Forage Fertilization and Rejuvenation with Liquid Fertilizers

B. Lkhagvasuren and J. J. Schoenau
University of Saskatchewan, Saskatoon, SK, Canada
R. Szwydky
Borden, SK, Canada

Introduction

Forages are the cheapest source of feed for livestock. The productivity of a seeded perennial forage stand declines over time. To increase the productivity of old stands, producers generally break up the stand through tillage and then re-seed (Kruger, 1997). This is expensive and time-consuming.

Rather than breaking the stand, rejuvenation of forage stands is probably the most economic and practical method to improve production and quality of forage stands (Lardner et al., 2002). Fertilization can be an effective strategy in rejuvenation.

Nitrogen is the most commonly deficient essential nutrient in soil and generally has greatest impact on forage production (Malhi, et al., 2004), but phosphorus also may be limiting in some soils (Sedivec and Manske, 1990; Berg and Sims, 1995)

The effectiveness of fertilizers in increasing forage dry matter yield (DMY) and economic return is dependent upon the levels of nutrients in soil, forage species, climatic conditions, source, rate and method of fertilizer application.

In-soil placement of granular urea (46-0-0) is preferred over surface application since large losses of N by ammonia volatilization can occur with broadcast applications of urea. Surface granular broadcast works best with ammonium nitrate (34-0-0), but this fertilizer product is becoming more difficult to access due to security concerns. Surface dribble banded UAN (urea-ammonium nitrate) solution (28-0-0) may be an effective alternative, especially if rain follows the application to help move the nitrogen into the soil.

Objective

To reveal plant and soil response of grass dominated hayland to N and P application as surface dribble banded and coultered in liquid fertilizer.

Materials & Methods

The experiment was set out on old (~10 yrs) meadow bromegrass dominated pastures near Rosthern, Vanscoy and Colonsay, Saskatchewan in spring 2005. The sites were located on what would be considered marginal land of sandy texture and were selected based on growth and suspected nutrient deficiency.

The experimental design for the fertilizer rates and application methods was a randomized complete block design. The treatments were UAN solution (28-0-0) applied at different rates of N (0,50,100 and 200 lb N/acre or 0, 56, 112 and 224 kg N/ha) without and with P as 10-34-0 solution blended in and applied at 25 lb P_2O_5 / acre (28 kg /ha). Two different application methods were compared for these treatments: 1) dribble banded in which fertilizer was surface - applied as a dribble band, and 2) coulter injected with a coulter disc placing the fertilizer directly in the soil at 3-4 cm depth as a band. Fertilizer treatments were applied in mid - April of 2005. Forage dry matter yield measurements were made in late June or early July of 2005, and again in 2006 to assess residual effects.

Results and Discussion

Yield Responses in Year of Application 2005

The N and P fertilizer treatments produced significantly higher forage dry matter yield than the control (no fertilizer) plots (Charts 1, 2 and 3). The 50 lbs N/acre rate produced close to one ton/acre (~ 2 tonnes/hectare) of additional hay yield over the unfertilized controls. Increasing the N rate above 50 lbs N/acre mainly went to increasing protein content rather than further increases in yield. Much of the response is attributed to the added N, as there was limited difference in yield between the N treatments with and without P. The lack of large response to added P may be related to adequate mineralization of organic P in the rhizosphere of these grasses. Other studies have also observed limited responses of grass - dominated stands to P fertilization but good responses to N addition. There was no significant difference between the two application methods (surface dribble band vs. coulter injected). At all sites there was good growing season moisture, and rain shortly after application of the fertilizer. Overall, 30 to 50 lbs N/acre dribble banded on the surface appeared to be an economically effective strategy for rejuvenation under the conditions of this experiment.

