pair row)



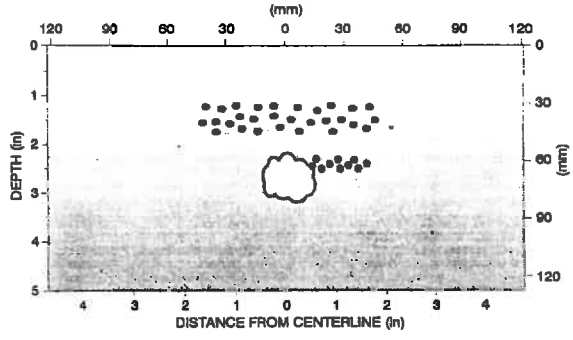
Canola (Pair row)



Barley (Single band)



Canola (Single band)



Key Ag Ventures Four Inch Chrome With Backswept Knife (Continued)

Pair Row

SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.49	12.4	0.31	7.9
AA* band thickness	1.00	25.4	1.13	28.7
Urea band thickness	0.84	21.3	0.96	24.4
Seed band width	1.29	32.8	1.68	42.7
AA* band width	0.63	16.0	1.29	32.8
Urea band width	0.81	20.6	1.21	30.7
Horizontal seed band separation	3.50	88.9	3.75	95.3
Horizontal separation	0.50	12.7	0.94	23.9
Vertical separation	1.19	30.2	0.56	14.2

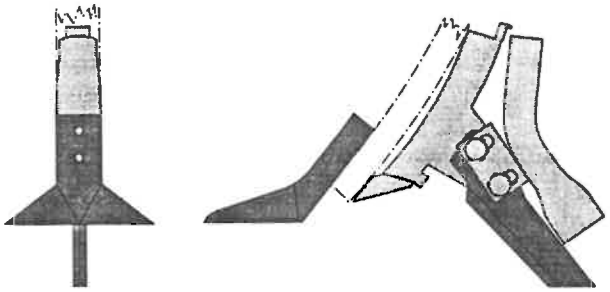
*AA: Anhydrous Ammonia

Single Band

SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.65	16.5	0.63	16.0
AA* band thickness	0.75	19.1	1.00	25.4
Urea band thickness	0.50	12.7	0.31	7.9
Seed band width	3.25	82.6	3.57	90.7
AA* band width	1.25	31.8	1.04	26.4
Urea band width	0.50	12.7	1.13	28.7
Horizontal separation	0.50	12.7	0.31	7.9
Vertical separation	0.00	0.0	1.07	27.2

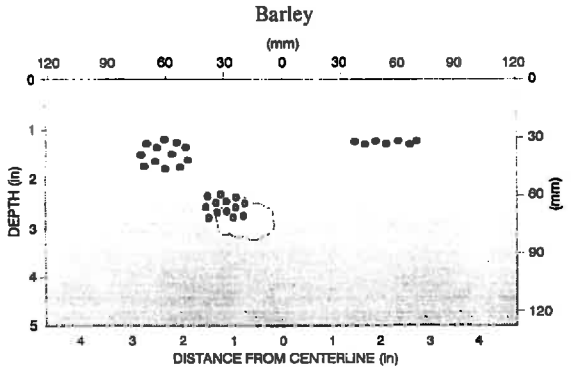
*AA: Anhydrous Ammonia

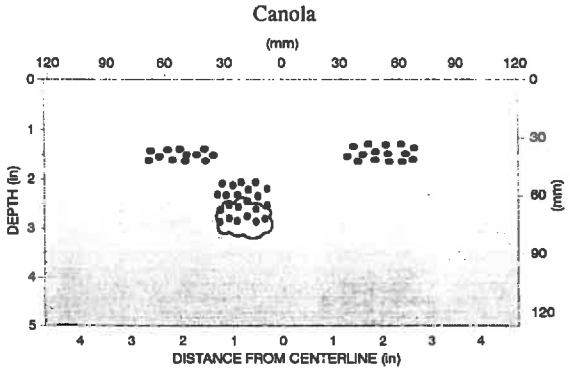
Key Ag Ventures Seven Inch Chrome With Backswept Knife



The Key Ag Ventures Seven Inch Chrome With Backswept Knife opener used a seven inch wide chrome tip with a splitter to place the seed and a backswept knife to place the fertilizer. The opener was designed to place the seeds in a paired row with the fertilizer in between and below the seed bands.

Both seed types at Barons were found to be in a single band. At Grande Prairie all seed types were found in paired rows. The seeds were mostly paired rows in Camrose. When placed in a single band, the canola was 0.38 in (9.7 mm) wider and 0.18 in (4.5 mm) thicker than the barley. When placed in paired rows the canola was 0.21 in (5.2 mm) wider than barley. There was no significant difference in vertical separation between the seed types. The anhydrous ammonia bands were 0.17 in (4.2 mm) wider than the urea. There was no significant difference in fertilizer band thickness between the fertilizer types. The anhydrous ammonia had 0.21 in (5.3 mm) more horizontal separation and 0.30 in (7.7 mm) more vertical separation from the seed bands than the urea. Mixing between seeds and fertilizer was recorded four times, all at Barons. Barley was found mixed with anhydrous ammonia twice, while canola was found mixed with both anhydrous ammonia and urea.

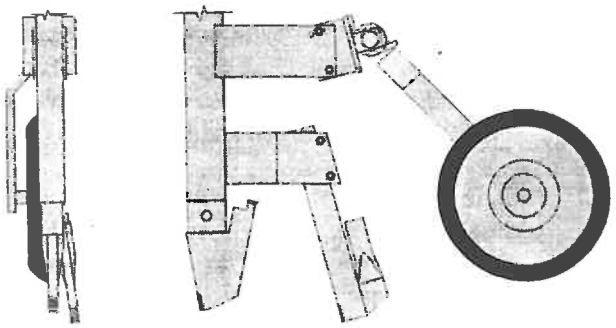




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.42	10.7	0.38	9.7
AA* band thickness	0.85	21.6	0.83	21.1
Urea band thickness	0.58	14.7	0.92	23.4
Seed band width	1.23	31.2	1.44	36.6
AA* band width	1.17	29.7	1.13	28.7
Urea band width	0.88	22.4	1.08	27.4
Horizontal seed band separation	4.48	113.8	3.98	101.1
Horizontal separation	1.43	36.3	1.18	30.0
Vertical separation	1.24	31.5	1.10	27.9

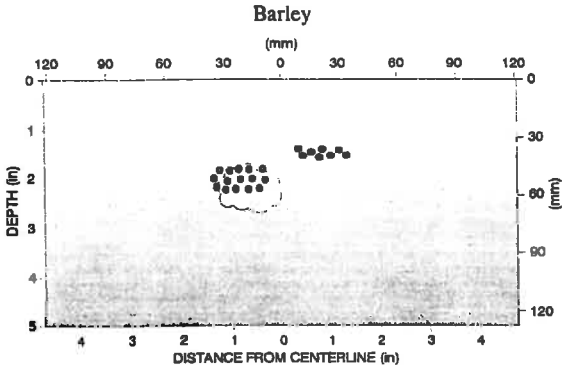
*AA: Anhydrous Ammonia

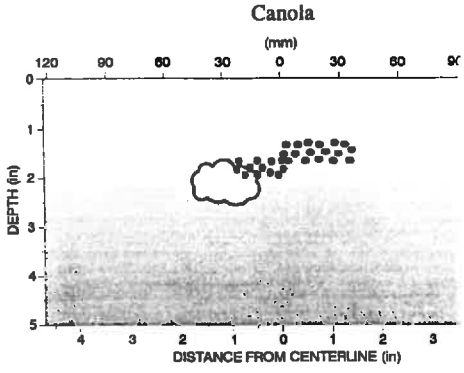
Melranda Zero Till System



The Melranda places single seed and fertiliz
The opener uses two backswept knives to pl
seed and fertilizer. The first knife places th
and the second the fertilizer, behind and to
of the seed.

The canola was placed in bands 0.37 in (9.
wider and 0.21 in (5.4 mm) thicker than th
Anhydrous ammonia bands were 0.23 in (5.
wider and 0.49 in (12.5 mm) thicker than t
bands. There was no significant difference
horizontal seed and fertilizer separation betw
seed types. The barley did have 0.18 in (4.5 mm) more vertical separation from the fertilizer than the
Anhydrous ammonia was placed with 0.26 in (6.5 mm) more horizontal and 0.24 in (6.2 mm) more ve
separation from the seed than urea. Seed and fertilizer were found to have mixed twice. Both cases of
involved canola. In Camrose, canola mixed with anhydrous ammonia and in Grande Prairie, canola w
with urea.

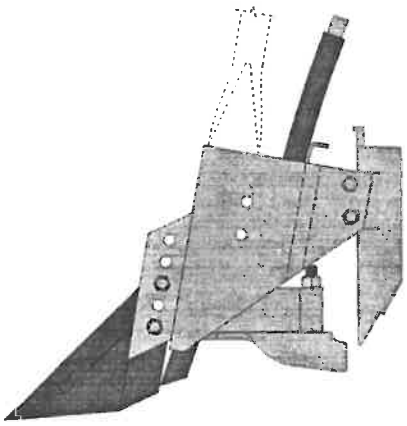




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.25	6.4	0.46	11.7
AA* band thickness	1.00	25.4	0.92	23.4
Urea band thickness	0.53	13.5	0.40	10.2
Seed band width	1.11	28.2	1.48	37.6
AA* band width	1.25	31.8	1.35	34.3
Urea band width	1.13	28.7	1.02	25.9
Horizontal separation	1.56	39.6	1.50	38.1
Vertical separation	0.63	16.0	0.45	11.4

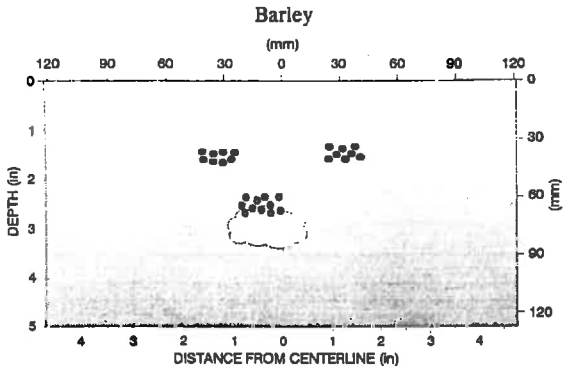
*AA: Anhydrous Ammonia

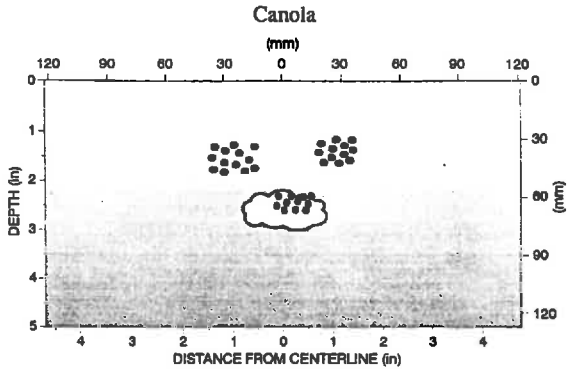
Morris Pair Row Double Shoot Opener



The Morris is a paired row opener that places the fertilizer in between and below the seed bands. The fertilizer is placed behind the tip of the front point and the seed is placed by a splitter at the back of the opener.

The seeds were mainly placed into paired rows but single bands did occur at all three sites. The most single bands were found at Grande Prairie. When placed in a paired row, the canola was 0.23 in (5.8 mm) thicker than the barley. When placed in single bands, the barley was 0.65 in (16.5 mm) wider and 0.29 in (7.3 mm) thinner than the canola. Canola had 0.2 in (5.0 mm) more horizontal and 0.21 in (5.3 mm) less vertical separation between the fertilizer than the barley. Anhydrous ammonia fertilizer bands were 0.8 in (20.3 mm) wider and 0.42 in (10.6 mm) thicker than the urea bands. There was no difference in horizontal separation between the fertilizer types. There was 0.29 in (7.4 mm) more vertical separation between seed and fertilizer with anhydrous ammonia than with urea. Mixing was found four times with the Morris opener. Three cases of mixing were found at Barons, where barley and canola were both found to have mixed with anhydrous ammonia. At Grande Prairie, canola was mixed with urea.

