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ALBERTA FARM MACHINERY RESEARCH CENTRE

Investigation Into Use Of Liquid Fertilizer With Flexi-coil Openers

Abstract

One of the main obstacles in the adoption of direct seeding is the application of fertilizer. Research in this area is very limited. Manufacturers state using liquid fertilizer results in increased emergence during seeding. An experiment was conducted to determine the effect of using four different openers with four rates of liquid and granular fertilizer on the emergence and yield of barley.

Generally, the nitrogen-type did not affect the emergence of barley in the study. The nitrogen-type did, however, affect the emergence with the various openers. The nitrogen-type affected the yield of barley in the study. Barley yield with liquid as the nitrogen source was significantly higher than with urea as the nitrogen source at the Coaldale site. The type of opener affected the emergence and yield of barley. In most conditions, the narrow opener resulted in lower emergence and yield. The experiment should continue in future to verify results and further investigate the interaction of nitrogen-type and openers.

Introduction

One of the main obstacles in the adoption of direct seeding is the application of fertilizer. Research in this area is very limited. Manufacturers state using liquid fertilizer results in increased emergence while applying during seeding. Reduced or no separation of seed and liquid fertilizer will result in demand for new designs of double shoot openers for liquid fertilizer. The result will be increased adoption of direct seeding because farmers can use cheaper soil openers with liquid fertilizer. Liquid fertilizer is also safer to use than anhydrous ammonia. The experiment will assess the effect of using four different openers with four rates of liquid and granular fertilizer on the emergence and yield of barley.

Experimental Procedure

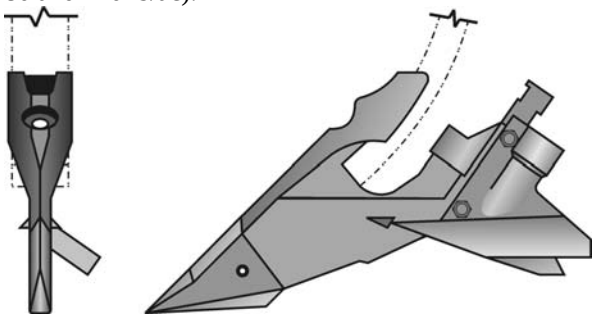
Experimental sites, for the project, were clay loam soil northwest of Coaldale and loam soil south of Edmonton. AC Lacombe barley was direct-seeded into moist soil on 5 June 1998 at the Coaldale site and on 10 June 1998 at the Edmonton site. Both sites were sprayed with glyphosate prior to seeding. The seeding rate was 112 kg/ha (100 lb/ac). Phosphate, in the form of 11-51-00, was placed with seed at a rate of 34 kg/ha (30 lb/ac). Seed and fertilizer separation and placement measurements were recorded on the highest fertilizer rate plots.

Crop emergence counts were taken on 7 July 1998 at the Coaldale site and 8 July 1998 at the Edmonton site. One count was taken for each row of every plot. Refine Extra and 2,4-D were sprayed at the Coaldale site on 7 July 1998. Champion Plus was sprayed at the Edmonton site on 9 July 1998.

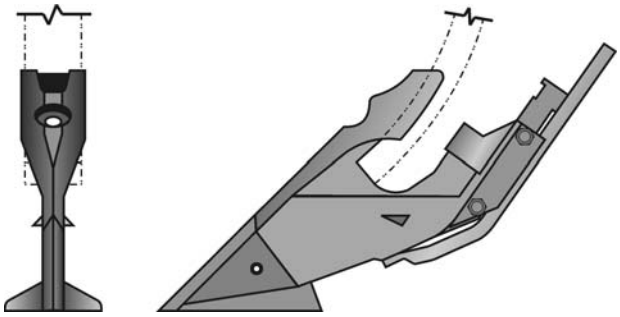
The crops were seeded later than normal in the study due to fabricated plot equipment delays and wet spring weather. Growing season conditions at the two sites were different. The Coaldale site was hot and dry and the Edmonton site was hot but received adequate moisture.

Plot yields were obtained with a self-propelled plot harvester. The Edmonton plots were harvested on 15 and 16 September 1998. The Coaldale plots were harvested on 11 September 1998.