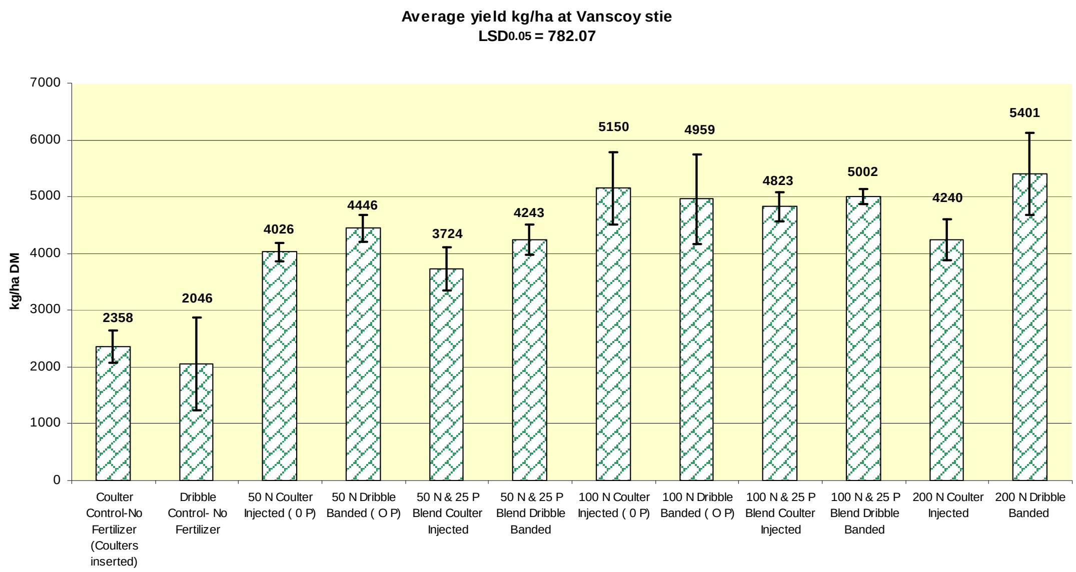

Chart 1. Forage yield response to fertilization at Vanscoy site in year of application (2005).

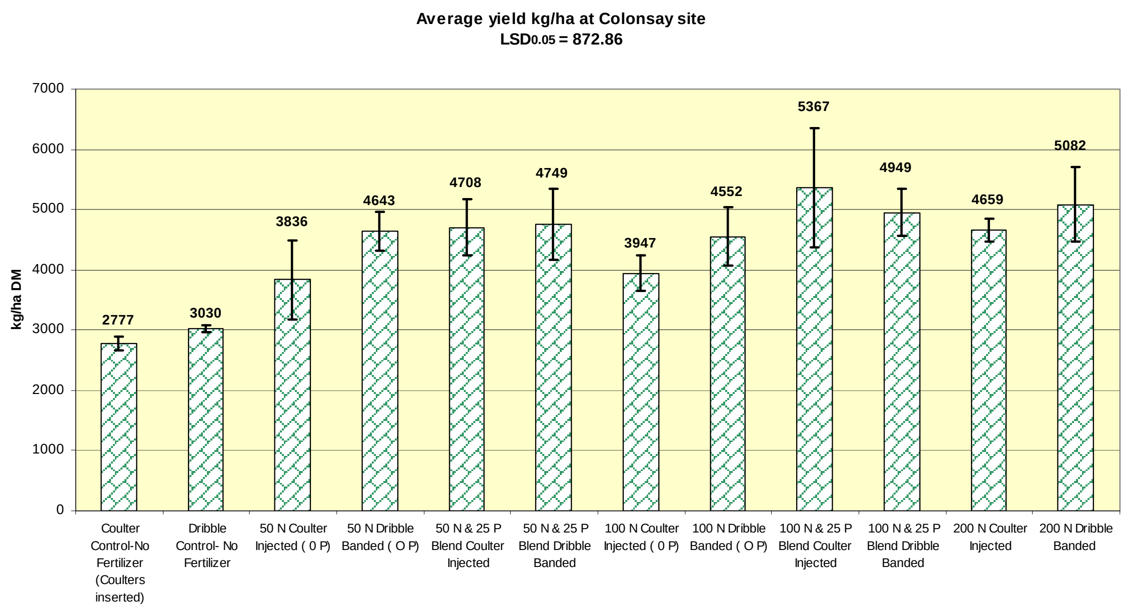

Chart 2. Forage yield response to fertilization at Colonsay site in year of application (2005).