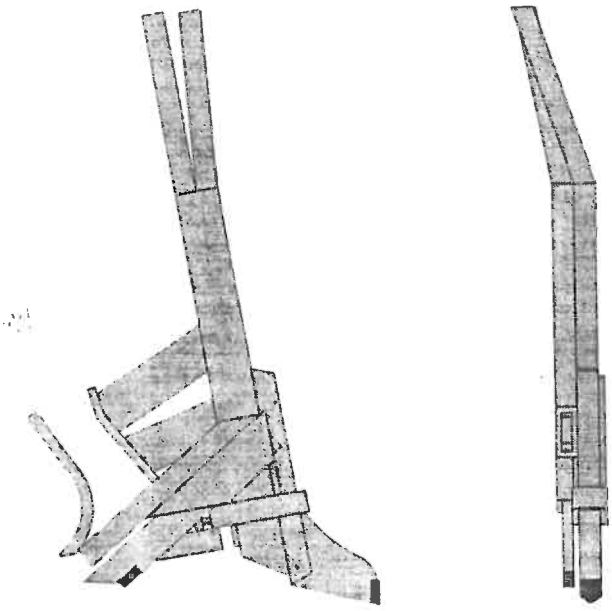




SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.33	8.4	0.61	15.5
AA* band thickness	0.85	21.6	0.81	20.6
Urea band thickness	0.44	11.2	0.40	10.2
Seed band width	0.78	19.8	0.90	22.9
AA* band width	1.58	40.1	1.67	42.4
Urea band width	0.88	22.4	0.78	19.8
Horizonal seed band separation	2.53	64.3	2.04	51.8
Horizontal separation	0.92	23.4	1.12	28.4
Vertical separation	1.18	30.0	0.97	24.6

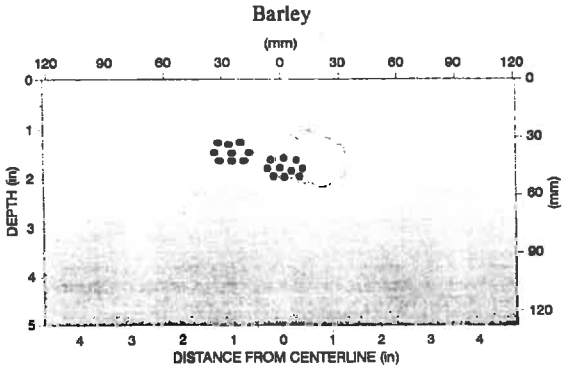
*AA: Anhydrous Ammonia

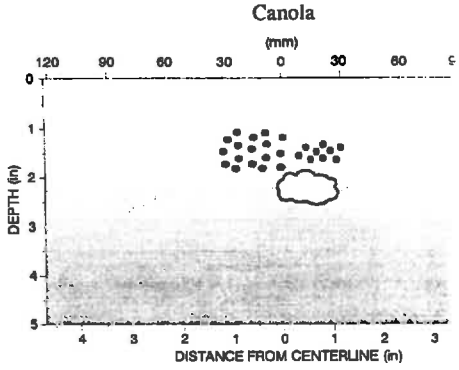
Poirier Double Shoot Opener



The Poirier places single seed and fertilizer b
was placed behind the front tip, while the fert
placed by a backswept knife. The backswept
off to the side and behind the front opener. A
ammonia was placed by a tube attached to the
the granular tube.

The canola was placed in a 0.49 in (12.5 mm
and 0.34 in (8.7 mm) thicker band than the b
There was no significant difference in horizo
and fertilizer separation between the seed typ
canola did have 0.18 in (4.5 mm) more verti
separation from the fertilizer than the barley.
anhydrous ammonia fertilizer band was 0.46
(11.6 mm) wider and 0.46 in (11.6 mm) thic
the urea. There was 0.15 in (3.7 mm) more
separation and 0.26 in (6.6 mm) more vertic
separation between seed and anhydrous amm
with urea. There were three instances where
fertilizer was above the seed. In Camrose u
placed above barley once as well as once ab
In Grande Prairie, anhydrous ammonia was
above barley. There were two cases where the seed and fertilizer mixed, both occurred at Barons while s
canola. One case was with anhydrous ammonia and the other with urea.

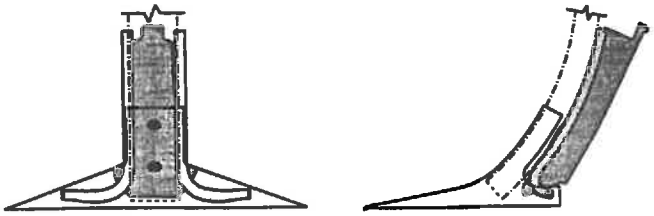




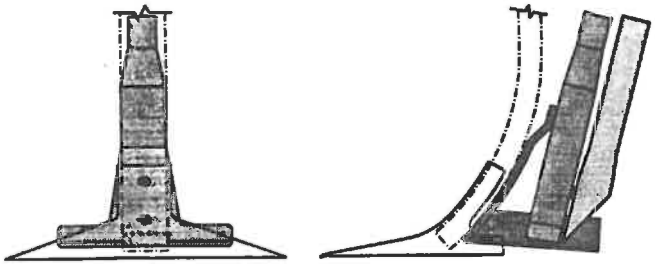
SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.48	12.2	0.82	20.8
AA* band thickness	1.13	28.7	0.67	17.0
Urea band thickness	0.48	12.2	0.42	10.7
Seed band width	0.83	21.1	1.32	33.5
AA* band width	1.42	36.1	1.19	30.2
Urea band width	0.78	19.8	0.92	23.4
Horizontal separation	1.31	33.3	1.21	30.7
Vertical separation	0.22	5.6	0.40	10.2

*AA: Anhydrous Ammonia

Sweep and Tube



Anhydrous Ammonia tubes set-up

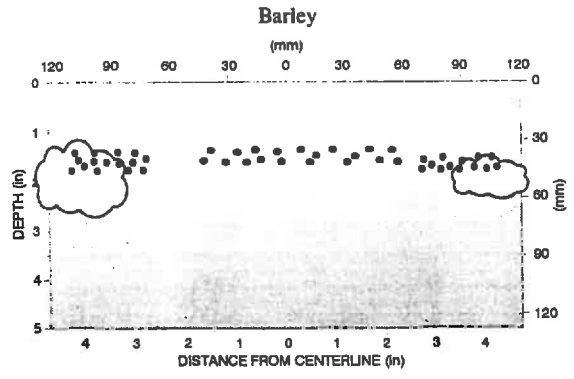


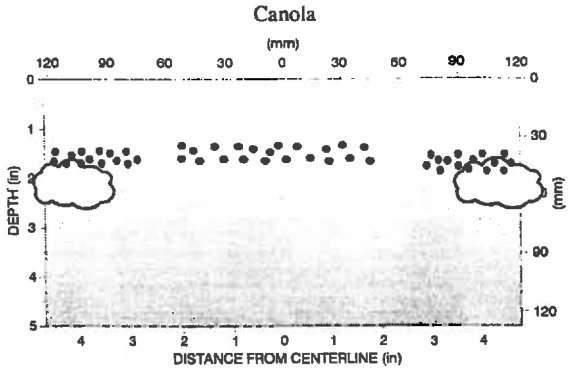
New Noble seed boot set-up

The sweep and tube placed seed in the centre with the fertilizer at the outside tips of the sweep. A New Noble seed boot was used to place granular urea on the outside of the sweep wings. Tubes, with a 1 in (2.5 cm) outside diameter, were used to place the anhydrous ammonia.

Barley placement was paired row in only one case. All other measurements placed barley in a single band. Canola placement was paired row a total of four times. There was no significant difference in seed band width of thickness between the two seed types.

The anhydrous ammonia bands were 0.59 in (15 mm) thicker than the urea bands. No significant difference in fertilizer width was found between the two fertilizer types. The anhydrous ammonia had 0.49 in (12.5 mm) more horizontal and 0.47 in (11.8 mm) more vertical separation from the seed than the urea. The fertilizer ranged from 0.88 in (22.2 mm) above to 1.88 in (47.6 mm) below the seed band elevation. There were also three cases where seed and fertilizer were mixed. These occurred at Strathmore with barley and canola, and at Camrose with canola. All three incidences occurred when placing anhydrous ammonia.



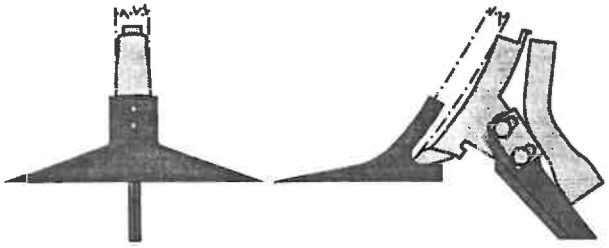


Sweep and Tube (Continued)

SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.35	8.9	0.41	10.4
AA* band thickness	1.01	25.7	1.00	25.4
Urea band thickness	0.43	10.9	0.40	10.2
Seed band width	4.03	102.4	3.94	100.1
AA* band width	1.70	43.2	1.68	42.7
Urea band width	1.61	40.9	1.77	45.0
Horizontal AA* band separation	8.25	209.6	8.50	215.9
Horizontal urea band separation	7.60	193.0	7.45	189.2
Horizontal separation	4.11	104.1	3.86	98.0
Vertical separation	0.24	6.1	0.35	8.9

*AA: Anhydrous Ammonia

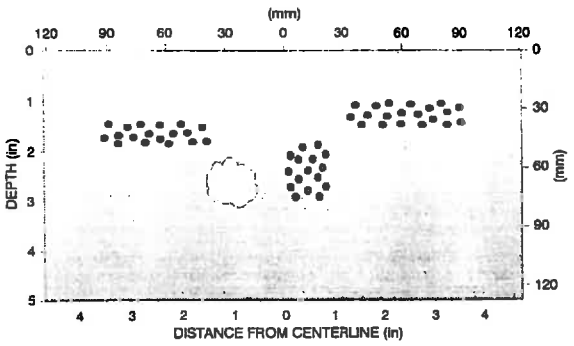
Sweep With Key Ag Ventures Backswept Knife



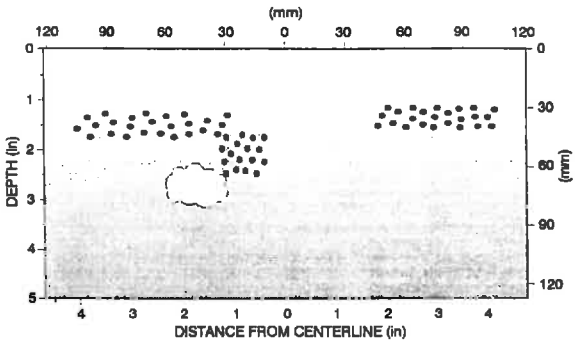
The Sweep with Key Ag Ventures Backswept Knife operates similar to the other Key Ag openers except that a sweep is used instead of a chrome tip.

The seed was placed mainly in single bands at Barons. At Grande Prairie, the seeds were placed in two bands and in Camrose the seeds were placed in two bands. When placed in single bands, the barley was 2.04 in (51.8 mm) wider than the canola. There was no difference in seed band thickness between the seed types. When placed in paired rows, the canola bands were 0.5 in (12.7 mm) wider than the barley bands. There was no significant difference in thickness between the seed types. Barley was placed with 0.91 in (23 mm) more horizontal separation from the fertilizer than canola. There was no significant difference in vertical separation. Anhydrous ammonia bands were 0.22 in (5.6 mm) wider than the urea bands. There was no significant difference in thickness of the fertilizer bands. Urea had 1.2 in (30.4 mm) more horizontal and 0.43 in (10.9 mm) less vertical separation from the seed than the anhydrous ammonia. Canola and urea were found mixed once at Barons.

Barley



Canola



SEED PLACEMENT	BARLEY (Average)		CANOLA (Average)	
	in	mm	in	mm
Seed band thickness	0.49	12.4	0.51	13.0
AA* band thickness	0.98	24.9	0.88	22.4
Urea band thickness	1.15	29.2	0.90	22.9
Seed band width	2.25	57.2	2.75	69.9
AA* band width	0.98	24.9	1.21	30.7
Urea band width	0.83	21.1	0.92	23.4
Horizontal seed band separation	4.97	126.2	5.58	141.7
Horizontal separation	2.23	56.6	1.32	33.5
Vertical separation	0.84	21.3	0.88	22.4

*AA: Anhydrous Ammonia

CONCLUSIONS

All of the openers were able to place the seed and fertilizer so that in most cases, the bands were kept from mixed. Some mixing was found with all of the openers tested except for the two Gen openers and the Bou Mid-Row Banding system. Most mixing was between the canola and anhydrous ammonia and occurred at

APPENDICES

APPENDIX 1

Tables 1 & 2

TABLE 1. Site Information.

SITE	Seeding Group[1]	SOIL TYPE	SOIL MOISTURE[2]	CROP SEEDED	PREVIOUS CROP	SOIL CONDITIONS
Burdett	1	Sandy Loam	24.1	Canola Barley Wheat	Canola	Stubble
Calmar	2	Loam	24.8	Canola Wheat	Feed Barley	Worked
Coaldale	1	Clay	31.0	Canola Barley Wheat	Silage Barley	Stubble
Irricana	2	Sandy Loam	21.1	Canola Barley	Barley	Stubble
Lethbridge	1	Clay Loam	31.4	Canola Barley Wheat	Barley	Stubble
Neerlandia	2	Silty Loam	19.6	Canola Barley	Malt Barley	Worked
Olds	2	Clay Loam	30.1 37.3	Barley Canola	Canola Barley	Stubble Harrowed
Strathmore	2	Loam	24.7	Canola Wheat	Wheat Canola	Stubble
Vermilion	2	Clay Loam	25.0	Wheat Barley	50% Wheat/ 50% Green-feed	Worked
Barons	3	Clay Loam	27.1	Canola Barley	Wheat	Stubble
Camrose	4	Clay Loam	34.5	Canola Barley	Wheat	Stubble
Grande Prairie	3	Clay Loam	N/A	Barley	Wheat	Stubble

[1] See TABLE 2 for site seeding groups.

[2] $(\frac{vol}{vol})\ \%$

TABLE 2. Site Opener Groups.