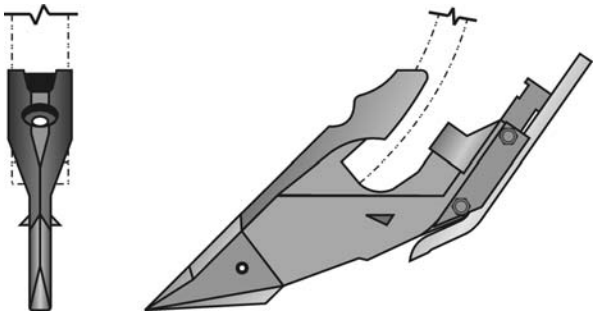
Experimental factors included four openers, two nitrogen types and four nitrogen rates. The openers, **Figure 1**, were a sideband double shoot with 25 x 25 mm (1 x 1 in) separation, sideband double shoot with 13 x 13 mm (0.5 x 0.5 in) separation, narrow row hoe single shoot and partial ribbon spread single shoot. Liquid tubes were bolted to the back of the narrow row hoe single shoot and the partial ribbon spread single shoot. The end of the liquid tube on the ribbon spread opener was pressed flat to spread liquid fertilizer. A liquid tube was placed in the granular fertilizer tubes on the double shoot openers. All the openers were supplied or fabricated by Flexi-coil. The nitrogen types were liquid and granular. The granular was in the form of urea (46-0-0). The liquid was 28-0-0. The nitrogen rates were 0, 45, 90 and 135 kg/ha (40, 80 and 120 lb/ac).



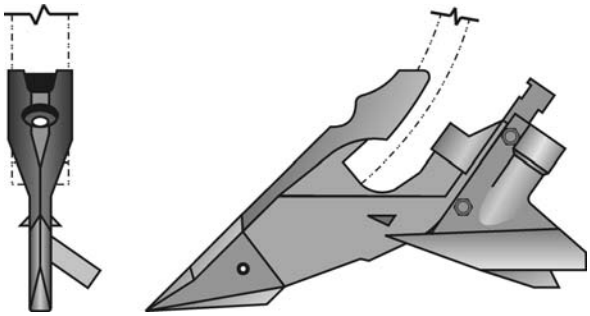
Sideband Double Shoot with 25 x 25 mm Separation.



Partial Ribbon Spread Single Shoot.



Narrow Row Hoe Single Shoot.



Sideband Double Shoot with 13 x 13 mm Separation.

Figure 1. Flexi-coil Openers.

The experiment used a split plot design with nitrogen rate as the subplot treatment with four replications. Each site consisted of 128 plots. Plots were 2.43 x 15.24 m (8 x 30 ft). A 6.1 m (20 ft) strip was used between the ends of plots in replication blocks. A 2.4 m (8 ft) strip was used between the sides of replication blocks. A 12.2 m (40 ft) strip was used between the ends of replication blocks. Border affects were controlled through winter crops on the sides of each plot.

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

Table 1.

Factor	Level
Seed Type (1)	Barley
Fertilizer Type (2)	Urea (46-0-0) Liquid (28-0-0)
Fertilizer Rate (4)	0, 45, 90, and 135 kg/ha (40, 80 and 120 lb/ac)
Openers	4
Replications	4

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
Liquid system - Electric pump with Raven controller

Results

An analysis of variance (ANOVA) was used to analyze the results. A Duncan's multiple range test was used to separate means that were significantly different. Mean plant counts for nitrogen-type are presented in **Figure 2**.

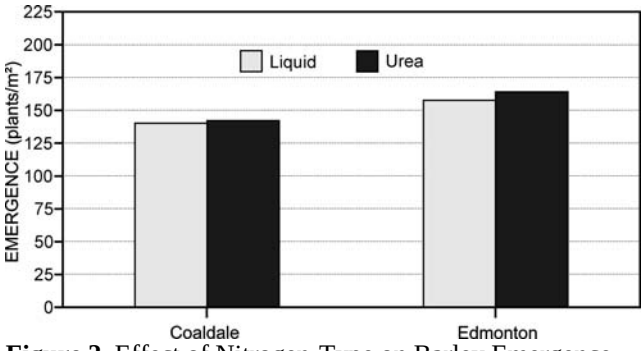


Figure 2. Effect of Nitrogen-Type on Barley Emergence.

