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Investigation into Placement of Anhydrous Ammonia and Urea with Seed

Abstract

Current recommendations for using anhydrous ammonia (82-0-0) are to place it in a separate furrow away from seed. Very little research has been completed on placing anhydrous ammonia (NH_3) in the seed row. A study was started in 1997 to determine the effect of seed-placed urea (46-0-0) and NH_3. Results from 1997 showed the type of seed-placed nitrogen did not affect the emergence or yield of canola and wheat. The study was continued in 1998 with a treatment consisting of sidebanded urea added.

Use of the sideband nitrogen system resulted in higher emergence and yield and shorter days to maturity than the seed-placed nitrogen systems at higher fertilizer rates. Use of the seed-placed urea nitrogen system usually resulted in higher emergence and yield than the seed-placed NH_3 nitrogen system. This result differs from the 1997 results. Possible explanations for the difference could be seed type and weather.

Introduction

Anhydrous Ammonia (NH_3) is a very popular form of nitrogen fertilizer. It is normally the lowest priced form of nitrogen fertilizer. The high concentration of NH_3 cuts transport to a minimum. Current recommendations for using NH_3 are to place it in a separate furrow away from seed. Very little research has been completed on placing NH_3 in the seed row. A study was started in 1997 to determine the effect of seed-placed Urea (46-0-0) and NH_3. Results from 1997 showed the type of seed-placed nitrogen did not affect the emergence or yield of canola and wheat. The study was continued in 1998 with barley as the seed-type. Six different rates of seed-placed Urea (46-0-0) and NH_3 (82-0-0) were compared to sidebanded Urea (46-0-0).

Experimental Procedure

Experimental sites for the project were a clay loam soil northeast of Lethbridge and a loam soil south of Edmonton. AC Lacombe barley was direct-seeded into moist soil on May 20, 1998 at the Edmonton site and on June 8 at the Lethbridge site. Both sites were sprayed with Roundup prior to seeding. The seeding rate was 112 kg/ha (100 lb/ac). Phosphate, in the form of 11-51-00, was placed with the seed at a rate of 34 kg/ha (30 lb/ac).

Crop emergence counts were taken on June 10 at the Edmonton site and July 7 at the Lethbridge site. One count was taken for each row of every plot. Champion Plus was sprayed at the Edmonton site on June 24. Refine Extra and 2,4-D were sprayed at the Lethbridge site on July 7.

The Edmonton canola plots were not harvested due to weeds. The Edmonton wheat plots were sprayed with Roundup on September 10 and harvested on September 24. The Lethbridge plots were harvested on August 28.

The crops were seeded later than normal in the study due to fabricated plot equipment delays and wet spring weather. Growing conditions at the three sites were different. The Lethbridge site was hot and dry during the growing season. The Edmonton site was also hot but received adequate moisture during the growing season.

Plot yields were obtained with a self-propelled plot harvester. The Edmonton plots were harvested on August 28. The Lethbridge plots were harvested on September 11.

A Gen 200 T1 opener, **Figure 1**, was used for the seed-placed nitrogen treatments. Seed, phosphate and urea were delivered through the front tube. Anhydrous ammonia was delivered through the 13 mm (0.5 in) outside diameter (O.D.) tube attached to the back of the opener. The delivery tube was 6.4 mm (0.25 in) O.D. The tube was placed through the metal tube flush with the end. This small delivery tube caused back pressure. This high pressure caused the NH_3 to turn into a vapour, commonly called hot flow.

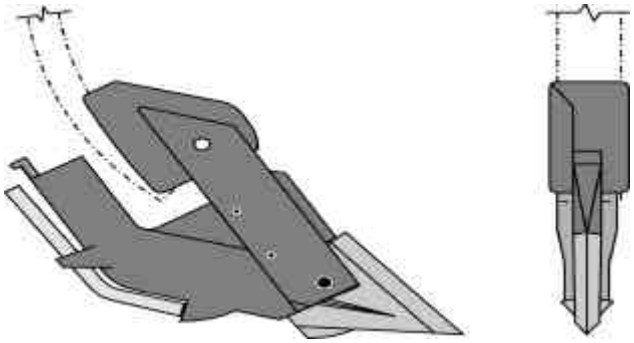

Figure 1. Gen 200 T1 Opener.

A Gen 200 T2 opener, **Figure 2**, was used for the sideband urea treatment. Seed and phosphate fertilizer were delivered through the front tube and placed by the wing on the side. The urea was delivered through the rear tube and placed by the front point.

Nitrogen fertilizer was applied at 0, 34, 67, 101, 134 and 168 kg/ha (0, 30, 60, 90, 120 and 150 lb/ac). The plots were replicated three times in a randomized complete block design experiment.