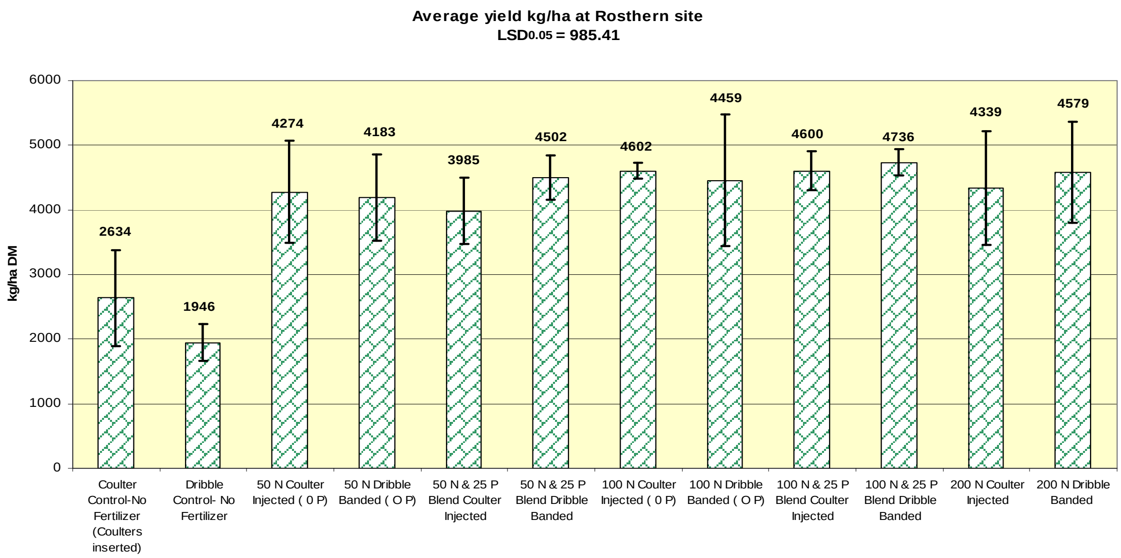

Chart 3. Forage yield response to fertilization at Rosthern site in year of application (2005).

Previous studies have also suggested that nitrogen is the major limiting nutrient in grass pastures (Sedivec and Manske, 1990; Berg and Sims, 1995; Malhi, et al., 2004) and the results of our study support this. Significant rainfall after application of the fertilizer likely contributed to a lack of difference between surface banding and coultering methods of application in this study, as the rainfall would move the surface banded nitrogen into the mineral soil. Given dry conditions following application of the surface dribble band, there is potential for the fertilizer to be "hung up" at the surface.

Yield Responses in Year Following Application: 2006 Residual Effects

Soil nitrate and phosphate supply rates were measured over a two week period using PRS probes inserted in soil cores collected in the fall of 2005 (Chart 4). The measurements revealed that only the high N rate treatments (200 lb N/acre) applied in 2005 had significantly higher soil available N supplies, indicating a possible carryover benefit into the 2006 season. There were no significant differences in phosphate supplies among treatments.

Treatment	*NO_3-N*	*PO_4-P*
Dribble Control no fertilizer	16.3	0.87
Dribble 56 kg N+ 28 kg P_2O_5 ha^{-1}	24.7	0.60
Dribble 112 kg N + 28 kg P_2O_5 ha^{-1}	15.8	0.44
Dribble 224 kg N ha^{-1}	58.8*	0.65
LSD $_{(0.05)}$	**27.6**	NS

* Significant at the 0.05 probability level.
NS denotes not significant

Chart 4. Supply rates of soil nitrate and phosphate (ug/cm^2/2wks) measured in fall of 2005.

As predicted by the soil N supply measurement, in 2006 only the high N application rate treatments made the previous year showed a significant yield benefit in 2006, with the 200 lb N/acre (224 kg N / ha) treatment yielding about 1 ton/acre higher than the rest of the treatments (Chart 5), similar to the response that was observed in the first year.

