A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
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Research Update

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Will Injection of Swine Manure into Grasslands Increase Forage Yield?

Hog manure has been used as a fertilizer on annual cropland with excellent results for many years. However, the increase in conservation tillage and continuous cropping has made summer fallow acres less available for the summer application of hog manure. Injecting hog manure into grassland would provide extra acreage for manure application for the hog producer, and would improve forage production, for the forage or livestock producer.

PAMI uses the GreenTrac for the application of hog manure.

A project was conducted by PAMI, the Saskatchewan Forage Council, and the University of Saskatchewan to assess the effects of swine manure injection on forages. The objective of the project was to demonstrate the effect of shallow hog manure injection on forage yield, quality, nitrate levels, and to assess the effects on soil nutrient levels at various application rates.

At a Glance

- Shallow injection of liquid hog manure into mature forage stands places nutrients in the root zone for maximum fertilizer efficiency resulting in increased forage and seed yields.
- Liquid manure injection usually did not affect forage quality. However, at one site in one year nitrate levels in Russian wild rye were high enough to be a concern for grazing or feeding cattle. Refer to the discussion about nitrate levels in the conclusion of this report.
- This study showed only slight increases in soil nutrient levels each year. Soil tests indicate that even at high rates of application, there were moderate levels of nutrients in the top 12 inches (30 cm) of the soil and no increases in nutrient levels below 12 inches (30 cm). This indicates there was no deep leaching of the manure nutrients.
- The application of liquid hog manure on forages can have beneficial effects for the livestock industry in economic savings for fertilizer, increased seed and feed production, and as an avenue for the utilization of manure from intensive livestock production facilities.

The Project

To investigate the possible benefits of grassland injection of swine manure, a three-year study (1998 - 2000) was conducted on three different grasses (crested wheatgrass, smooth brome/alfalfa, and Russian wild rye). PAMI, using the Greentrac manure injection machine which is manufactured in Ireland, injected liquid hog manure 3½ inches (9 cm) deep into mature grass stands. The coulter-type openers were arranged to inject the manure at a row spacing of 10 inches (25 cm). The liquid manure was hauled directly from the earthen manure storage to the various sites, where it was injected into crested wheatgrass (Englefeld, Sask.), smooth brome/alfalfa stands (Burr,Sask.) in the fall of 1997, and into a Russian wild rye stand (Lanigan, Sask.) in April 1998. Liquid hog manure was injected again at all sites in the fall of 1998 and 1999. See Table 1 below for the manure application rates and injection timing.

The Saskatchewan Forage Council took grass samples just after heading was complete to determine yield per plot. Samples were also taken to determine crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and the nitrate content of the forage for each treatment. Seed yield was also determined each year for the crested wheatgrass site at Englefeld, Sask.

Table 1. Application Sequence.

Location/Crop	1997		1998		1999	
	Spring	Fall	Spring	Fall	Spring	Fall
Englefeld, SK Crested Wheatgrass		37,000 L/ha 74,000 L/ha 148,000 L/ha		37,000 L/ha		37,000 L/ha 74,000 L/ha
Burr, SK Smooth Bromegrass/Alfalfa		37,000 L/ha 74,000 L/ha 148,000 L/ha		37,000 L/ha		37,000 L/ha 74,000 L/ha
Lanigan, SK Russian Wild Rye			37,000 L/ha 74,000 L/ha 148,000 L/ha	37,000 L/ha		37,000 L/ha 74,000 L/ha

Conversion Equivalents
3,300 gpa = 37,000 L/ha
6,600 gpa = 74,000 L/ha
13,200 gpa = 148,000 L/ha
gpa - gallons per acre
L/ha - Litres per hectare

Note: Two control plots were established at each site, an undisturbed check where no treatment was applied and a disturbed check where a pass was made with the injectors to produce similar soil disturbance but no injection of hog manure. The disturbed check treatment was applied each time that the treatments were applied to the other plots.