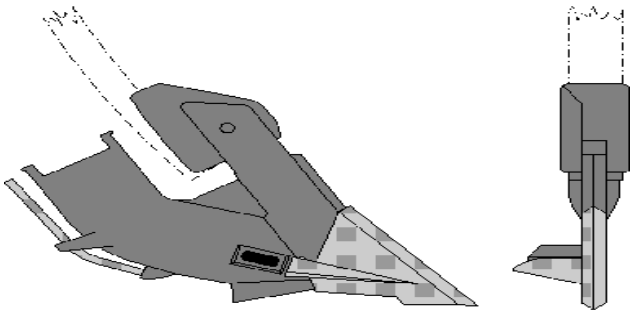

Figure 2. Gen 200 T2 Opener.

The plots were 2.43 x 15.24 m (8 x 30 ft). A 10.7 m (35 ft) strip was left between each block to

allow for turning and starting of implements. Border affects were controlled through plot randomization and winter crops on sides.

Table 1 outlines the levels of factors used in the experiment.

Table 1.

Factor	Level
Nitrogen Systems (3)	Seed-placed Urea Seed-placed NH_3 Sideband Urea
Nitrogen Rate (6)	0, 34, 67, 101, 134 and 168 kg/ha (0, 30, 60, 90, 120 and 150 lb/ac)
Replications	3

The following experimental constants were used for the experiment:

Implements

Travel Speed	-	6.4 km/h (4 mph)
Tractor	-	63 kW (85 hp) tractor
Row Spacing	-	24.5 cm (10 in)
Seeder	-	AFMRC plot seeder
Phosphate rate	-	34 kg/ha (30 lb/ac) of 11-51-00

Results

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

Mean plant counts for nitrogen rate are presented in **Figure 3**. Differences in crop emergence between nitrogen rates were highly significant at both sites. At the Lethbridge site, the emergence at the two lowest nitrogen rates was significantly higher than the emergence at the three highest nitrogen rates. At the Edmonton site, the emergence at the lowest nitrogen rate was significantly higher than the emergence at the three highest nitrogen rates. Treatments with the same letter do not have significantly different means.

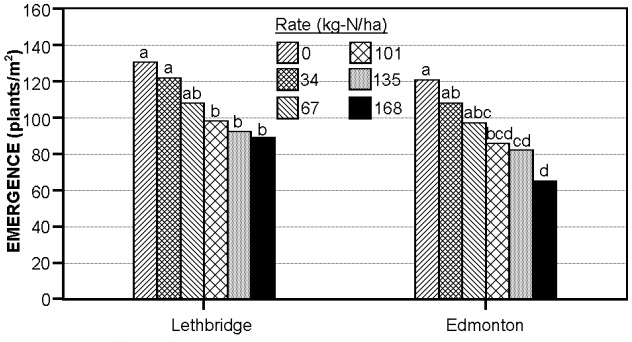

Figure 3. Effect of Nitrogen Rate on Barley Emergence.

Mean plant counts for various nitrogen systems are presented in **Figure 4**. Differences in crop emergence between the various nitrogen systems were highly significant at both sites. Use of the sideband system resulted in significantly higher emergence than the two seed-placed systems at the Lethbridge site. Use of the sideband system resulted in significantly higher emergence than the seed-placed NH_3 system at Edmonton's site.

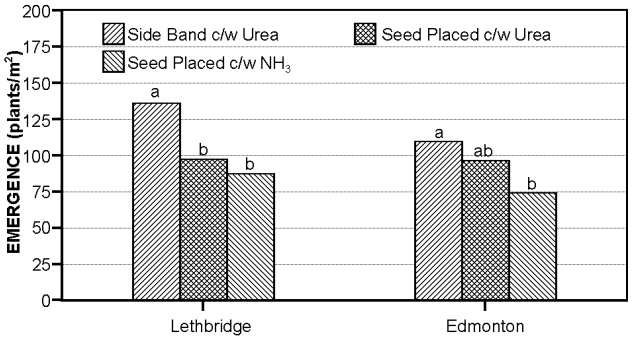

Figure 4. Effect of Nitrogen System on Barley Emergence.

The ANOVA of the plant count data at both sites resulted in a highly significant first order interaction. **Figures 5 and 6** show the effect of nitrogen rate and system on barley emergence at both sites. An increase in nitrogen rate resulted in a decrease in emergence for the two seed placed systems. The nitrogen rate did not affect the emergence with the sideband system.