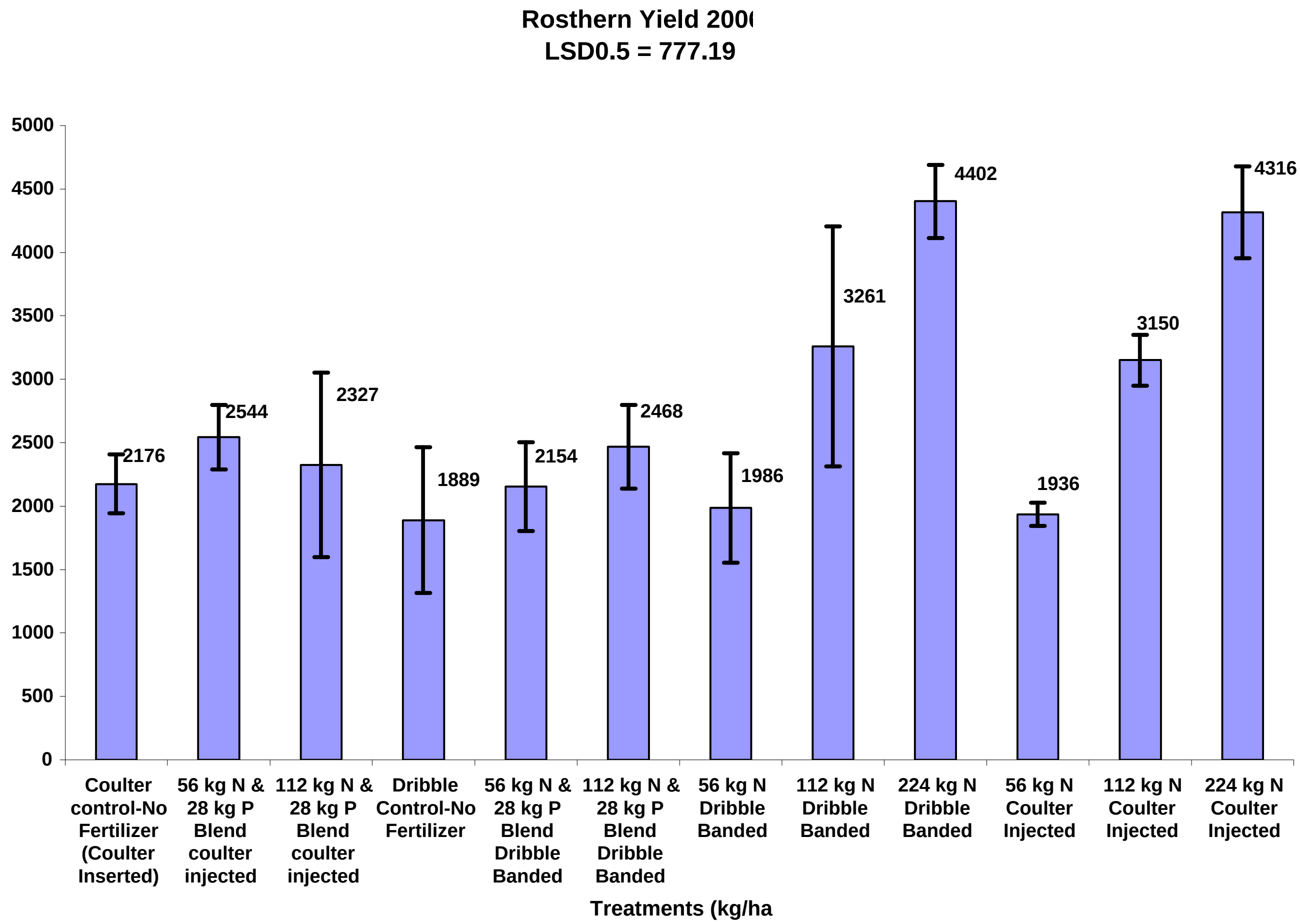

Chart 5. Forage yield response in 2006 from fertilizer applications made in the spring of 2005.

Conclusions

Fertilizer N additions are effective in rejuvenating productivity of grass dominated pastures. Surface dribble banded UAN solution is an effective means of fertilization, given good moisture conditions and rainfall after application. Larger single applications of nitrogen contribute to increased protein, and unused residual nitrogen appears to carry over efficiently into the following season in these hayland systems.

Acknowledgements

We thank the GreenCover program, Saskatchewan Agriculture and Food, and Mongolia Training for Rural Development Project for funding.

References

1. **Kruger** G. 1997. Seed production of meadow bromegrass (*Bromus riparius* Rehm.). Agric. and Agri-Food Can., Saskatoon, SK;
2. **Lardner H.A., Wright S.B.M., Colen R.D.H., Curry P. and MacFaelane.** 2002. Rejuvenation affects nutritive value of long-established tame forages. Can. J. Animal Sci.;
3. **Malhi S.S., Gill K.S., McCartney D.H. and Malmgren R.** 2004. Fertilizer management of forage crops in the Canadian Great Plains. Recent Res. Devel. Crop Sci 1:237-271.
4. **Sedivec K.K. and Manske L.L.** 1990. Renovation of rangeland and grassland pastures. N.D.S.U. Ext. Serv. Publ. Fargo N.D. Vol. **14**: 6;
5. **Berg W.A. and Sims P.L.** 1995. Nitrogen fertilizer use efficiency in steer gain on old world bluestem. J. Range Manage. 48: 64-67.