The Results

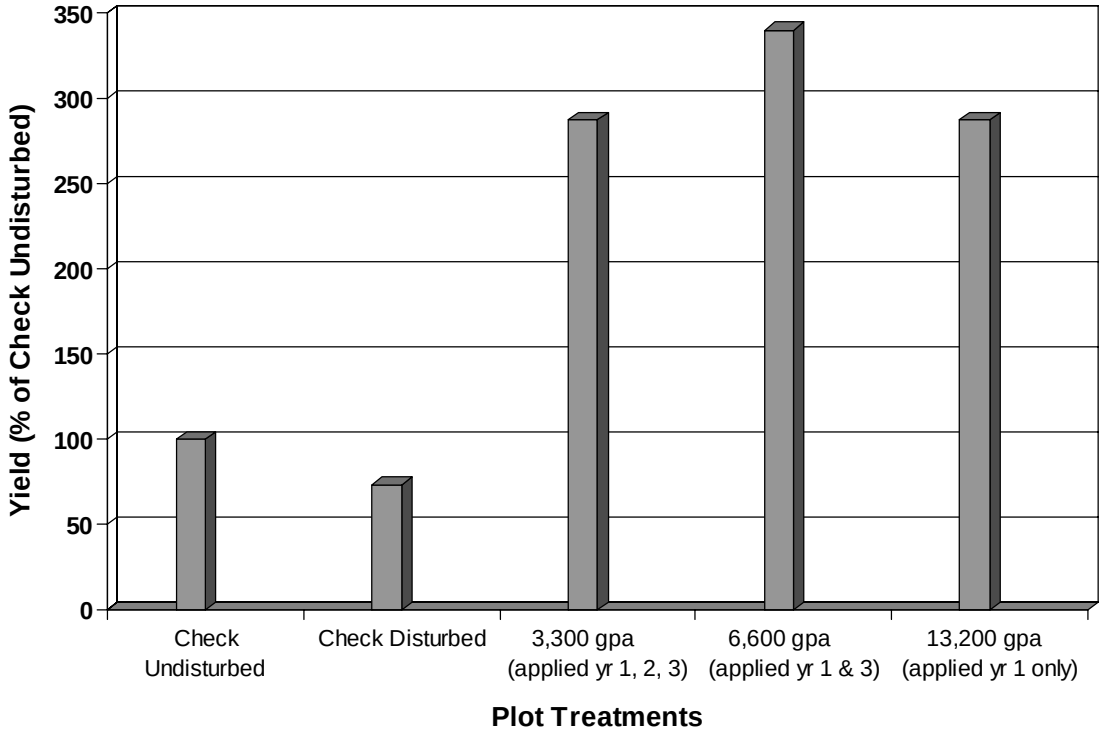

Figure 1. Three Year Total Forage Yield - Crested Wheatgrass.

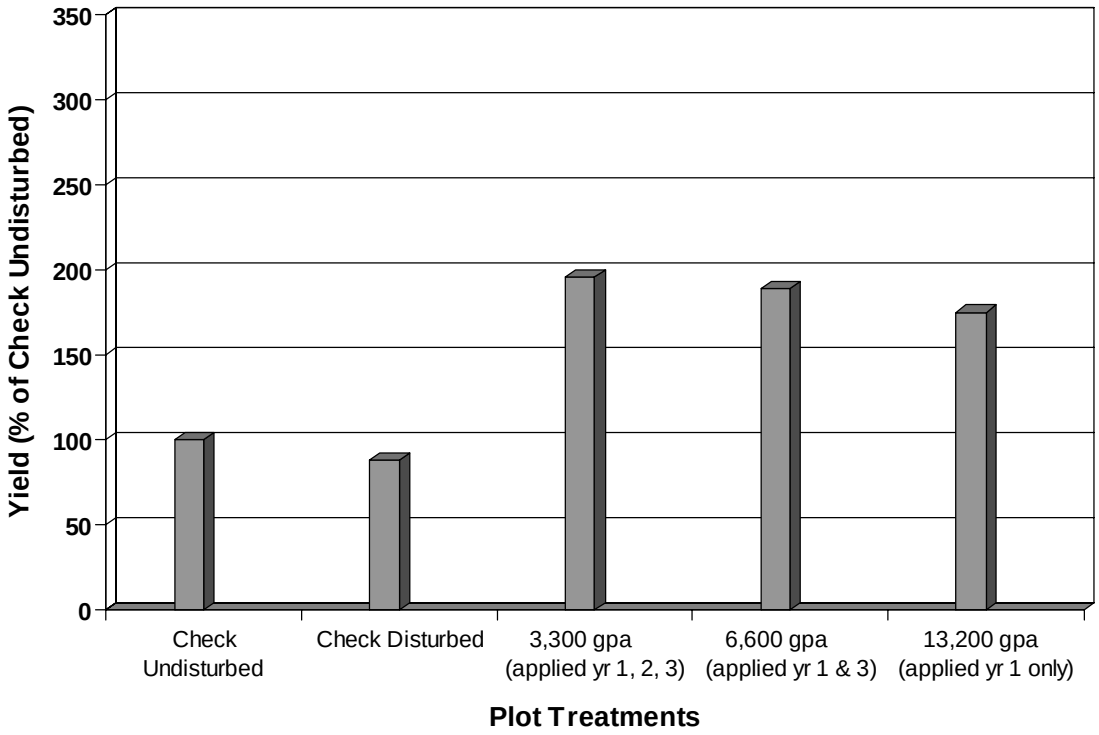

Figure 2. Three Year Total Forage Yield - Smooth Brome/Alfalfa.