Differences in crop emergence between nitrogen types were not significant at both sites.

Mean plant counts for various nitrogen rates are presented in **Figure 3**. Differences in crop emergence between various nitrogen rates were highly significant at the Coaldale site and significant at the Edmonton site. The comparison of means showed no difference at the Edmonton site and a significant difference between the two high nitrogen rates and zero rate at the Coaldale site. Treatments with the same letter do not have significantly different means. An increase in nitrogen rate resulted in a decrease in crop emergence at the Coaldale site.

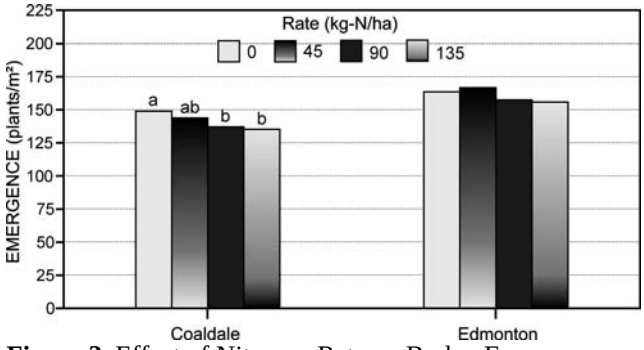


Figure 3. Effect of Nitrogen Rate on Barley Emergence.

Mean plant counts for the various openers are presented in **Figure 4**. At both sites the use of the narrow opener resulted in significantly lower emergence than the other openers.

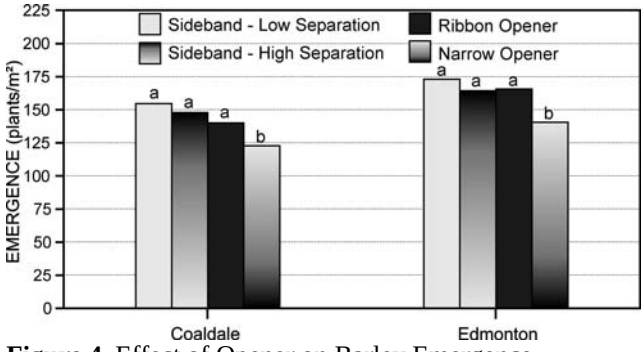


Figure 4. Effect of Opener on Barley Emergence.

The analysis of variance for the plant count data at the Edmonton site resulted in a first order interaction. **Figure 5** shows the effect of nitrogen-type and opener on barley emergence at the Edmonton site. Emergence with urea as the nitrogen-type resulted in variance among the openers. Emergence with liquid as the nitrogen-type resulted in similar values among the openers except for the narrow opener which was much less.

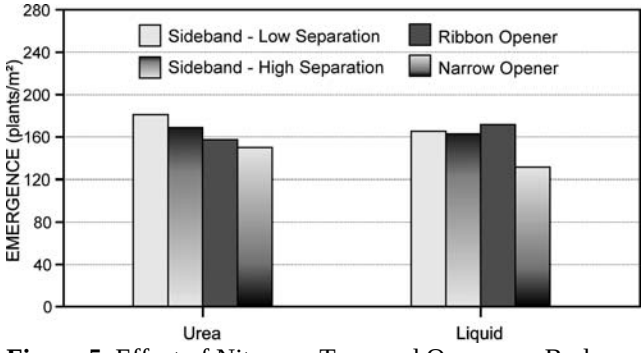


Figure 5. Effect of Nitrogen-Type and Opener on Barley Emergence.

Mean crop yields for nitrogen-type are presented in **Figure 6**. Differences in crop yield were highly significant at the Coaldale site and significant at the Edmonton site. Use of liquid as the nitrogen source resulted in significantly higher yields than the granular urea at the Coaldale site. The comparison of means

resulted in no difference between the nitrogen types at the Edmonton site.