GROUP 1	GROUP 2	GROUP 3	GROUP 4
Bourgault Mid-Row Banding System	Flexi-Coil Double Shoot Angle Disk OpenerFlexi-Coil Paired Row	Bourgault Double Shoot Opener	Bourgault Doubl Shoot Opener
Flexi-Coil Paired Row	Flexi-Coil Paired Row	Bourgault Mid-Row Banding System	Bourgault Mid-R Banding Systen
Flexi-Coil Side Band	Flexi-Coil Side Band	Flexi-Coil Paired Row	Flexi-Coil Doubl Shoot Angle Dis Opener
Sweep and Tube	Sweep and Tube	Flexi-Coil Side Band	Flexi-Coil Paire
		Gen 200 T2	Flexi-Coil Side
		Gen 200 T2X2	Gen 200 T2
		Key Ag 4 Inch	Gen 200 T2X2
		Key Ag 7 Inch Sweep	Key Ag 4 Inch
		Melranda Zero Till System	Key Ag 7 Inch Chrome
		Morris	Melranda Zero System
		Poirier Double Shoot Opener	Morris
		Sweep and Tube	Poirier Double Opener
		Sweep with Key Ag Backswept Knife	Sweep and Tub
			Sweep with Ke Backswept Knif

APPENDIX 2

Field Data

BOURGAULT

			SEED BANDS			FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND			BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	CANOLA	AA	2.750	1.000	0.000	2.000	1.375	0.000	1.500	0.250
BARONS	CANOLA	AA	2.000	0.375	0.875	1.500	0.875	0.875	1.500	0.625
BARONS	CANOLA	UREA	2.500	0.625	0.000	1.250	0.625	0.375	2.000	0.000
BARONS	CANOLA	UREA	2.000	0.750	0.000	1.000	0.500	1.000	1.500	0.875
BARONS	BARLEY	UREA	1.000	0.625	1.625	1.000	0.750	2.500	1.000	1.000
BARONS	BARLEY	UREA	1.000	0.250	1.250	1.500	0.500	1.500	1.500	0.375
BARONS	BARLEY	AA	1.500	0.500	0.000	1.250	2.000	0.000	1.500	0.750
BARONS	BARLEY	AA	1.000	0.375	1.125	1.500	0.875	1.375	2.750	0.625
CAMROSE	CANOLA	UREA	0.625	0.750	0.625	0.750	0.875	1.875	1.000	1.375
CAMROSE	CANOLA	UREA	1.375	0.250	0.875	1.000	0.375	1.875	2.500	1.000
CAMROSE	CANOLA	AA	1.250	0.125	0.875	1.250	0.750	1.125	2.500	0.500
CAMROSE	CANOLA	AA	1.125	0.875	1.250	0.875	0.750	2.500	2.500	1.250
CAMROSE	BARLEY	UREA	0.500	0.125	0.375	1.125	0.375	1.625	1.750	1.250
CAMROSE	BARLEY	UREA	1.250	0.250	1.500	0.875	0.500	2.500	1.375	1.125
CAMROSE	BARLEY	AA	0.500	0.250	0.500	1.250	1.125	1.250	0.625	1.250
CAMROSE	BARLEY	AA	0.750	0.125	0.875	1.250	0.750	2.500	2.750	2.000
GRANDE PRAIRIE	BARLEY	UREA	1.500	0.625	0.625	0.625	0.250	1.375	1.250	0.500
GRANDE PRAIRIE	BARLEY	UREA	1.000	1.000	1.000	1.000	0.500	2.500	2.000	1.750
GRANDE PRAIRIE	BARLEY	AA	1.000	0.500	0.750	0.875	0.625	2.125	1.500	1.375
GRANDE PRAIRIE	BARLEY	AA	1.125	0.625	0.500	1.000	0.625	1.375	1.625	0.250
GRANDE PRAIRIE	CANOLA	AA	1.375	0.750	0.750	1.625	0.750	1.500	1.875	0.750
GRANDE PRAIRIE	CANOLA	AA	1.500	0.625	0.500	1.250	0.750	1.750	2.250	0.250
GRANDE PRAIRIE	CANOLA	UREA	1.250	0.500	1.000	1.125	0.500	1.250	1.500	0.250
GRANDE PRAIRIE	CANOLA	UREA	1.125	0.500	0.500	1.000	0.250	2.250	2.500	1.625

Bourgault Mid-Row Bander

			SEED BANDS								FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND	RIGHT BAND		BAND	SEED TO SEED				BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BURDETT	CANOLA	AA			0.750						2.250	0.500			4.000
BURDETT	WHEAT	UREA			0.500								1.000	6.000	
COALDALE	CANOLA	UREA	1.500	0.500	1.000						1.750	0.500	3.000	5.500	2.500
COALDALE	CANOLA	AA	1.000	0.500	1.500						0.500	2.000	0.000	3.000	0.750
COALDALE	WHEAT	AA	1.500	0.250	1.000						1.500	2.000	2.000	4.000	1.875
COALDALE	WHEAT	UREA	1.000	0.250	1.250						1.500	0.500	3.500	5.000	2.625
SUNNYSIDE	BARLEY	AA	1.500	0.500	1.000						1.500	2.000	2.000	5.000	1.750
SUNNYSIDE	BARLEY	UREA	1.500	0.500	1.500						1.000	0.500	3.000	5.000	1.500
SUNNYSIDE	CANOLA	UREA	1.000	0.250	1.000						1.250	1.000	3.000	4.500	2.375
SUNNYSIDE	CANOLA	AA	1.000	0.250	0.750						1.000	4.000	0.000	6.000	1.125
BARONS	CANOLA	AA	1.000	0.250	0.750	1.000	0.250	0.750	10.000	0.000	3.250	1.250	1.250	0.000	0.750
BARONS	CANOLA	AA	1.250	0.500	0.500	1.500	0.375	0.625	10.000	0.000	3.750	1.750	0.750	0.000	5.750
BARONS	CANOLA	UREA		0.500	0.000									4.000	
BARONS	CANOLA	UREA	1.250	0.250	0.500						2.250	2.000	1.500	4.000	1.875
BARONS	BARLEY	UREA	2.000	0.625	1.250						1.000	0.750	1.000	5.000	0.250
BARONS	BARLEY	UREA	1.250	0.125	1.125						1.000	1.000	2.250	5.000	1.500
BARONS	BARLEY	AA	1.250	0.125	1.250						2.500	2.250	0.000	4.000	0.375
BARONS	BARLEY	AA	1.125	0.375	0.125						2.500	0.875	1.500	5.000	1.625
CAMROSE	CANOLA	AA	0.500	0.500	0.000						2.500	2.500	0.500	3.875	1.500
CAMROSE	CANOLA	AA	0.500	0.250	1.250						1.750	2.000	1.000	3.250	0.625
CAMROSE	CANOLA	UREA	0.625	0.250	0.750						1.000	1.500	1.000	5.500	0.875
CAMROSE	CANOLA	UREA	0.500	0.125	1.500						1.500	0.625	2.000	5.625	0.750
CAMROSE	BARLEY	AA	0.500	0.125	0.875	0.875	0.250	0.250	9.750	0.500	1.125	0.875	2.125	4.750	0.625
CAMROSE	BARLEY	AA	0.750	0.125	0.375	0.625	0.375	1.000	10.000	0.250	0.500	1.500	2.000	7.000	1.375
CAMROSE	BARLEY	UREA	0.750	0.125	0.500	0.500	0.250	0.625	10.750	0.250	2.250	0.625	1.375	3.750	1.125
CAMROSE	BARLEY	UREA	0.875	0.250	0.875						0.500	0.500	1.375	4.000	0.625
GRANDE PRAIRIE	BARLEY	AA	0.750	0.375	1.500						1.250	1.000	3.000	4.500	1.875
GRANDE PRAIRIE	BARLEY	AA	1.000	0.250	1.000						0.750	0.500	2.000	2.750	1.125
GRANDE PRAIRIE	BARLEY	UREA	1.000	0.375	1.125						0.750	0.875	1.750	4.500	0.875
GRANDE PRAIRIE	BARLEY	UREA	1.500	0.750	0.500						0.750	0.625	2.250	3.500	0.625
GRANDE PRAIRIE	CANOLA	AA	1.125	0.750	0.875						1.500	1.500	2.500	4.250	2.000
GRANDE PRAIRIE	CANOLA	AA	1.000	0.500	0.750						1.750	1.250	2.250	3.500	1.875
GRANDE PRAIRIE	CANOLA	UREA	1.250	0.250	0.875						1.250	1.750	1.250	3.750	1.125
GRANDE PRAIRIE	CANOLA	UREA	1.500	0.375	0.875						1.000	0.500	2.000	6.500	1.125

Flexi-Coil Paired Row

LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	SEED TO SEED HORZ.	SEED TO SEED VERT.	FERTILIZER BAND WIDTH	FERTILIZER BAND DEPTH	FERTILIZER BAND DEPTH
BURDETT	CANOLA	AA			1.000						1.000	0.500	1.5
BURDETT	CANOLA	UREA			1.000								1.0
BURDETT	WHEAT	UREA			0.875			0.875	2.500	0.000	1.000		1.5
BURDETT	WHEAT	AA			0.875				2.000		2.000	0.500	1.7
COALDALE	CANOLA	AA	1.500	1.000	0.500	1.500	1.000	0.500	3.000	0.000	1.500	1.500	2.5
COALDALE	CANOLA	UREA	0.750	0.500	1.000	1.000	0.500	1.000	2.500	0.000	1.250	0.500	2.5
COALDALE	WHEAT	UREA	2.000	0.500	0.500						1.500	1.000	1.5
COALDALE	WHEAT	UREA	1.000	0.500	1.500	1.000	0.500	1.500	2.000	0.000	1.000	0.500	2.5
SUNNYSIDE	BARLEY	AA	1.000	0.500	2.000	1.000	0.500	2.000	2.500	0.000	1.250	1.000	2.5
SUNNYSIDE	BARLEY	UREA	1.250	0.500	1.500	1.500	0.500	1.500	2.500	0.000	1.500	0.500	2.5
SUNNYSIDE	CANOLA	UREA	3.500	0.500	1.000							0.500	2.5
SUNNYSIDE	CANOLA	AA	3.500	0.500	1.000						2.000	1.500	1.5
STRATHMORE	WHEAT	AA	0.375	0.750	0.000	0.500	0.500	0.625	1.250	0.500	1.125	0.500	0.7
STRATHMORE	WHEAT	AA	0.500	0.250	0.750	0.500	0.250	0.750	2.000	0.000	1.000	1.125	1.5
STRATHMORE	WHEAT	UREA	1.125	0.250	1.000	0.500	0.250	1.000	2.000	0.000	0.875	0.125	2.5
STRATHMORE	WHEAT	UREA	0.500	0.375	1.000	0.750	0.375	1.000	2.000	0.000	0.875	0.250	2.5
STRATHMORE	CANOLA	UREA	0.500	0.125	1.000	0.250	0.250	1.000	1.375	0.000	0.625	0.625	1
STRATHMORE	CANOLA	UREA	1.375	0.625	0.375	2.000	0.875	0.375	3.000	0.125	0.625	0.250	1.5
STRATHMORE	CANOLA	AA	0.500	1.000	1.125	0.750	0.625	1.375	1.500	0.000	1.250	0.875	1
STRATHMORE	CANOLA	AA	0.750	0.125	1.125	1.000	0.250	1.125	2.250	0.000	1.000	0.500	2.
IRRICANNA	BARLEY	AA	0.500	0.500	1.500	0.750	0.500	2.000	2.000	0.500	1.250	0.625	2.
IRRICANNA	BARLEY	AA	0.750	0.125	1.000	1.000	0.375	1.000	2.500	0.250	1.125	0.750	2.
IRRICANNA	BARLEY	UREA	0.750	0.250	0.750	1.000	0.625	0.375	2.125	0.250	1.000	0.250	2.
IRRICANNA	BARLEY	UREA	0.500	0.125	1.125	1.000	0.375	1.125	2.125	0.000	0.750	0.875	2.
IRRICANNA	CANOLA	UREA	1.250	0.625	0.500	1.000	0.125	1.875		1:125	0.750	0.875	1
IRRICANNA	CANOLA	UREA	1.750	1.250	0.000						0.750	0.250	1
IRRICANNA	CANOLA	AA	0.500	0.875	1.000	1.250	0.500	1.500	2.000	0.375	1.125	1.000	3
IRRICANNA	CANOLA	AA				1.625	0.500	0.750			1.250	0.625	2
OLDS	BARLEY	AA	0.875	0.375	1.000	0.500	0.375	1.375	1.750	0.375	0.750	1.125	2
OLDS	BARLEY	AA	1.000	0.125	1.375	0.500	0.250	1.250	2.000	0.000	1.500	1.375	2
OLDS	BARLEY	UREA	1.000	0.250	1.000	0.750	0.500	1.000	1.750	0.125	1.250	0.500	1
OLDS	BARLEY	UREA	0.500	0.500	2.250	0.500	0.500	2.250	2.000	0.000	0.750	0.250	2
OLDS	CANOLA	UREA	3.750	0.500	1.500						1.250	1.000	2
OLDS	CANOLA	UREA	3.000	0.750	0.500						1.000	1.500	2
OLDS	CANOLA	AA	2.250	0.500	0.750						1.000	0.500	1
OLDS	CANOLA	AA	3.000	0.750	1.000						0.750	0.500	2
BARONS	BARLEY	UREA	1.000	1.000	2.000	1.000	1.000	2.000	2.500	0.000	1.250	1.000	2
BARONS	BARLEY	UREA	0.500	0.500	1.500	0.500	0.500	1.500	2.500	0.000	1.000	0.625	2
BARONS	BARLEY	AA	0.750	0.500	1.750	0.750	0.500	1.750	2.000	0.000	1.000	0.250	2
BARONS	BARLEY	AA	0.750	0.250	2.750	0.750	0.250	2.750	2.500	0.000	1.500	0.500	4
BARONS	CANOLA	UREA	3.500	0.750	0.250						1.000	0.500	1
BARONS	CANOLA	UREA	1.000	0.500	1.750	1.250	0.500	1.750	2.500	0.000	1.000	0.625	2
BARONS	CANOLA	AA	1.375	0.375	0.750	1.000	0.375	0.750	2.000	0.000	1.375	0.875	2
BARONS	CANOLA	AA	3.500	0.500	0.750						1.750	1.000	1
CAMROSE	CANOLA	UREA	2.375	0.375	1.125	2.250	0.375	1.125	2.250	0.000	1.125	0.500	2
CAMROSE	CANOLA	AA	1.375	0.250	1.500						1.375	1.125	2
CAMROSE	CANOLA	AA	1.000	0.625	0.500	1.000	0.500	1.500	2.500	0.875	1.375	2.250	4
CAMROSE	BARLEY	AA	0.375	0.375	1.375	1.000	0.375	1.125	1.750	0.250	1.250	0.500	2
CAMROSE	BARLEY	AA	1.000	0.250	2.000	1.375	0.125	1.875	2.500	0.125	0.750	0.500	2
CAMROSE	BARLEY	UREA	1.000	0.375	0.375	0.750	0.750	0.500	2.500	0.375	1.125	0.500	1
CAMROSE	BARLEY	UREA	0.500	0.375	1.625	0.500	0.125	1.750	2.000	0.000	0.875	0.500	2
VERMILION	BARLEY	UREA	2.500	0.500	1.000						1.750	0.500	1
VERMILION	BARLEY	UREA	0.500	0.250	1.500	0.500	0.250	1.500	2.500	0.000	0.750	0.500	2
VERMILION	BARLEY	AA									1.250	1.000	2
VERMILION	BARLEY	AA	1.500	0.250	1.500	1.250	0.500	1.500	2.500	0.125	1.000	0.500	2
CALMAR	WHEAT	UREA	0.750	0.250	2.000	0.500	0.250	2.500	1.250	0.500	0.750	0.250	2
CALMAR	WHEAT	UREA	3.000	0.750	0.000						1.000	0.500	1
CALMAR	WHEAT	AA	1.000	0.750	2.000						1.000	1.250	2
CALMAR	WHEAT	AA	0.750	0.250	1.500						0.750	0.750	2
CALMAR	CANOLA	AA	3.000	0.500	1.500						1.000	1.000	2
CALMAR	CANOLA	AA	2.250	0.500	1.000						1.250	1.000	2
CALMAR	CANOLA	UREA	1.000	0.500	1.000	1.000	0.750	1.250	2.250	0.375	1.000	0.500	2
CALMAR	CANOLA	UREA	1.250	0.750	1.250	1.000	0.500	1.500	2.000	0.125	0.750	0.500	2
NEERLANDIA	BARLEY	UREA	0.750	0.500	1.000						1.000	0.500	2
NEERLANDIA	BARLEY	UREA	1.750	0.250	1.250	1.250	0.250	1.250	3.500	0.000	1.250	0.750	2
NEERLANDIA	BARLEY	AA	0.750	0.750	0.750	1.000	0.250	1.000	2.250	0.000	1.250	0.750	
NEERLANDIA	BARLEY	AA	2.250	0.250	2.000						0.750	0.500	
NEERLANDIA	CANOLA	AA	1.500	0.250	1.000	1.500	0.250	1.500	2.250	0.500	0.750	1.000	
NEERLANDIA	CANOLA	AA	1.000	0.250	2.500	0.750	0.250	2.500	2.000	0.000	1.000	0.750	
NEERLANDIA	CANOLA	UREA	1.250	0.250	1.000	0.750	0.250	1.000	2.000	0.000	1.250	1.000	
NEERLANDIA	CANOLA	UREA	0.750	0.250	1.000	1.250	0.500	0.750	2.250	0.125	1.250	0.500	
GRANDE PRAIRIE	BARLEY	UREA	1.000	0.125	1.000	0.500	0.375	0.750	1.875	0.125	0.750	0.500	
GRANDE PRAIRIE	BARLEY	UREA	0.750	0.625	0.500	1.000	0.250	1.000	1.750	0.500	0.750	0.250	
GRANDE PRAIRIE	BARLEY	AA	0.500	0.125	1.000	0.500	0.250	1.750	2.250	0.750	1.500	0.750	
GRANDE PRAIRIE	BARLEY	AA	1.000	0.500	0.500	0.500	0.250	0.750	2.125	0.125	1.500	0.500	