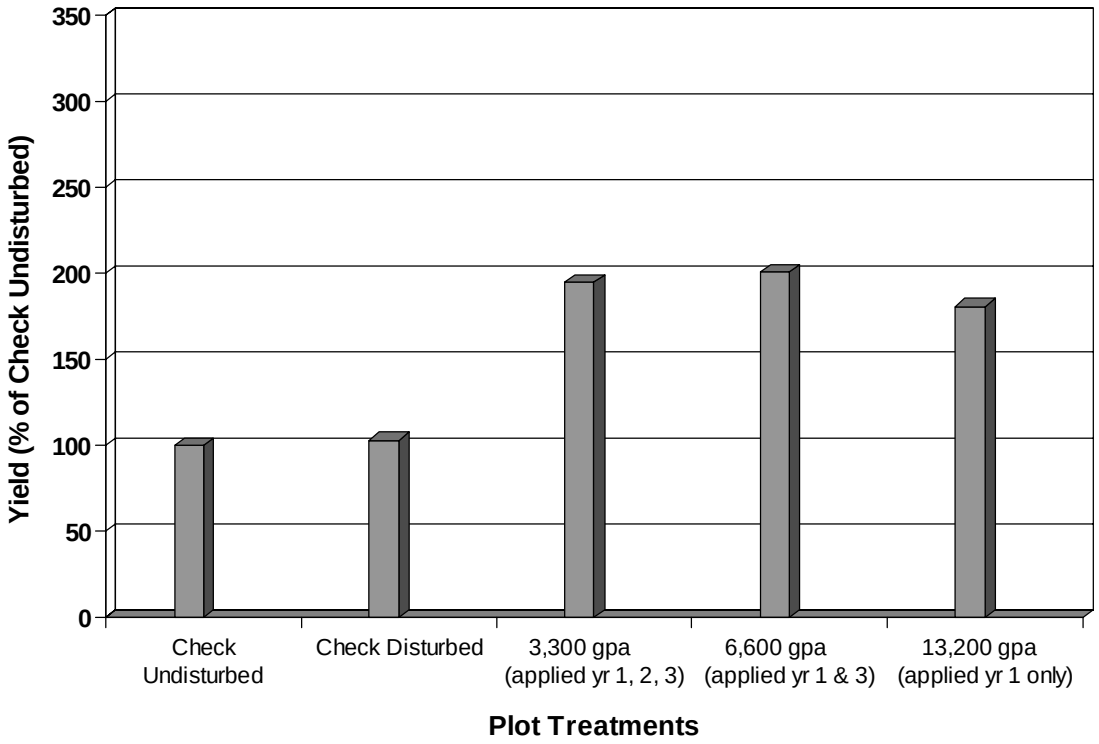

Figure 3. Three Year Total Forage Yield - Russian Wild Rye.

The application of injected hog manure showed large forage yield increases for all treatments as all plots had higher yields compared to the control plots. Crested wheatgrass was most responsive to the manure in terms of percentage yield, with up to a 300% increase in forage yield over the control. Yield increases for the smooth brome/alfalfa and Russian wild rye averaged about 200% higher than the control.

Conclusions

Shallow injection of liquid hog manure is a low-cost fertilizer alternative for grasslands.

Tests showed that there were large seed and forage yield increases in grassland forages injected with liquid hog manure. The study also showed minimal effects to the crude protein, neutral detergent fiber, and acid detergent fiber for forage stands injected with liquid hog manure.

The most economical application strategy was 6,600 gpa (74,000 L/ha) every other year.

Nitrate levels in forages are of concern when feeding livestock. Samples found that smooth brome/ alfalfa and crested wheatgrass remained within acceptable levels (0.0% to 0.15%) for all application rates for all three years. The Russian wild rye, however, had nitrate content of .20 at the 3,300 gpa (37,000 L/ha) application rate to 1.10 at the 13,200 gpa (148,000 L/ha) application rate in year one of the study. These nitrate levels are well above acceptable levels. This result was found only with Russian wild rye and only with spring/summer manure application, and may have been related to grass variety, drought, or cold growing conditions. Based on these limited results, producers should use some caution when applying swine manure to forages. Farmers should have their feed tested for nitrates after manure injection. However, further research with varieties, timing of application, and limits on application rates, should result in guidelines for safe application of manure.

Other properties of the soil, in particular electrical conductivity and soil pH were not affected by the manure application. However, land that will have liquid hog manure applied on an ongoing basis should be routinely tested for salt content and concentration as well as nutrient concentration as a safety measure.

Increased nitrogen availability is another added benefit. Grass yield increases are due to the increase in N availability. The increase in availability of phosphorus and potassium may also have been a contributing factor.

The application of hog manure using a low disturbance coulter application system did not appear to increase the weed density (visual observation) and, in fact, appeared to give the grass stands a competitive advantage over the weeds. Grasslands appear to be well suited to injected hog manure applications. Grassland can be injected during the summer so that the manure application period can be extended from the current spring and fall periods.

A manure injector system that works well in forages has been developed and is now available from Bourgault Industries of St. Brieux.

Crested Wheat Grass comparison with manure injected as a fertilizer and without.

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