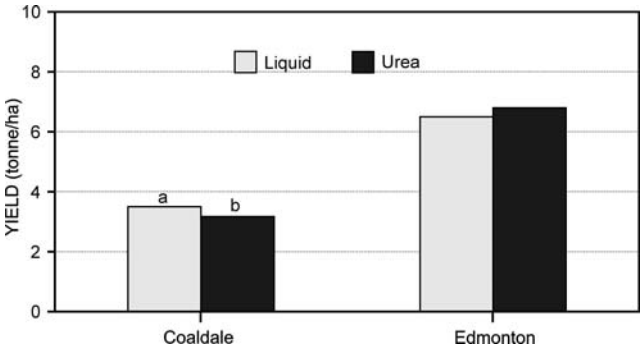


Figure 6. Effect of Nitrogen-Type on Barley Yield.

Mean crop yields for the nitrogen rates are presented in **Figure 7**. Differences in crop yield between the nitrogen rates were highly significant at the Coaldale site and significant at the Edmonton site. The barley yield at the Coaldale site increased significantly with every nitrogen rate increment. At the Edmonton site, the barley yield from the zero nitrogen rate was significantly lower than the other three nitrogen rates.

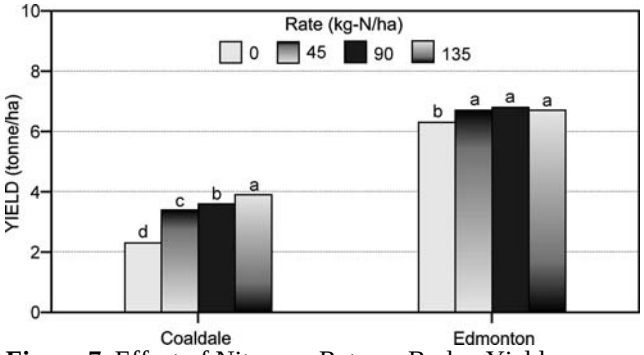


Figure 7. Effect of Nitrogen-Rate on Barley Yield.

Mean crop yields for opener-type are presented in **Figure 8**. Differences in crop yield with different openers were highly significant at the Coaldale site and not significant at the Edmonton site. The use of the sideband with low separation resulted in significantly higher barley yield than the narrow opener at the Coaldale site.

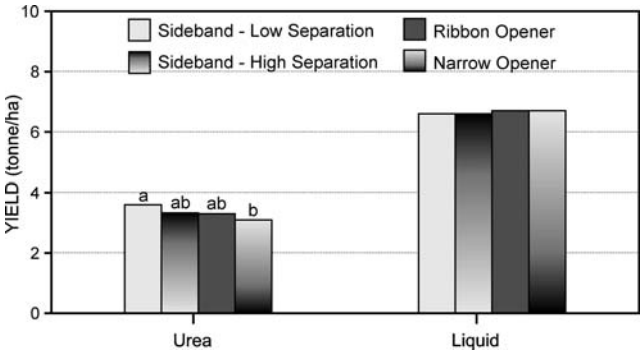


Figure 8. Effect of Opener-Type on Barley Yield.

The seed and fertilizer measurements results are listed in **Appendix 1**. Days to maturity were calculated and analyzed. The days to maturity values for the Edmonton site are listed in **Appendix 2**. Significant differences among days to maturity values were found with the nitrogen rate and combination of nitrogen rate and openers.

Discussion

Generally, nitrogen-type did not affect the emergence of barley in the study. The nitrogen-type did, however, affect the emergence with the various openers. Emergence with urea as the nitrogen-type resulted in variance among the openers. The sideband low separation had the highest emergence and the narrow opener the lowest. Emergence with liquid as the nitrogen source resulted in similar values among the openers except for the narrow opener which was less. There are two possible explanations for this trend. Using liquid as the nitrogen source does not affect the crop emergence when placed in different positions relative to the seed. The other explanation, with the ribbon opener the urea was spread evenly but the liquid was placed mainly to the centre of the seed row resulting in higher emergence. A change in the emergence of the ribbon opener with liquid as the nitrogen source would change the trend of the graph. More investigation is needed in this area.

The nitrogen-type affected the yield of barley in the study. Barley yield with liquid as the nitrogen source was significantly higher than with urea as the nitrogen source at the Coaldale site. Barley yield with urea as the nitrogen source was higher than with liquid as the nitrogen source at the Edmonton site but the difference was not significant. The growing conditions may have contributed to yield differences at the two sites.

The nitrogen rate affected the emergence and yield of barley. An increase in nitrogen rate resulted in decreased emergence and increased yield. The yields at the two sites peaked at different rates. This was most likely due to the different background nutrient levels.