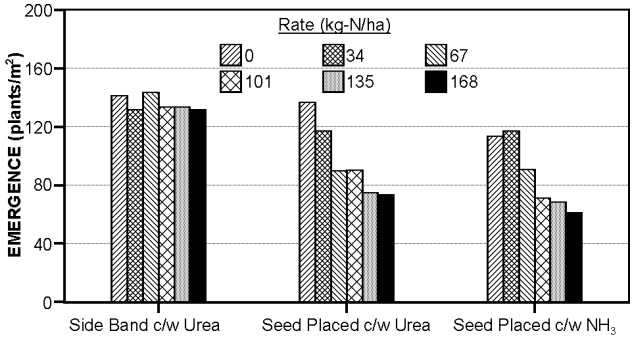

Figure 5. Effect of Nitrogen Rate and System on Barley Emergence at Lethbridge Site.

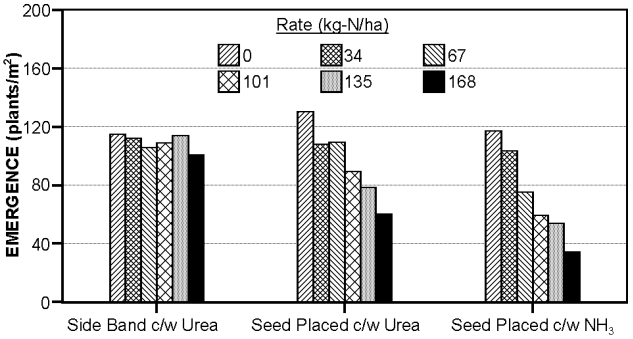

Figure 6. Effect of Nitrogen Rate and System on Barley Emergence at Edmonton Site.

Mean crop yields for nitrogen rate are presented in **Figure 7**. Differences in crop yield were highly significant at both sites. At the Lethbridge site, the highest nitrogen rate yielded significantly higher than the zero rate. At the Edmonton site, the three highest nitrogen rates yielded significantly higher than the two lowest nitrogen rates.

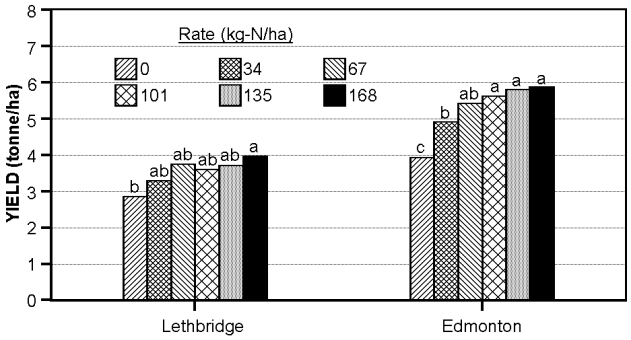

Figure 7. Effect of Nitrogen Rate on Barley Yield.

Mean barley yields for nitrogen system are presented in **Figure 8**. Differences in barley yield between nitrogen systems were highly significant at both sites. The comparison of means showed no significant difference at the Lethbridge site. Use of the sideband and seed placed with urea systems yielded significantly higher than the seed placed with urea system at Edmonton's site.

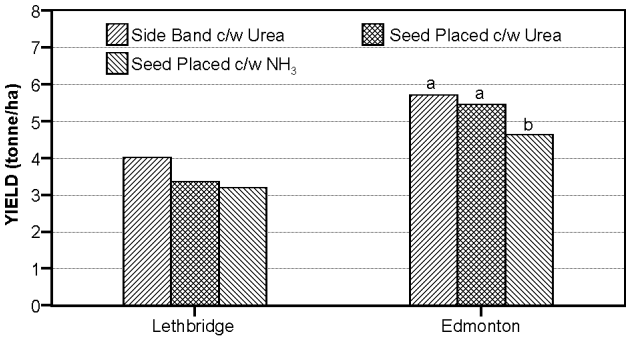

Figure 8. Effect of Nitrogen System on Barley Yield.

The ANOVA of the yield at Edmonton resulted in a significant first order interaction. **Figure 9** shows the effect of nitrogen rate and system on barley yield at the Edmonton site. An increase in nitrogen rate resulted in an increase in yield for all nitrogen systems. The amount of the yield increase varied for the different nitrogen systems. The sideband with urea nitrogen system peaked at a slightly higher yield than the seed placed with urea nitrogen system. The seed placed with NH_3 nitrogen system peaked at a much lower yield than the other two systems.

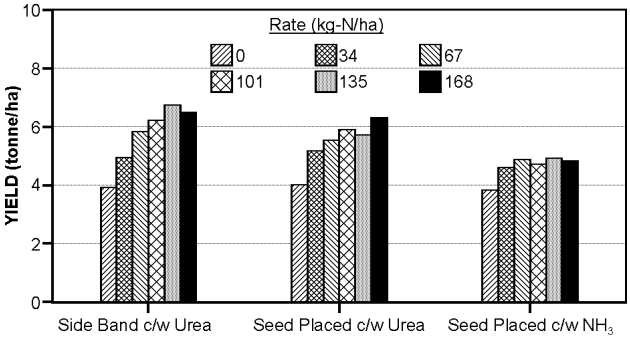

Figure 9. Effect of Nitrogen Rate and System on Barley Yield at the Edmonton Site.