PROTOTYPE DISK

			SEED BANDS			FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND			BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
STRATHMORE	WHEAT	AA	0.375	0.500	0.500	1.250	1.250	1.250	2.750	1.375
STRATHMORE	WHEAT	AA	0.500	0.500	0.500	1.125	0.750	0.750	1.000	0.375
STRATHMORE	WHEAT	UREA	0.375	0.125	0.375	0.500	0.375	0.375	1.000	0.250
STRATHMORE	WHEAT	UREA	0.500	0.250	0.750	0.750	0.750	1.500	1.250	1.375
STRATHMORE	CANOLA	AA	0.500	0.250	0.750	0.500	0.625	2.500	2.000	2.000
STRATHMORE	CANOLA	AA	0.500	0.250	1.000	0.500	0.625	2.000	2.000	1.250
STRATHMORE	CANOLA	UREA	0.500	0.125	0.375	0.500	0.250	1.750	2.250	0.375
STRATHMORE	CANOLA	UREA	0.500	0.250	0.500	0.500	0.250	1.500	2.000	1.000
IRRICANNA	BARLEY	AA				1.500	2.000	2.500		
IRRICANNA	BARLEY	AA	0.500	0.625	1.750	2.250	1.125	2.625	1.500	1.125
IRRICANNA	BARLEY	UREA	0.750	0.500	2.000	0.750	0.250	3.250	1.500	1.125
IRRICANNA	BARLEY	UREA	0.500	0.250	1.500	0.625	0.250	2.500	1.000	1.000
IRRICANNA	CANOLA	AA	0.500	0.500	0.000	2.000	2.000	0.000	3.250	0.750
IRRICANNA	CANOLA	AA	0.375	0.375	0.375	2.000	1.250	1.750	2.000	1.875
IRRICANNA	CANOLA	UREA	1.000	0.250	0.000	0.750	0.250	1.250	3.000	1.250
IRRICANNA	CANOLA	UREA	2.250	0.500	0.000	0.750	0.750	1.000	3.250	1.125
OLDS	BARLEY	AA	1.500	1.000	0.000	1.500	1.000	2.375	2.000	2.375
OLDS	BARLEY	AA	0.500	0.250	0.875	0.625	0.625	2.625	2.000	2.000
OLDS	BARLEY	UREA	1.000	0.375	0.875	1.500	0.625	1.500	2.000	0.750
OLDS	BARLEY	UREA	1.000	0.125	1.125	0.500	0.250	1.750	1.000	0.625
OLDS	CANOLA	AA	1.250	0.500	0.500	2.000	4.000	0.000	2.500	1.250
OLDS	CANOLA	AA	0.750	0.500	1.500	1.750	1.000	2.000	1.500	0.750
OLDS	CANOLA	UREA	1.000	0.500	0.500	1.250	0.750	2.500	2.000	2.125
OLDS	CANOLA	UREA	1.500	0.250	0.750	1.000	0.500	2.250	2.750	0.625
CAMROSE	BARLEY	AA	1.500	0.625	1.000	0.500	2.625	1.625	0.750	1.500
CAMROSE	BARLEY	AA	0.250	1.000	0.250	1.125	2.125	0.000	0.250	0.250
CAMROSE	BARLEY	UREA	0.625	0.625	0.500	0.500	0.500	1.500	1.500	1.000
CAMROSE	BARLEY	UREA	2.000	0.250	1.500	0.500	0.250	1.750	1.250	0.250
CAMROSE	CANOLA	AA	0.500	0.500	0.750	1.250	1.125	0.750		0.375
CAMROSE	CANOLA	AA	0.500	0.375	0.250	1.125	0.625	3.625	0.500	3.500
CAMROSE	CANOLA	UREA	1.000	0.250		0.375	0.125	1.500	1.375	1.375
CAMROSE	CANOLA	UREA	0.750	1.125	0.875	1.000	0.375	2.125	2.500	0.875
VERMILION	BARLEY	AA	1.250	0.250	2.250	1.500	1.000	2.000	1.500	0.125
VERMILION	BARLEY	AA	1.250	0.750	1.500	2.000	1.500	2.000	2.250	0.875
VERMILION	BARLEY	UREA	1.500	0.250	2.500	1.250	0.750	2.250	2.250	0.000
VERMILION	BARLEY	UREA	0.750	0.500	2.000	1.250	0.250	3.000	1.750	0.875
VERMILION	WHEAT	AA	1.250	0.750	1.500	0.750	0.500	2.500	2.250	0.875
VERMILION	WHEAT	AA	1.250	0.500	1.750	0.750	0.750	2.500	2.250	0.875
VERMILION	WHEAT	UREA	1.250	0.250	1.500	0.750	0.750	2.500	2.500	1.250
VERMILION	WHEAT	UREA	0.500	0.500	1.250	0.750	0.500	2.000	2.500	0.750
CALMAR	WHEAT	AA	0.500	0.500	1.750	0.500	0.750	2.750	1.500	1.125
CALMAR	WHEAT	AA	0.750	1.250	1.250	0.750	0.750	3.250	2.750	1.750
CALMAR	WHEAT	UREA	1.250	0.250	1.250	1.250	0.250	2.250	2.250	1.000
CALMAR	WHEAT	UREA	1.000	0.500	2.750	1.500	0.250	4.000	2.750	1.125
CALMAR	CANOLA	AA	0.500	0.500	1.000	1.750	0.750	2.500	2.500	1.625
CALMAR	CANOLA	UREA	1.000	1.000	0.500	1.000	0.500	2.000	2.500	1.250
CALMAR	CANOLA	UREA	0.500	0.250	1.250	1.000	1.000	2.500	2.500	1.625
NEERLANDIA	BARLEY	AA	1.000	0.250	2.500	0.750	0.750	3.000	1.000	0.750
NEERLANDIA	BARLEY	AA	0.250	0.250	1.750	1.000	0.500	2.750	2.000	1.125
NEERLANDIA	BARLEY	UREA	1.000	0.500	1.000	0.500	0.500	1.500	1.000	0.500
NEERLANDIA	CANOLA	AA	1.250	0.500	1.750	0.750	1.000	2.500	2.750	1.000
NEERLANDIA	CANOLA	AA	0.750	0.250	0.250	0.750	1.000	1.500	1.750	1.625
NEERLANDIA	CANOLA	UREA	1.000	0.500	0.500	1.000	0.500	1.500	2.250	1.000
NEERLANDIA	CANOLA	UREA	0.750	0.250	2.250	1.500	0.500	3.500	1.250	1.375