The type of opener affected the emergence and yield of barley. In most conditions, the narrow opener resulted in lower emergence and yield. The exception was the yield at the Edmonton site where there was no difference among openers. This may again be caused by background nutrient levels at the site.

Summary and Conclusions

Generally, nitrogen-type did not affect the emergence of barley in the study. The nitrogen-type did, however, affect the emergence with the various openers. Urea, as the nitrogen-type, resulted in variance among openers with the sideband low separation the highest emergence and the narrow opener the lowest. Liquid as the nitrogen source resulted in similar values among openers except for the narrow opener which had a lower emergence.

The nitrogen-type affected the yield of barley in the study. Barley yield with liquid as the nitrogen was significantly higher than with urea as the nitrogen

source at the Coaldale site.

The nitrogen rate affected the emergence and yield of barley. An increase in nitrogen rate resulted in decreased emergence and increased yield.

The type of opener affected the emergence and yield of barley. In most conditions, the narrow opener resulted in lower emergence and yield. The exception was yield at the Edmonton site where there was no difference among openers.

The experiment should continue to verify results and further investigate the interaction of nitrogen-type and openers.

References

Alberta Farm Machinery Research Centre, *The Effect of Urea and Cold and Hot Flow Anhydrous Ammonia on Emergence and Yield on Wheat, Barley and Canola*. 1996.

Alberta Farm Machinery Research Centre, *Effectiveness of Double Shoot Openers for Applying Anhydrous Ammonia While Seeding Wheat, Barley and Canola*. 1995.

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Appendix 1

Investigation Into Use of Liquid Fertilizer With Flexi-coil Openers
Seed and Fertilizer Placement Summary

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	Coaldale		Edmonton	
	mm	in	mm	in
Sideband Double Shoot with Low Separation:				
Seed depth	25	1	25	1
Seed band width	32	1.25	19	0.75
Liquid band thickness	13	0.5	13	0.5
Urea band thickness	13	0.5	6	0.25
Liquid band width	13	0.5	13	0.5
Urea band width	25	1	13	0.5
Horizontal separation	32	1.25	19	0.75
Vertical separation Liquid	13	0.5	13	0.5
Vertical separation Urea	19	0.75	13	0.5
Sideband Double Shoot with High Separation:				
Seed depth	38	1.5	38	1.5
Seed band width	19	0.75	25	1
Liquid band thickness	13	0.5	19	0.75
Urea band thickness	13	0.5	19	0.75
Liquid band width	13	0.5	19	0.75
Urea band width	13	0.5	19	0.75
Horizontal separation	32	1.25	25	1
Vertical separation Liquid	32	1.25	32	1.25
Vertical separation Urea	25	1	19	0.75
Narrow Row Hoe Single Shoot:				
Seed depth	51	2	32	1.25
Seed band width	25	1	19	0.75
Seed band thickness	13	0.5	13	0.5
Liquid band thickness	13	0.5	13	0.5
Urea band thickness	13	0.5	13	0.5
Liquid band width	13	0.5	13	0.5
Urea band width	25	1	13	0.5
Vertical separation Liquid	13	0.5	0	0
Vertical separation Urea	0	0	0	0
Partial Ribbon Spread Single Shoot:				
Seed depth	51	2	51	2
Seed and liquid band thickness	13	0.5	13	0.5
Seed and urea band thickness	19	0.75	8	0.3
Seed and liquid band width	44	1.75	38	1.5
Seed and urea band width	51	2	51	2

All measurements were taken at the 120 lb/ac fertilizer rates.

Appendix 2

Effect of Nitrogen Rate on Days to Maturity
Edmonton - 1998

Nitrogen Rate	Days to Maturity
0	88.3
40	87.9
80	88.6
120	89.1

Effect of Nitrogen Rate and Opener Type on Days to Maturity
Edmonton - 1998

Nitrogen Rate	Sideband Double Shoot		Partial Ribbon Spread Single Shoot	Narrow Row Hoe Single Shoot
	Low Separation	High Separation		
0	88.3	88.1	88.6	88.3
40	88.0	88.0	87.4	88.1
80	88.1	88.5	88.5	89.2
120	87.7	89.1	89.3	90.2