Days to maturity were calculated and analyzed for both sites. Mean days to maturity for nitrogen rate and system are presented in **Tables 2 and 3**. Differences in days to maturity between nitrogen rates and systems were highly significant at both sites. An increase in nitrogen rate resulted in an increase in days to maturity at both sites. Use of the three lowest nitrogen rates resulted in significantly lower days to maturity than the highest nitrogen rate at the Lethbridge site. At Edmonton's site, use of the three lowest nitrogen rates resulted in significantly lower days to maturity than the two highest nitrogen rates. Use of the sideband urea nitrogen system resulted in significantly lower days to maturity than the other two nitrogen systems at the Lethbridge site. At the Edmonton site, use of the of the sideband urea nitrogen system resulted in significantly lower days to maturity than the seed-placed NH_3 nitrogen system.

Table 2. Effect of Nitrogen Rate on Days to Maturity.

Nitrogen Rate (kg/ha)	Lethbridge	Edmonton
0	86.2 a	91.9 a
34	85.4 a	92.0 a
67	85.8 a	92.3 a
101	86.7 ab	92.8 ab
134	87.3 ab	93.8 bc
168	88.3 b	94.7 c

Table 3. Effect of Nitrogen System on Days to Maturity.

Nitrogen System	Lethbridge	Edmonton
Sideband Urea	85.1 a	92.4 a
Seed-placed Urea	87.7 b	92.7 ab
Seed-placed NH_3	87.1 b	93.7 b

The ANOVA of the days to maturity resulted in highly significant first order interactions at both sites. **Tables 4 and 5** show the effect of nitrogen rate and system on days to maturity at both sites.

Table 4. Effect of Nitrogen Rate and System on Days to Maturity at Lethbridge.

Nitrogen Rate (kg/ha)	Sideband Urea	Seed-placed Urea	Seed-placed NH_3
0	86.1	86.2	86.5
34	85.0	86.0	85.8
67	85.0	86.5	85.9
101	84.8	88.1	87.3
134	85.1	89.0	87.8
168	84.8	90.6	89.6

Table 5. Effect of Nitrogen Rate and System on Days to Maturity at Edmonton.

Nitrogen Rate (kg/ha)	Sideband Urea	Seed-placed Urea	Seed-placed NH_3
0	92.1	91.8	91.8
34	92.4	91.7	92.0
67	92.1	92.0	92.8
101	92.1	92.4	94.0
134	92.7	93.3	95.3
168	92.7	94.6	96.6

An increase in nitrogen rate resulted in an increase in days to maturity for the two seed-placed nitrogen systems. The days to maturity for the sideband urea nitrogen system remained constant over the range of nitrogen rates.

Discussion and Conclusions

Nitrogen rate affected the emergence of barley with both seed-placed nitrogen systems. An increase in nitrogen rate resulted in a decrease in emergence. Nitrogen rate did not affect the emergence of barley with the sideband nitrogen system. The emergence remained constant through the range of nitrogen rates.

Nitrogen system affected the emergence of barley. The use of the sideband nitrogen system resulted in higher emergence than the two seed-placed nitrogen systems. At the Lethbridge site, the difference in emergence between the sideband and seed-placed nitrogen systems was significant. At the Edmonton site, the use of the sideband nitrogen system resulted in significantly higher emergence than the seed-placed NH_3 nitrogen system. Barley emergence with the seed-placed NH_3 nitrogen system was lower than the seed-placed urea nitrogen system at both sites but the difference was not significant.

Nitrogen rate affected barley yield. An increase in nitrogen rate resulted in an increase in barley yield. The barley yield response to nitrogen rate was less at the Lethbridge site. This was probably due to the hot dry summer at the Lethbridge site which depressed yields.

Nitrogen system affected barley yield. At the Edmonton site, the use of the seed-placed NH_3 nitrogen system resulted in significantly less barley yield than the other two nitrogen systems. Investigation of the interaction between nitrogen rate and nitrogen system showed the seed-placed nitrogen system peaked at a much lower nitrogen rate than the other two nitrogen systems.

Nitrogen rate affected days to maturity of barley. An increase in nitrogen rate resulted in an increase in days to maturity. Nitrogen system affected days to maturity. The use of the sideband nitrogen system resulted in lower days to maturity than the two seed-placed nitrogen systems at higher fertilizer rates.

Results from 1998 differ from the 1997 results. In 1998, the crop emergence and yield with the seed-placed urea nitrogen system was usually higher than the seed-placed NH_3 nitrogen system. In 1997, the type of seed-placed nitrogen did not affect the crop emergence or yield. Possible explanations for the difference could be seed type and weather.

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