Flexi-Coil Side Band

LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	SEED BANDS LEFT BAND DEPTH	SEED BANDS BAND DEPTH	FERTILIZER BAND WIDTH	FERTILIZER BAND DEPTH	FERTILIZER BAND BAND DEPTH	RELATIVE POS. SEED TO FERT. HORZ.	RELATIVE POS. SEED TO FERT. VERT.
BURDETT	CANOLA	AA			1.000	1.000	0.500	1.500		
BURDETT	CANOLA	UREA			1.000			1.000	0.750	
BURDETT	WHEAT	AA	0.500		1.000	1.250	1.000	1.500		
BURDETT	WHEAT	UREA	1.250		1.000					
COALDALE	WHEAT	UREA	1.000	0.500	1.500	0.750	0.500	2.500	1.500	1.000
COALDALE	WHEAT	AA	2.000	0.750	1.000	2.000	0.500	3.000	2.500	1.875
COALDALE	CANOLA	AA	1.500	0.500	1.000	2.500	1.250	2.250	1.750	1.875
COALDALE	CANOLA	UREA	2.000	1.500	0.000	2.500	0.500	2.000	1.750	1.500
SUNNYSIDE	CANOLA	AA	1.500	1.000	1.000	1.500	0.750	2.250	1.750	1.125
SUNNYSIDE	CANOLA	UREA	1.000	0.500	1.000	1.000	0.500	1.500	2.000	0.500
SUNNYSIDE	BARLEY	UREA	1.500	0.250	0.750	1.000	0.250	1.750	1.500	2.000
SUNNYSIDE	BARLEY	AA	1.000	0.500	1.000	1.500	0.500	3.000	1.750	2.000
STRATHMORE	WHEAT	UREA	1.000	0.375	0.750	0.750	1.000	1.750	1.750	1.750
STRATHMORE	WHEAT	UREA	1.000	0.375	0.750	1.000	0.875	1.875	1.875	1.500
STRATHMORE	WHEAT	AA	1.000	0.250	1.250	1.125	0.625	2.250	1.000	1.250
STRATHMORE	WHEAT	AA	1.250	0.500	0.625	1.750	0.875	1.250	1.250	0.625
STRATHMORE	CANOLA	AA	1.000	0.500	1.000	1.250	1.000	1.500	1.000	0.750
STRATHMORE	CANOLA	AA	1.500	0.250	0.000	1.500	0.625	0.750	1.250	1.250
STRATHMORE	CANOLA	UREA	0.750	0.500	1.250	0.750	0.500	2.000	3.000	0.750
STRATHMORE	CANOLA	UREA	0.750	1.375	1.500	0.625	1.250	2.000	1.125	0.500
IRRICANNA	BARLEY	UREA	1.000	0.750	0.625	0.875	0.500	2.375	1.250	1.125
IRRICANNA	BARLEY	UREA	0.750	0.250	1.250	1.500	0.625	1.750	1.125	0.625
IRRICANNA	BARLEY	AA	0.750	1.000	0.000	0.750	0.500	1.750	1.500	1.500
IRRICANNA	BARLEY	AA	0.500	0.625	1.125	1.500	0.750	2.750	0.375	1.500
IRRICANNA	CANOLA	AA	0.500	0.250	1.250	1.500	0.750	2.250	1.000	1.250
IRRICANNA	CANOLA	AA	0.500	0.500	0.500	0.750	0.625	2.500	1.125	2.000
IRRICANNA	CANOLA	UREA	0.500	0.125	1.000	0.750	0.250	2.250	1.625	1.375
IRRICANNA	CANOLA	UREA	0.875	0.500	0.000	0.750	0.250	1.375	1.500	1.250
OLDS	BARLEY	UREA	0.750	0.250	1.250	1.000	0.500	2.000	0.750	1.125
OLDS	BARLEY	UREA	1.125	0.375	1.000	0.875	0.500	1.875	1.250	1.000
OLDS	BARLEY	AA	1.000	0.500	0.500	1.750	0.625	1.625	1.500	1.250
OLDS	BARLEY	AA	0.625	0.250	0.750	1.000	0.750	1.750	1.250	1.250
OLDS	CANOLA	UREA	1.000	0.750	0.500	1.000	0.500	2.000	1.000	1.375
OLDS	CANOLA	UREA	1.500	1.000	1.000	1.000	0.250	2.250	1.250	0.875
OLDS	CANOLA	AA	1.500	0.500	1.000	1.250	1.000	2.500	1.500	1.750
OLDS	CANOLA	AA	1.750	0.750	0.500	1.500	0.500	1.500	1.500	0.875
BARONS	BARLEY	UREA	2.500	0.500	1.000	2.000	0.500	2.000	1.500	1.000
BARONS	BARLEY	UREA	1.500	0.500	1.500	1.000	0.500	2.500	1.250	1.000
BARONS	BARLEY	AA	1.500	0.500	2.000	1.250	1.500	2.250	2.000	0.750
BARONS	BARLEY	AA	1.250	0.500	1.500	1.250	1.000	2.500		1.250
BARONS	CANOLA	AA	2.000	0.625	1.750	1.375	0.750	2.375	1.000	0.625
BARONS	CANOLA	AA	1.500	0.750	2.000	1.500	0.750	2.750	1.000	0.750
BARONS	CANOLA	UREA	1.250	0.250	1.000	1.250	0.500	1.500	1.750	0.625
BARONS	CANOLA	UREA	1.000	0.250	1.500	1.000	0.375	2.750	2.000	1.500
CAMROSE	CANOLA	AA	1.750	0.250	0.625	0.625	0.875	2.000	2.000	1.625
CAMROSE	CANOLA	AA	1.125	0.625	0.875	0.500	0.375	1.625	1.250	0.625
CAMROSE	CANOLA	UREA	1.000	0.250	1.625	0.875	0.500	1.875	1.000	0.375
CAMROSE	CANOLA	UREA	0.750	0.500	0.750	1.000	0.500	2.125	1.125	1.375
CAMROSE	BARLEY	UREA	2.125	0.375	0.750	0.750	0.500	1.250	1.250	0.500
CAMROSE	BARLEY	UREA	1.125	1.625	0.000	0.750	0.500	2.000	1.750	1.375
CAMROSE	BARLEY	AA	0.750	0.250	1.375	1.500	1.000	1.750	1.000	0.750
CAMROSE	BARLEY	AA	1.000	0.125	2.000	0.500	0.625	2.375	1.000	0.625
VERMILION	BARLEY	AA	1.500	0.250	2.000	1.250	2.000	2.250	1.250	1.125
VERMILION	BARLEY	AA	0.750	0.500	1.750	1.000	0.750	3.500	1.250	1.875
VERMILION	BARLEY	UREA	2.000	0.500	1.000	0.500	0.500	2.250	1.500	1.250
VERMILION	BARLEY	UREA	2.000	0.500	1.000	0.750	0.500	2.250	1.500	1.250
CALMAR	WHEAT	AA	1.500	0.500	2.750	0.750	0.500	4.000	1.000	1.250
CALMAR	WHEAT	AA	1.000	0.250	3.000	0.500	0.750	4.250	1.000	1.500
CALMAR	WHEAT	UREA	0.750	1.000	2.000	1.500	0.250	3.750		1.375
CALMAR	WHEAT	UREA	1.500	0.250	1.500	1.000	0.750	3.250	2.000	2.000
CALMAR	CANOLA	UREA	1.000	0.750	1.500	0.750	0.250	2.750	1.000	1.000
CALMAR	CANOLA	UREA	2.500	0.750	0.250	1.750	0.750	1.000	1.750	0.750
CALMAR	CANOLA	AA	1.000	0.500	2.000	0.500	0.500	3.000	2.750	1.000
CALMAR	CANOLA	AA	1.250	0.250	1.750	0.500	0.500	3.000	2.000	1.375
NEERLANDIA	BARLEY	AA	2.000	0.500	1.000	1.500	1.000	2.000	0.750	1.250
NEERLANDIA	BARLEY	AA	1.250	0.250	1.000	1.000	1.000	2.000	2.000	1.375
NEERLANDIA	BARLEY	UREA	1.000	1.000	2.250	0.750	0.750	3.500	2.250	1.125
NEERLANDIA	BARLEY	UREA	1.750	0.750	2.000	1.250	0.500	3.000	1.250	1.125
NEERLANDIA	CANOLA	UREA	1.250	0.250	1.250	0.750	0.500	2.000	1.500	0.875
NEERLANDIA	CANOLA	UREA	1.000	0.500	1.000	0.750	0.750	2.250	1.250	1.375
NEERLANDIA	CANOLA	AA	1.000	0.500	2.000	0.500	0.500	3.500	1.500	1.500
NEERLANDIA	CANOLA	AA	1.250	0.250	0.750	0.750	1.000	1.750	1.000	1.375
GRANDE PRAIRIE	BARLEY	AA	0.750	0.250	0.500	1.250	0.375	2.000	1.250	1.500
GRANDE PRAIRIE	BARLEY	AA	1.000	0.500	0.000	1.500	1.000	1.000	2.000	1.250
GRANDE PRAIRIE	BARLEY	UREA	1.375	1.125	0.000	0.750	0.500	1.750	1.875	1.375
GRANDE PRAIRIE	BARLEY	UREA	1.250	0.250	0.500	0.625	0.375	1.375	1.500	1.000

GEN 200

			SEED BANDS			FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND			BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	BARLEY	AA	1.500	1.000	2.000	1.500	1.000	4.000	3.000	2.000
BARONS	BARLEY	AA	1.000	0.500	1.500	1.250	1.000	3.000	3.000	1.750
BARONS	BARLEY	UREA	1.500	0.500	3.250	0.500	0.500	5.000	3.000	1.750
BARONS	BARLEY	UREA	1.000	0.500	2.250	0.500	0.375	3.625	3.125	1.375
BARONS	CANOLA	AA	1.250	0.500	0.250	1.125	0.625	1.250	2.750	1.000
BARONS	CANOLA	AA	2.250	1.000	0.000	1.500	1.375	0.000	3.000	0.250
BARONS	CANOLA	UREA	1.500	0.250	0.000	1.000	1.125	1.250	2.000	1.625
BARONS	CANOLA	UREA	2.500	0.750	0.000	1.000	0.625	1.500	3.250	1.500
CAMROSE	CANOLA	AA	2.250	0.625	0.375	1.000	2.250	1.250	3.000	1.625
CAMROSE	CANOLA	AA	1.625	0.375	0.625	1.000	0.375	2.250	4.000	1.625
CAMROSE	CANOLA	UREA	1.500	0.250	2.500	1.500	0.500	3.000	2.500	0.625
CAMROSE	CANOLA	UREA	0.750	0.500	0.500	1.000	0.625	1.250	2.250	0.750
CAMROSE	BARLEY	AA	1.375	0.250	0.250	0.750	0.625	1.625	0.500	1.500
CAMROSE	BARLEY	AA	1.000	0.750	1.125	1.375	0.250	2.500	2.000	1.125
CAMROSE	BARLEY	UREA	1.375	0.500	0.250	0.750	0.500	1.750	2.250	1.500
CAMROSE	BARLEY	UREA	1.375	0.500	2.500	1.000	0.375	3.000	2.250	0.500
GRANDE PRAIRIE	BARLEY	AA	1.500	0.250	1.250	1.500	0.875	2.000	2.500	1.000
GRANDE PRAIRIE	BARLEY	AA	1.500	0.250	0.750	1.250	1.000	1.000	2.500	0.625
GRANDE PRAIRIE	BARLEY	UREA	1.000	0.375	0.625	1.250	0.500	1.750	3.875	1.125
GRANDE PRAIRIE	BARLEY	UREA	2.250	0.500	0.000	1.250	0.750	1.625	2.125	1.750

GEN 200 T2X2

			SEED BANDS							FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND	RIGHT BAND		BAND	SEED TO SEED			BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ	VERT.	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	BARLEY	AA	1.000	0.500	1.500	1.000	0.500	1.500	5.000	0.000	1.000	1.000	3.000	2.500	1.750
BARONS	BARLEY	AA	1.000	0.500	1.500	1.000	0.500	1.500	5.500	0.000		0.500	3.500	2.750	2.000
BARONS	BARLEY	UREA	1.000	0.500	3.500	1.000	0.500	3.500	4.750	0.000	0.625	0.250	5.000	2.375	1.375
BARONS	BARLEY	UREA	1.000	0.500	2.000	1.000	0.500	2.000	5.000	0.000	0.750	0.500	3.000	2.500	1.000
BARONS	CANOLA	AA	1.500	0.375	0.750	0.750	0.375	0.750	6.000	0.000	1.125	0.875	2.125	3.000	1.625
BARONS	CANOLA	AA	1.375	0.375	0.750	0.500	0.375	0.750	6.250	0.000	1.500	0.625	1.750	3.125	1.125
BARONS	CANOLA	UREA	1.750	0.375	1.125	2.000	0.375	1.125	4.750	0.000	0.500	0.500	1.500	2.375	0.375
BARONS	CANOLA	UREA	2.000	0.500	0.000	1.500	0.500	0.000	5.000	0.000	1.000	0.500	1.250	2.500	1.250
CAMROSE	CANOLA	AA	1.250	0.375	0.750	0.500	0.250	1.500	5.000	0.500	1.000	0.625	2.875	2.500	2.125
CAMROSE	CANOLA	AA	1.500	0.375	1.750	1.000	0.750	1.750	4.750	0.250	1.000	0.750	3.500	2.500	2.000
CAMROSE	CANOLA	UREA	1.750	0.375	1.125	0.750	0.500	0.750	5.000	0.375	1.000	0.375	2.125	2.000	1.000
CAMROSE	CANOLA	UREA	2.500	0.250	0.000	1.000	0.625	0.375	6.000	0.500	0.875	0.250	1.625	2.000	1.625
CAMROSE	BARLEY	AA	2.000	0.375	1.000	1.000	0.125	1.125	5.500	0.000	1.000	0.625	2.000	2.250	1.125
CAMROSE	BARLEY	AA	0.500	1.000	0.500	0.500	0.750	1.250	5.000	0.625	0.500	0.500	2.500	2.500	1.750
CAMROSE	BARLEY	UREA	1.875	0.375	0.250	2.000	0.500	1.500	5.500	0.250	1.000	0.500	1.500	2.750	1.375
CAMROSE	BARLEY	UREA	1.250	0.250	0.750	1.000	0.250	0.500	5.500	0.250	1.000	0.750	1.250	2.750	0.750
GRANDE PRAIRIE	BARLEY	AA	1.250	0.625	1.500	0.500	0.125	1.375	6.125	0.125	0.750	0.500	2.875	3.000	1.500
GRANDE PRAIRIE	BARLEY	AA	1.250	0.625	0.750	1.250	1.000	0.500	6.250	0.000	0.500	0.375	2.500	3.125	1.625
GRANDE PRAIRIE	BARLEY	UREA	0.750	0.500	0.750	0.500	0.750	0.250	4.750	0.375	1.750	0.750	2.000	2.750	1.375
GRANDE PRAIRIE	BARLEY	UREA	1.250	0.500	1.250	1.000	0.125	1.000	4.000	0.375	1.125	0.500	2.500	1.750	1.250

KEY AG 4"

LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	SEED TO SEED HORZ.	SEED TO SEED VERT.	FERTILIZER BAND WIDTH	FERTILIZER BAND DEPTH	BAND DEP
BARONS	BARLEY	UREA	3.000	0.500	0.500						0.500	0.500	
BARONS	BARLEY	UREA	4.000	0.500	0.500						0.500	0.500	
BARONS	BARLEY	AA	3.500	0.500	1.500						1.500	0.750	
BARONS	BARLEY	AA		0.500	1.500							0.500	
BARONS	CANOLA	UREA	3.000	0.750	0.000							0.750	
BARONS	CANOLA	UREA	4.000	0.250	1.000						0.750	0.250	
BARONS	CANOLA	AA	5.000	0.750	0.000						1.250	1.000	
BARONS	CANOLA	AA	4.000	0.250	0.625						0.750	1.000	
CAMROSE	CANOLA	UREA	2.000	0.375	0.000	2.000	0.375	0.000	4.000	0.000	1.250	0.500	
CAMROSE	CANOLA	UREA	1.000	0.250	0.000	2.750	0.250	0.000	5.750	0.000	1.375	0.625	
CAMROSE	CANOLA	AA	2.250	0.125	0.000						1.250	1.250	
CAMROSE	CANOLA	AA	2.375	0.125	0.000	1.500	0.125	0.000	3.750	0.000	1.500	1.625	
CAMROSE	BARLEY	AA	2.000	1.000	1.250						0.750	0.500	
CAMROSE	BARLEY	AA	3.750	0.875	0.000						1.500	1.000	
CAMROSE	BARLEY	UREA	1.000	0.375	0.000	1.375	0.375	0.000	4.000	0.000	0.750	0.375	
CAMROSE	BARLEY	UREA	1.250	0.500	0.500	1.500	0.500	0.000	3.500	0.500	1.375	1.000	
GRANDE PRAIRIE	BARLEY	UREA	1.250	0.500	1.250	1.125	0.500	1.125	3.500	0.125	0.625	1.250	
GRANDE PRAIRIE	BARLEY	UREA	1.750	0.125	2.500	0.500	0.125	2.500		0.000	0.500	0.750	
GRANDE PRAIRIE	BARLEY	AA	1.000	0.375	1.625	1.250	0.750	1.000	2.250	0.375	0.625	1.625	
GRANDE PRAIRIE	BARLEY	AA	1.750	1.250	0.750	1.750	0.500	1.500	4.250	0.375	0.625	0.375	
GRANDE PRAIRIE	CANOLA	AA	0.625	0.250	1.500	1.250	0.500	1.375	2.500	0.000	1.125	0.500	
GRANDE PRAIRIE	CANOLA	AA	2.750	0.250	1.000						1.125	1.000	
GRANDE PRAIRIE	CANOLA	UREA	1.250	0.500	0.500	2.000	0.375	0.750	2.750	0.250	1.000	1 750	
GRANDE PRAIRIE	CANOLA	UREA	4.000	2.000	1.000						1.500	0.375	

KEY AG 7"

LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	SEED TO SEED HORZ.	SEED TO SEED VERT.	FERTILIZER BAND WIDTH	FERTILIZER BAND DEPTH	BAND DEPTH
BARONS	BARLEY	AA	2.000	0.500	1.500						2.250	2.000	2.0
BARONS	BARLEY	AA	3.000	0.500	2.000						1.250	0.875	2.2
BARONS	BARLEY	UREA	5.500	0.500	2.250						0.500	0.250	3.7
BARONS	BARLEY	UREA	5.000	0.250	1.250							0.500	2.0
BARONS	CANOLA	UREA	6.000	0.375	1.750						2.500	1.375	2.1
BARONS	CANOLA	UREA	6.250	0.375	0.750						1.250	1.000	1.2
BARONS	CANOLA	AA	4.000	0.875	0.750						1.125	0.750	1.5
BARONS	CANOLA	AA	4.000	0.500	0.750						1.750	1.000	1.7
CAMROSE	CANOLA	AA	1.750	0.250	0.000	1.000	0.250	0.000	3.750	0.000	0.750	0.500	1.7
CAMROSE	CANOLA	AA				0.750	0.500	0.000			0.750	1.000	2.0
CAMROSE	CANOLA	UREA	1.500	0.250	1.000	3.000	0.250	1.000	3.250	0.000	0.500	1.250	1.5
CAMROSE	CANOLA	UREA	1.250	0.375	2.000	1.250	0.625	1.625	4.000	0.250	0.750	0.375	3.2
CAMROSE	BARLEY	UREA	1.000	0.500	0.000	1.500	0.125	0.250	4.250	0.000	1.000	0.625	0.7
CAMROSE	BARLEY	UREA	1.250	0.625	0.625						1.000	0.625	1.7
CAMROSE	BARLEY	AA	1.000	0.250	0.500	1.875	0.250	0.500	3.750	0.000	0.750	0.625	1.7
CAMROSE	BARLEY	AA	2.000	2.000	0.000	2.250	0.125	1.500	5.000	0.500	0.500	0.375	2.2
GRANDE PRAIRIE	BARLEY	AA	0.250	0.250	1.750	0.625	0.125	1.625	4.500	0.125	1.000	0.500	3.0
GRANDE PRAIRIE	BARLEY	AA	1.250	0.500	2.500	1.250	0.125	2.625	5.750	0.000	1.250	0.750	3.5
GRANDE PRAIRIE	BARLEY	UREA	0.875	0.500	1.375	1.500	0.250	1.750	3.625	0.250	1.000	0.750	2.5
GRANDE PRAIRIE	BARLEY	UREA	1.125	0.750	1.750	0.750	0.125	1.875	4.500	0.750	0.875	0.750	2.5
GRANDE PRAIRIE	CANOLA	UREA	1.250	0.625	0.375	1.750	0.625	0.375	4.000	0.000	1.000	0.750	1.7
GRANDE PRAIRIE	CANOLA	UREA	0.625	0.125	1.250	0.750	0.375	1.125	4.000	0.000	0.500	0.750	1.7
GRANDE PRAIRIE	CANOLA	AA	2.000	0.375	0.875	1.250	0.750	0.625	3.500	0.000	1.000	0.750	1.7
GRANDE PRAIRIE	CANOLA	AA	1.500	0.250	0.625	1.250	0.125	0.625	5.375	0.000	1.375	1.000	1.7

MELRANDA

					SEED BANDS			FERTILIZER BAND			RELATIVE POS.	
	TYPE	TYPE	SEED	FERT.	LEFT BAND		BAND			BAND	SEED TO FERT.	
LOCATION	SEED	FERT.	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	BARLEY	UREA	1.000	0.250	0.500	1.250	0.500	1.250	1.500	0.875	0.375	0.500
BARONS	BARLEY	UREA	1.250	0.250	0.750	1.000	0.500	1.500	1.250	0.875	0.125	0.500
BARONS	BARLEY	AA	0.750	0.375	0.500	1.500	0.750	0.500	1.500	0.500	0.375	-0.063
BARONS	BARLEY	AA	0.750	0.250	0.500	1.250	1.250	0.000	2.000	0.000	1.000	-0.750
BARONS	CANOLA	AA	1.125	0.250	0.500	0.875	0.750	1.000	2.500	0.750	1.500	0.250
BARONS	CANOLA	AA	0.750	0.250	0.750	1.125	1.250	0.625	1.500	0.375	0.563	-0.375
BARONS	CANOLA	UREA	1.000	0.500	0.500	1.000	0.250	1.250	1.500	0.625	0.500	0.250
BARONS	CANOLA	UREA	1.000	0.250	1.750	1.000	0.250	1.750	1.000	0.000	0.000	-0.250
CAMROSE	CANOLA	UREA	1.125	0.500	0.375	1.000	0.500	0.000	1.000	0.375	-0.063	-0.125
CAMROSE	CANOLA	AA				2.000	0.875	0.875			-1.000	-0.438
CAMROSE	CANOLA	AA	1.000	0.875	0.375	1.750	0.750	1.000	1.625	0.500	0.250	-0.313
GRANDE PRAIRIE	BARLEY	UREA	0.750	0.250	0.750	1.250	0.500	0.750	2.125	0.125	1.125	-0.250
GRANDE PRAIRIE	BARLEY	UREA	1.625	0.125	1.375	1.000	0.625	1.375	1.750	0.250	0.438	-0.125
GRANDE PRAIRIE	BARLEY	AA	1.250	0.375	1.875	1.000	1.500	2.250	1.500	2.000	0.375	1.063
GRANDE PRAIRIE	BARLEY	AA	1.500	0.125	1.250	1.250	0.500	1.500	0.875	0.375	-0.500	0.063
GRANDE PRAIRIE	CANOLA	AA	1.500	0.875	0.750	1.375	1.000	0.750	1.125	0.000	-0.313	-0.938
GRANDE PRAIRIE	CANOLA	AA	3.250	0.500	0.750	1.000	0.875	2.000	2.500	1.375	0.375	0.688
GRANDE PRAIRIE	CANOLA	UREA	2.500	0.500	0.500	1.125	0.500	1.000	0.625	0.500	-1.188	0.000
GRANDE PRAIRIE	CANOLA	UREA	1.500	0.375	0.750	1.000	0.500	0.750	1.625	0.000	0.375	-0.438

MORRIS

			SEED BANDS								FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND	RIGHT BAND		BAND	SEED TO SEED				BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	CANOLA	AA	2.500	1.000	1.500						1.500	0.750	2.000	0.000	0.375
BARONS	CANOLA	AA	1.000	1.000	1.000	0.750	0.500	1.000	2.500	0.250	1.125	0.750	2.750	1.250	1.625
BARONS	CANOLA	UREA	1.000	1.000	1.000	0.750	1.000	1.000	2.000	0.000		0.500	3.000	1.000	1.750
BARONS	CANOLA	UREA	0.750	0.250	1.000	0.750	0.500	0.500	1.250	0.250	0.750	0.250	1.500	1.250	0.500
BARONS	BARLEY	UREA	3.000	0.500	1.000						1.250	0.500	2.750	0.000	1.750
BARONS	BARLEY	UREA	1.125	0.375	2.000	1.000	0.375	2.000	3.000	0.000	1.000	0.250	2.750	1.500	0.625
BARONS	BARLEY	AA	1.000	0.250	1.750	1.000	0.250	1.750	2.500	0.000	2.250	1.000	2.000	1.250	0.625
BARONS	BARLEY	AA	0.750	0.250	1.750	0.750	0.500	1.500	2.000	0.125	1.750	1.000	2.000	1.000	0.625
CAMROSE	BARLEY	AA	0.500	0.125	1.125	0.500	0.125	1.125	2.250	0.000	2.000	1.500	2.750	0.000	2.375
CAMROSE	BARLEY	AA	0.750	0.250	1.250	0.750	0.375	0.625	2.500	0.375	1.375	0.750	3.250	1.000	2.500
CAMROSE	BARLEY	UREA				0.750	0.250	1.250			0.750	0.750	1.625	0.500	0.625
CAMROSE	BARLEY	UREA				0.750	1.000	0.750			0.750	0.250	2.250	0.500	0.875
CAMROSE	CANOLA	UREA				4.500	0.875	0.000			0.875	0.250	1.125	2.125	0.750
CAMROSE	CANOLA	UREA	1.250	0.750	0.250	1.000	0.750	0.250	2.000	0.000	0.500	0.375	1.125	1.000	0.625
CAMROSE	CANOLA	AA	1.250	0.875	0.875	0.750	0.875	0.875	1.750	0.000	1.750	1.000	2.250	1.000	1.500
CAMROSE	CANOLA	AA	1.000	0.375	0.000	0.500	0.125	0.375	2.750	0.250	4.000	1.125	0.875	2.000	1.250
GRANDE PRAIRIE	CANOLA	AA	2.000	1.000	0.000						1.000	0.500	1.250	1.250	1.000
GRANDE PRAIRIE	CANOLA	AA	0.750	0.250	1.000	1.125	0.250	0.750	2.000	0.250	0.625	0.750	1.250	0.625	0.500
GRANDE PRAIRIE	CANOLA	UREA	3.500	1.000	0.750						0.750	0.250	2.000	1.250	0.875
GRANDE PRAIRIE	CANOLA	UREA	3.000	1.000	0.375						1.000	0.750	1.375	0.625	0.875
GRANDE PRAIRIE	BARLEY	UREA	0.625	0.500	0.625	0.500	0.125	0.625	3.000	0.250	0.500	0.500	1.250	1.500	0.625
GRANDE PRAIRIE	BARLEY	UREA	1.000	0.375	0.750	1.000	0.375	0.750	2.250	0.000	1.000	0.375	2.000	1.125	1.250
GRANDE PRAIRIE	BARLEY	AA	4.500	0.875	0.750						1.125	0.625	1.875	2.000	1.000
GRANDE PRAIRIE	BARLEY	AA	0.500	0.250	0.500	0.750	0.250	0.500	2.750	0.000	1.000	0.250	1.750	0.625	1.250

POIRIER

			SEED BANDS			FERTILIZER BAND			RELATIVE POS.	
	SEED	FERT.	LEFT BAND		BAND			BAND	SEED TO FERT.	
LOCATION	TYPE	TYPE	WIDTH	DEPTH	DEPTH	WIDTH	DEPTH	DEPTH	HORZ.	VERT.
BARONS	BARLEY	AA	1.250	0.500	2.000	1.000	1.000	1.500		0.250
BARONS	BARLEY	AA	0.750	0.500	1.500	1.500	1.000	2.000	1.500	0.750
BARONS	BARLEY	UREA	1.000	0.500	3.000		0.250	4.500	0.750	1.375
BARONS	BARLEY	UREA	1.250	0.375	3.250	0.500	0.250	3.750	1.000	0.250
BARONS	CANOLA	AA	0.750	0.500	1.500	1.500	0.500	1.500	0.000	0.000
BARONS	CANOLA	AA	1.500	0.500	1.250	1.750	1.250	1.750	1.625	1.125
BARONS	CANOLA	UREA	1.500	1.250	0.750	1.000	0.500	1.000	1.500	0.625
BARONS	CANOLA	UREA	1.500	1.750	2.250	1.000	0.250	4.000	1.000	1.000
CAMROSE	CANOLA	AA	1.250	0.750	0.750	1.000	0.750	2.000	2.000	1.750
CAMROSE	CANOLA	AA	0.750	0.500	0.500	0.500	0.250	0.750	0.750	0.125
CAMROSE	CANOLA	UREA	2.000	0.500	2.375	0.750	0.500	1.875	1.500	-1.500
CAMROSE	BARLEY	AA	1.000	0.250	0.750	1.000	1.000	1.000	0.000	0.625
CAMROSE	BARLEY	AA		0.500	0.500	1.000	1.500	0.000	2.750	0.000
CAMROSE	BARLEY	UREA	0.500	0.250	1.750	0.625	0.500	1.500	0.750	0.125
CAMROSE	BARLEY	UREA	0.500	0.125	1.625	1.000	0.750	1.000	0.750	-0.250
GRANDE PRAIRIE	BARLEY	AA	0.750	0.750	1.250	2.250	1.250	0.000	1.625	-1.000
GRANDE PRAIRIE	BARLEY	AA	0.750	0.375	0.875	1.750	1.000	0.750	2.000	0.125
GRANDE PRAIRIE	BARLEY	UREA	0.625	0.625	0.000	0.750	0.625	0.250	1.250	0.250
GRANDE PRAIRIE	BARLEY	UREA	0.750	1.000	0.625	1.000	0.500	1.000	1.750	0.125

SWEEP	LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	SEED TO SEED HORZ.	SEED TO SEED VERT.	FERTILIZER BAND LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	FERT. T HORZ.	FERT. T VERT.	RELATIVE POS. SEED TO FERT. HORZ	RELATIVE POS. SEED TO FERT. VERT.
	BURDETT	CANOLA	UREA	ALL ON SURFACE														12.000		6.000	
	BURDETT	CANOLA	AA		0.250	0.000														4.000	
	BURDETT	WHEAT	AA			1.500						3.000	3.000	0.500							
	COALDALE	WHEAT	AA	6.000	1.000	1.750						1.000	2.250	2.000	2.000	0.750	1.000				
	COALDALE	WHEAT	UREA	2.750		1.500						2.000		1.500	2.000		1.500	7.000	0.000	3.500	0.000
	COALDALE	CANOLA	AA	7.000	0.500	2.000						2.000	1.500	1.000	1.750	1.500	1.000		0.000	3.500	0.000
	COALDALE	CANOLA	UREA		0.500	1.500						1.500	0.500	1.000	2.000	0.500	1.500	7.000	0.000	3.500	0.000
	SUNNYSIDE	CANOLA	UREA	1.750	0.500	0.500						1.500	0.500	0.500	2.000	0.500	0.500	7.000	0.000	3.500	0.000
	SUNNYSIDE	CANOLA	AA	3.000	0.500	0.500							0.500	2.000		0.500	2.000	5.000	0.000	2.500	1.500
	SUNNYSIDE	BARLEY	AA	6.500	0.500	1.500						1.500	1.000	2.000	1.000	1.000	2.000	10.000	0.000	5.000	1.000
	SUNNYSIDE	BARLEY	UREA	2.500	0.500	1.500						2.000	0.500	1.500	2.000	0.500	1.500	7.500	0.000	3.750	0.000
	STRATHMORE	WHEAT	AA	10.000	0.250	1.500						2.500	0.750	1.500						0.000	0.250
	STRATHMORE	WHEAT	AA	2.000	0.125	0.875	1.250	0.125	0.875	7.500	0.000	1.875	0.625	1.000						3.750	0.500
	STRATHMORE	WHEAT	UREA	1.500	0.500	1.000						1.500	0.500	1.000	2.000	0.500	1.000	6.000	0.000	3.000	0.000
	STRATHMORE	WHEAT	UREA	2.500	0.500	1.000						1.250	0.500	0.750	2.000	0.500	0.750	14.000	0.000	7.000	0.000
	STRATHMORE	CANOLA	UREA	5.000	0.250	1.250						2.000	0.250	1.250	1.750	0.250	1.250	7.500	0.000	3.750	0.000
	STRATHMORE	CANOLA	UREA	4.500	0.750	1.250						0.750	0.250	1.750	1.000	0.250	1.750	8.000	0.000	4.000	0.250
	STRATHMORE	CANOLA	AA	9.000	0.250	1.000						1.250	1.000	1.500						6.500	0.875
	STRATHMORE	CANOLA	AA	5.250	0.500	1.000						2.000	0.750	1.250						4.000	0.375
	IRRICANNA	BARLEY	AA	8.000	0.250	0.875						2.500	0.500	0.750						6.000	0.000
	IRRICANNA	BARLEY	AA	7.500	0.125	1.000						1.250	1.000	0.375	1.000					6.500	0.125
	IRRICANNA	BARLEY	UREA	5.500	0.250	1.250						1.625	0.125	1.375	1.500	0.125	1.375	10.000	0.000	5.000	0.000
	IRRICANNA	BARLEY	UREA	1.000	0.375	0.875						1.500	0.375	1.125	1.500	0.375	1.125	9.000	0.000	4.500	0.250
	IRRICANNA	CANOLA	UREA	6.250	0.250	0.000						1.750	0.250	0.000	1.750	0.250	0.000	8.000	0.000	4.000	0.000
	IRRICANNA	CANOLA	UREA	5.750	0.250	1.250						1.250	0.250	1.250	1.250	0.625	0.875	7.000	0.250	3.500	0.000
	IRRICANNA	CANOLA	AA	4.500	0.125	0.750	3.000	0.125	1.375	7.250	0.625	1.000	0.500	1.500						3.250	1.000
	IRRICANNA	CANOLA	AA	2.000	0.500	1.000	2.500	0.125	0.750	5.500	0.125	0.750	0.625	0.375						3.500	0.500
	OLDS	BARLEY	AA	1.500	0.250	0.250						3.000	1.500	0.000						3.750	0.375
	OLDS	BARLEY	AA	4.500	0.125	0.375						1.500	1.500	0.000						4.000	0.375
	OLDS	BARLEY	UREA	1.750	0.250	1.000						1.250	0.625	0.750	1.250	0.375	0.875	6.500	0.125	3.500	0.000
	OLDS	BARLEY	UREA	2.375	0.375	0.875						1.500	0.125	1.125	1.500	0.125	1.125	6.750	0.000	3.375	0.250
	OLDS	CANOLA	UREA	4.500	0.500	0.000						3.000	0.500	0.000	2.500	1.000	0.000	8.500	0.250	4.250	0.000
	OLDS	CANOLA	UREA	3.750	0.250	0.500						1.750	0.250	0.250	2.000	0.250	0.500	7.000	0.250	3.500	0.250
	OLDS	CANOLA	AA	3.750	0.250	0.250						1.500	1.000	0.000						4.250	0.125
	OLDS	CANOLA	AA	4.000	0.250	0.000						1.750	1.250	0.000						5.000	0.500
	BARONS	BARLEY	AA	7.000	0.500	2.000						1.500	1.000	3.000							1.250
	BARONS	BARLEY	UREA		0.500	1.500						2.000	0.500	2.000	2.000	0.500	2.000	7.000	0.000	3.500	0.000
	BARONS	CANOLA	UREA	1.500	0.500	0.500						2.500	0.500	0.500	2.000	0.500	0.500	6.000	0.000	3.000	0.000
	BARONS	CANOLA	UREA	3.500	0.500	2.000						3.000	0.500	2.000	3.000	0.500	2.000	6.500	0.000	3.250	0.000
	BARONS	CANOLA	AA	4.000	0.500	0.625						2.125	1.500	2.000						5.000	1.875
	BARONS	CANOLA	AA	2.750	0.500	2.000						2.500	0.875	2.500						3.750	0.625
	CAMROSE	CANOLA	UREA	3.000	0.375	0.375						1.250	0.500	0.500	1.250	0.500	0.500	8.000	0.000	4.000	0.125
	CAMROSE	CANOLA	UREA	4.000	0.125	1.000						2.000	0.250	0.750	2.000	0.250	0.750	10.000	0.000	5.000	0.125
	CAMROSE	CANOLA	AA	3.250	1.250	0.000	5.000	1.000	0.000	6.250	0.125	3.250	0.750	1.250						2.250	1.000
	CAMROSE	CANOLA	AA	2.000	0.125	0.375	2.250	0.125	0.375		0.000	2.000	0.875	0.625							0.500
	CAMROSE	CANOLA	AA	3.000	0.125	1.875						2.000	0.250	1.625	1.250	0.250	1.625	7.000	0.000	4.000	0.000
	CAMROSE	BARLEY	UREA	2.250	0.125	2.750						2.250	0.125	2.750	2.250	0.125	2.750	6.500	0.000	2.500	0.000
	CAMROSE	BARLEY	UREA	2.500	0.250	1.250						2.000	0.625	1.375						5.500	0.375
	CAMROSE	BARLEY	AA	5.250	0.250	2.000						1.250	0.625	2.750						4.750	1.000
	CAMROSE	BARLEY	AA	4.000	0.125	1.500						0.750	2.500	1.500						5.250	1.250
	VERMILION	BARLEY	AA	6.000	0.125	1.250						4.000	1.000	1.500						5.000	0.750
	VERMILION	BARLEY	UREA	6.000	0.500	2.250						1.750	0.500	2.500	1.500	0.500	2.500	7.000	0.000	3.500	0.125
	VERMILION	BARLEY	UREA		0.500	1.250						1.500	0.250	1.250	1.250	0.250	1.500	7.500	0.250	3.750	-0.125
	VERMILION	BARLEY	UREA	4.750	0.250	1.250						1.500	1.000	1.250						4.250	0.375
	CALMAR	WHEAT	UREA	6.750	0.250	1.000						1.250	0.750	1.500						4.250	0.750
	CALMAR	WHEAT	UREA		0.375	1.500						2.000	0.250	1.250	1.750	0.250	1.250	7.500	0.000	3.750	-0.375
	CALMAR	WHEAT	AA		0.250	1.500						2.750	1.500	1.250	2.000	1.500	1.250	7.250	0.000	3.625	0.375
	CALMAR	WHEAT	AA		0.250	1.500						1.500	0.250	1.250	1.500	0.500	1.250	6.500	0.125	2.750	-0.250
	CALMAR	CANOLA	UREA	3.000	0.750	1.250						1.250	0.250	1.500	1.000	0.250	1.250	6.250	0.250	3.125	0.250
	CALMAR	CANOLA	UREA	1.500	0.250	1.250						1.000	1.750	2.250						2.500	1.250
	CALMAR	CANOLA	AA	3.500	0.250	1.750						1.250	1.000	2.000						4.000	-0.750
	CALMAR	CANOLA	AA	5.000	1.000	2.750						1.250	0.750	1.500						5.000	0.625
	NEERLANDIA	BARLEY	AA	2.500	0.500	0.750						1.750	1.500	0.500						4.250	-0.500
	NEERLANDIA	BARLEY	AA	2.250	0.500	1.000						1.250	0.500	1.750	1.500	0.500	1.750	6.500	0.000	3.250	0.500
	NEERLANDIA	BARLEY	UREA	1.750	1.000	1.000						2.000	1.000	0.500	2.250	0.500	1.500	7.250	0.750	3.625	-0.875
	NEERLANDIA	BARLEY	UREA	1.250	0.250	1.750						1.500	0.250	0.750	1.500	0.500	0.750	7.500	0.125	3.750	0.375
	NEERLANDIA	CANOLA	UREA	1.750	0.500	1.000						1.500	0.500	0.250	2.000	0.500	0.750	8.500	0.500	3.000	0.375
	NEERLANDIA	CANOLA	UREA	3.500	0.250	0.750						1.000	0.750	1.250						6.000	0.375
	NEERLANDIA	CANOLA	AA	2.250	0.500	1.000						0.750	1.250	1.500						3.500	0.000
	NEERLANDIA	CANOLA	AA	3.750	0.250	2.000						1.000	0.500	1.250						3.625	0.250
	GRANDE PRAIRIE	BARLEY	AA	5.250	0.625	1.000						0.500	0.750	1.500						4.750	
	GRANDE PRAIRIE	BARLEY	AA	5.250		1.750						1.125	0.500	0.500	1.000	0.250	0.750	6.500	0.125	3.250	-0.125
	GRANDE PRAIRIE	BARLEY	UREA	3.375	0.125	0.875						1.000	0.750	1.000	1.000	0.500	1.500	7.250	0.375	3.750	-0.500
	GRANDE PRAIRIE	BARLEY	UREA	2.000	0.125	1.875															

KEY AG SWEEP

LOCATION	SEED TYPE	FERT. TYPE	SEED BANDS LEFT BAND WIDTH	LEFT BAND DEPTH	BAND DEPTH	RIGHT BAND WIDTH	RIGHT BAND DEPTH	BAND DEPTH	SEED TO SEED HORZ.	SEED TO SEED VERT.	FERTILIZER BAND WIDTH	FERTILIZER BAND DEPTH	BA DE
BARONS	BARLEY	UREA	7.000		2.250						0.500	4.000	
BARONS	BARLEY	UREA	1.000	0.500	2.500	1.000	0.500	2.500			0.500	0.500	
BARONS	BARLEY	AA	10.000	0.500	2.500						1.250	1.500	
BARONS	BARLEY	AA	11.000	0.500	2.500						1.250	1.250	
BARONS	CANOLA	AA	9.000	0.500	0.000						1.125	1.000	
BARONS	CANOLA	AA	4.000	0.250	1.750						1.250	1.000	
BARONS	CANOLA	UREA	10.000	0.500	0.000						1.500	1.500	
BARONS	CANOLA	UREA	6.000	0.250	1.750						1.000	0.875	
CAMROSE	CANOLA	UREA	3.750	0.625	0.375	4.375	0.625	0.375	7.500	0.000	0.500	0.875	
CAMROSE	CANOLA	UREA	2.000	0.625	1.125	0.750	0.875	1.000	3.750	0.000	0.500	0.750	
CAMROSE	CANOLA	AA	6.750	0.500	0.000						1.250	0.750	
CAMROSE	CANOLA	AA	6.000	0.500	0.000						1.000	0.500	
CAMROSE	BARLEY	AA	1.500	1.000	1.000	1.000	0.500	0.500	3.500	0.750	1.000	0.750	
CAMROSE	BARLEY	AA	2.000	1.125	1.625	3.500	1.125	1.625	5.500	0.000	0.750	0.625	
CAMROSE	BARLEY	UREA	3.000	0.125	0.625	3.000	0.375	0.625	5.000	0.125	0.500	0.375	
CAMROSE	BARLEY	UREA	2.000	0.250	1.625	1.250	0.500	1.500	8.000	0.000	0.500	1.250	
GRANDE PRAIRIE	BARLEY	UREA	2.000	0.500	0.500	3.000	0.750	1.000	5.500	1.625	1.250	0.500	
GRANDE PRAIRIE	BARLEY	UREA	1.000	0.250	1.750	1.000	0.125	1.375	6.750	0.375	1.750	0.250	
GRANDE PRAIRIE	BARLEY	AA	3.750	0.250	0.750	3.000	0.250	1.250	6.000	0.500	0.625	1.000	
GRANDE PRAIRIE	BARLEY	AA	3.250	0.250	0.750	4.250	0.500	0.500	4.500	0.125	1.000	0.750	
GRANDE PRAIRIE	CANOLA	AA	4.000	0.500	0.750	1.375	0.125	1.000	4.750	0.000	1.625	0.875	
GRANDE PRAIRIE	CANOLA	AA	2.500	0.500	0.750	1.250	0.250	1.375	5.500	0.500	1.000	1.125	
GRANDE PRAIRIE	CANOLA	UREA	2.750	0.500	0.750	4.500	0.250	0.750	5.750	0.125	1.000	0.500	
GRANDE PRAIRIE	CANOLA	UREA	3.500	0.500	1.125	2.250	0.750	0.750	6.250	0.250	1.000	0.875	

Appendix 2

Factor Averages

Southern Alberta Fertility Sites

BURDETT	Emergence (plant/m^2)			Yield (bu/ac)		
	Barley	*Wheat*	*Canola*	*Barley*	*Wheat*	*Canola*
Seeding Opener						
Bourgault Mid-Row	101.38	140.27	149.32	112.98	72.80	-
Flexi-Coil Pair Row	136.26	138.69	143.90	103.41	57.47	-
Flexi-Coil Side Band	136.60	138.85	207.20	112.76	66.78	-
Sweep and Tube	158.03	157.15	217.80	103.07	61.87	-
Fertilizer Type						
Urea	141.08	146.31	178.53	107.14	63.64	-
NH_3	125.06	141.21	180.58	108.97	65.82	-
Fertilizer Rate						
0 lb/ac	140.00	146.86	193.72	81.92	47.43	-
50 lb/ac	136.70	146.12	182.05	105.41	62.94	-
100 lb/ac	136.10	148.54	172.22	121.08	72.90	-
150 lb/ac	119.48	133.52	170.23	123.81	75.62	-

COALDALE	Emergence (plant/m^2)			Yield (bu/ac)		
	Barley	*Wheat*	*Canola*	*Barley*	*Wheat*	*Canola*
Seeding Opener						
Bourgault Mid-Row	135.15	90.72	175.72	80.23	53.30	41.49
Flexi-Coil Pair Row	153.05	132.06	173.73	87.39	58.04	41.21
Flexi-Coil Side Band	161.35	141.14	192.67	81.84	51.37	37.55
Sweep and Tube	195.16	154.22	276.87	85.25	48.68	38.62
Fertilizer Type						
Urea	164.89	137.14	208.85	84.26	53.89	39.38
NH_3	159.47	121.93	200.93	83.09	51.80	40.05
Fertilizer Rate						
0 lb/ac	164.79	143.46	241.48	64.79	44.75	38.50
50 lb/ac	165.86	130.48	198.43	85.41	51.34	40.04
100 lb/ac	160.21	123.22	195.43	92.45	48.20	41.14
150 lb/ac	153.86	121.03	183.15	92.06	57.60	38.50

LETHBRIDGE	Emergence (plant/m^2)			Yield (bu/ac)		
	Barley	*Wheat*	*Canola*	*Barley*	*Wheat*	*Canola*
Seeding Opener						
Bourgault Mid-Row	218.77	98.33	267.92	89.82	73.69	34.89
Flexi-Coil Pair Row	191.29	110.96	198.15	95.52	83.16	38.98
Flexi-Coil Side Band	210.23	102.58	242.29	96.38	76.87	37.12
Sweep and Tube	201.08	104.18	185.68	94.34	78.07	37.71
Fertilizer Type						
Urea	213.78	105.24	225.81	97.88	78.87	36.72
NH_3	196.91	102.79	221.22	90.16	77.03	37.62
Fertilizer Rate						
0 lb/ac	202.22	93.03	246.46	77.39	69.72	33.49
50 lb/ac	208.18	105.63	223.62	94.18	79.16	37.73
100 lb/ac	207.98	106.89	220.56	100.93	80.11	38.83
150 lb/ac	203.00	110.51	203.40	103.56	82.82	38.65

Central-Alberta Fertility Sites

IRRICANA	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Canola*	*Barley*	*Canola*
Seeding Opener				
Barton	107.72	129.41	62.08	19.20
Flexi-Coil Pair Row	118.94	153.75	61.84	19.10
Flexi-Coil Side Band	124.09	152.09	62.56	19.18
Sweep and Tube	119.09	159.88	69.20	20.17
Fertilizer Type				
Urea	118.61	155.45	64.62	19.61
NH_3	116.31	142.11	63.23	19.22
Fertilizer Rate				
0 lb/ac	118.56	153.25	50.19	15.11
50 lb/ac	116.41	157.69	65.45	19.20
100 lb/ac	118.94	150.72	69.71	21.48
150 lb/ac	115.94	133.47	70.33	21.87

STRATHMORE	Emergence (plant/m^2)		Yield (bu/ac)	
	Wheat	*Canola*	*Wheat*	*Canola*
Seeding Opener				
Barton	130.13	92.25	59.98	20.72
Flexi-Coil Pair Row	130.69	139.94	64.09	16.48
Flexi-Coil Side Band	131.31	132.97	63.28	18.02
Sweep and Tube	140.03	142.69	62.88	17.80
Fertilizer Type				
Urea	132.94	128.64	63.07	17.81
NH_3	133.14	125.28	62.04	18.70
Fertilizer Rate				
0 lb/ac	129.88	125.94	53.14	16.42
50 lb/ac	136.63	128.34	62.53	17.92
100 lb/ac	135.81	128.97	66.55	19.23
150 lb/ac	129.84	124.59	68.00	19.45

OLDS	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Canola*	*Barley*	*Canola*
Seeding Opener				
Barton	113.50	-	106.31	25.80
Flexi-Coil Pair Row	100.88	-	106.49	26.35
Flexi-Coil Side Band	111.53	-	111.99	24.63
Sweep and Tube	111.59	-	112.11	26.09
Fertilizer Type				
Urea	110.94	-	110.92	25.75
NH_3	107.81	-	107.53	25.68
Fertilizer Rate				
0 lb/ac	111.47	-	90.10	24.13
50 lb/ac	110.25	-	111.17	25.67
100 lb/ac	108.44	-	118.21	26.57
150 lb/ac	107.34	-	117.42	26.49

Northern Alberta Fertility Sites

CALMAR	Emergence (plant/m^2)		Yield (bu/ac)	
	Wheat	*Canola*	*Wheat*	*Canola*
Seeding Opener				
Barton	-	93.87	46.65	30.95
Flexi-Coil Pair Row	-	125.98	45.31	39.84
Flexi-Coil Side Band	-	116.63	46.42	35.07
Sweep and Type	-	126.11	44.81	37.77
Fertilizer Type				
Urea	-	110.61	45.78	37.78
NH_3	-	120.69	45.81	34.04
Fertilizer Rate				
0 lb/ac	-	128.94	33.85	24.94
50 lb/ac	-	116.88	45.88	35.91
100 lb/ac	-	110.48	51.31	40.70
150 lb/ac	-	106.30	52.15	42.08

NEERLANDIA	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Canola*	*Barley*	*Canola*
Seeding Opener				
Barton	110.11	67.05	93.16	24.13
Flexi-Coil Pair Row	100.89	94.24	96.63	25.74
Flexi-Coil Side Band	99.66	84.65	100.01	23.78
Sweep and Tube	108.15	102.24	100.60	27.76
Fertilizer Type				
Urea	102.79	84.77	99.94	26.36
NH_3	106.61	86.20	95.26	24.34
Fertilizer Rate				
0 lb/ac	106.91	95.84	71.19	24.47
50 lb/ac	107.53	89.07	95.40	24.68
100 lb/ac	104.08	82.80	108.61	26.37
150 lb/ac	100.27	80.46	115.20	25.89

VERMILION	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Wheat*	*Barley*	*Wheat*
Seeding Opener				
Barton	108.51	107.04	46.10	24.48
Flexi-Coil Pair Row	103.22	111.71	47.04	26.08
Flexi-Coil Side Band	118.23	120.69	48.99	25.81
Sweep and Tube	81.08	99.29	45.96	26.79
Fertilizer Type				
Urea	101.75	112.82	48.21	27.16
NH_3	103.78	106.54	45.83	24.41
Fertilizer Rate				
0 lb/ac	104.57	112.33	40.14	21.13
50 lb/ac	108.88	111.34	48.42	26.63
100 lb/ac	102.85	111.22	52.01	27.26
150 lb/ac	94.74	103.84	47.53	28.13

Opener Sites

BARONS	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Canola*	*Barley*	*Canola*
Seeding Opener				
Bourgault Mid-Row	173.30	256.06	96.97	30.49
Bourgault Side Band	177.36	242.55	98.05	28.28
Flexi-Coil Pair Row	148.54	202.48	98.35	30.91
Flexi-Coil Side Band	152.01	178.32	90.72	30.54
Gen 200 T2	147.22	225.68	101.69	29.23
Gen 200 T2x2	164.21	211.45	108.59	28.78
Key Ag 4 inch	169.47	211.33	106.61	30.47
Key Ag 7 inch	158.47	185.97	101.35	31.32
Key Ag Sweep	143.16	163.85	98.18	30.07
Melranda	151.77	182.27	91.50	30.02
Morris	153.44	170.19	96.43	30.00
Poirier	144.47	177.24	87.95	33.27
Sweep and Tube	170.31	171.51	92.53	31.83
Fertilizer Type				
Urea	158.66	203.92	100.19	31.41
NH_3	157.30	186.37	95.03	29.40
Fertilizer Rate				
0 lb/ac	156.63	230.51	63.26	17.13
50 lb/ac	156.10	196.26	101.73	31.70
150 lb/ac	161.21	168.35	127.83	42.38

CAMROSE	Emergence (plant/m^2)		Yield (bu/ac)	
	Barley	*Canola*	*Barley*	*Canola*
Seeding Opener				
Barton	119.36	246.73	94.34	21.49
Bourgault Mid-Row	160.59	294.21	97.60	20.04
Bourgault Side Band	161.94	180.59	100.46	21.54
Flexi-Coil Pair Row	181.55	103.93	87.25	25.26
Flexi-Coil Side Band	187.53	174.25	84.39	26.85
Gen 200 T2	170.31	145.55	87.88	22.94
Gen 200 T2x2	160.98	126.30	89.69	24.72
Key Ag 4 inch	161.10	201.88	92.54	23.42
Key Ag 7 inch	181.55	212.28	93.46	24.01
Key Ag Sweep	160.38	153.68	91.82	21.85
Melranda	162.17	108.00	96.68	20.92
Morris	139.22	-	96.78	26.65
Poirier	157.99	87.43	85.62	21.64
Sweep and Tube	152.01	167.20	81.93	31.68
Fertilizer Type				
Urea	159.75	171.14	91.00	25.42
NH_3	162.62	167.64	91.93	24.14
Fertilizer Rate				
0 lb/ac	166.12	178.04	88.81	22.17
50 lb/ac	160.53	171.58	91.99	24.22
150 lb/ac	156.90	158.53	93.58	27.95

GRANDE PRAIRIE	Emergence (plant/m^2) *Barley*	Yield (bu/ac) *Barley*
Seeding Opener		
Bourgault Double Shoot	138.73	115.72
Bourgault Mid-Row	100.87	116.88
Flexi-Coil Pair Row	126.78	118.52
Flexi-Coil Side Band	122.95	116.23
Gen 200 T2	88.74	125.48
Gen 200 T2x2	96.64	123.87
Key Ag 4 inch	93.41	105.61
Key Ag 7 inch	103.69	110.41
Key Ag Sweep	127.61	115.93
Melranda	133.47	116.33
Morris	143.28	113.74
Poirier	116.13	120.43
Sweep and Tube	131.44	112.17
Fertilizer Type		
Urea	115.31	115.39
NH_3	120.65	117.12
Fertilizer Rate		
0 lb/ac	119.61	127.04
50 lb/ac	110.60	124.29
150 lb/ac	119.84	97.44