BENEFITS OF APPLYING COW SLURRY IN BANDS BENEATH GRASS CANOPIES

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ABSTRACT

Efficient methods of application may enable dairy producers to use slurry manure as aœreplacement for inorganic nitrogen on grassland. This study compares the effect of slurry applied in bands beneath the grass canopy (drag-shoe) with a broadcast of slurry on top of the canopy (splash-plate), and with fertilizer nitrogen on yield of grass. Trials were conducted in spring, summer and fall of 1995 on established tall fescue in south-coastal B.C. Slurry manure was applied by drag-shoe or splash-plate at 50 and 100 kg ha^{-1} (nominally), at start of grass regrowth or 7-8 days later. A range of rates of NH_4NO_3 was applied on both dates. Grass yield responded more to drag-shoe than to splash-plate applied slurry, particularly at the high rate where the differences averaged 0.9 t ha^{-1} per cut. Most of the drag-shoe treatments were not different from NH_4NO_3 but all splash-plate treatments were lower. Despite differences in weather conditions following application, the treatment effects were consistent in all trials. The results show that fertilizer nitrogen can be replaced by slurry applied with a drag shoe-implement.

KEYWORDS

Drag-shoe, splash-plate, trailing shoe, tall fescue, yield, manure

INTRODUCTION

It is difficult for farmers to effectively utilize slurry as a nitrogen source for grass crops because the efficacy is variable, the ammonia concentration is unknown, the manure cannot be applied uniformly, and there is a risk of smothering and fouling of leaves (Whitehead, 1995). Up to 80% of the ammonia contained in slurry may be lost after broadcasting on grassland, depending on weather conditions, manure concentration and application rate (Amberger, 1990). Slurry injection reduces ammonia loss but this techniques is not widely used on grassland because of equipment costs, stones, and damage to stands. Recent European studies have shown that slurry applied in bands with drag-shoe implements loses less ammonium than slurry applied with conventional spreaders (Lorenz and Steffens, 1996). Drag-shoe applicators chop then deliver slurry via individual hoses to shoes which drag along the ground surface beneath the grass canopy. This study was conducted to compare the effects of slurry application techniques and mineral fertilizer on yield of established grassland.

METHODS

Trials were conducted at the Research Centre in Agassiz in south coastal B.C. in spring, summer, and fall of 1994 and 1995 (only 1995 reported). Separate grass swards comprising of 2-3 year old tall fescue (*Festuca arundinacea* Schreb.) were used for each trial. In the years prior to the trial, conventional application of mineral fertilizer and slurry and harvesting were carried out.

The fertilizer and manure treatments were randomized within each of 4 blocks. Manure treatments included all combinations of 2 field-scale methods of application (splash-plate and drag-shoe), 2 rates (nominally 50 and 100 kg ha^{-1} of NH_4-N) and 2 times (Early and Late). The drag-shoe applicator (Buts Meulepas BV, Oss, The Netherlands) shoes are spaced 20 cm apart and apply the slurry in 5-7 cm wide bands. Early treatments were applied just as the grass was beginning to grow for the spring trial (March 15) and 1-2 days after previous harvest for the summer (June 29) and fall (Sept. 14) trials. 'Late' treatments were applied 7-8 days after 'Early' application. A range of fertilizer (NH_4NO_3) rates (0-150 kg ha^{-1} in 25 unit increments) were broadcast on the 'Early' date and 'Late' dates (50 and 100 kg ha^{-1}). Areas (1.5 X 8 m) within plots were harvested at boot stage in spring and 5-6 weeks after previous harvest in summer and fall; harvested material was weighed wet and 'subsampled' for dry matter.

Characteristics of slurry and weather conditions at 'Early' applications are shown below:

Trial	%Total N	% NH_4-N	% Dry Matter	Tmax (Tmin.)(°C)	Precip. (mm)
March 15	0.34-0.37	0.16-0.18	10.5	11 (3)	5.6
June 29	0.28-0.30	0.15-0.17	5.5-6.5	3 (16)	0
Sept.14	0.26-0.30	0.13-0.16	4.8-5.6	30 (14)	0

Fertilizer effects on yield were fitted with 2nd order polynomial equations ($r^2>0.99$) in all trials (Fig. 1). Because actual rates of manure application differed from target levels, analysis of variance (randomized complete block in a split plot in time) was done on differences in yield between manure treatments and the fertilizer treatments at equivalent levels of mineral N, determined from the polynomial equations. Difference values were compared with zero using t-tests to determine if manure was less effective than fertilizer.

RESULTS AND DISCUSSION

Response of grass yield to NH_4NO_3 is shown in Fig. 1. 'Late' fertilizer application produced lower yields than 'Early' application at the 100 but not at the 50 kg N ha^{-1} rate. Both yield and response of yield to fertilizer and manure was greatest in spring and least in fall.

Grass yield responded to both methods of slurry application in all trials (Fig. 1, Table 1). The comparative effectiveness of manure treatments did not interact with the time of year, despite differences in temperature and rainfall at application (see Methods), so combined results are shown in Table. Yield increased more when slurry was applied by drag-shoe than by splash-plate at both the low and high application rates; interaction between application method and rate was not significant. The yields of plots treated with the drag-shoe were generally not significantly lower than fertilized plots at equivalent mineral N levels in contrast to the splash-plate treatments which yielded up to 1.3 t ha^{-1} less per cut. Unlike the fertilizer treatments, delay in manure application did not significantly reduce yield, even at the high application rates.

These results show that application of slurry by splash-plate can result in yield equivalent to inorganic fertilizer at 50 kg N ha^{-1} but not at the 75 kg N ha^{-1} rate commonly used by farmers, probably because of ammonia loss and smothering. This helps to explain why local farmers continue to apply nitrogen fertilizer on manured grass fields. In contrast, slurry applied with a drag-shoe can produce yields equivalent to those from inorganic N. Under unfavourable spreading conditions, drag-shoe application rates can be safely increased to maintain yield.

The drag-shoe attachment enables uniform application, necessary for optimum production and conservation of nutrients. By banding beneath the canopy, the drag-shoe reduces the risk of smothering and fouling and reduces odour compared to conventional systems. Longterm effects of manure application on grass need to be tested.

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Table 1
Values are for difference in yield for grass fertilized with NH_4NO_3 and slurry at equivalent rates of mineral N. The difference values for methods slurry application, averaged over trials, were compared by AOV. (Probability that difference values =0)

	Low Rate[1]		High Rate[1]		
	Early	Late	Early	Late	MEAN
	Yield Difference (t ha^{-1})				
Drag-shoe	-0.11 (n.s.)	-0.16 (n.s.)	-0.25 (n.s.)	-0.42 (0.01)	-0.23b[2]
Splash-plate	-0.56 (0.01)	-0.30 (0.01)	-1.25 (0.01)	-1.15 (0.01)	-0.82a–
MEAN	-0.29B3		-0.77A		

[1]Nominally 50 and 100 kg NH_4-N ha^{-1}. See Fig. 1 for actual rates.
[2]a.b Means are significantly different at P<0.05.
[3]a,b Means are significantly different at P<0.05.

Figure 1
Yield of tall fescue in spring, summer, and fall as affected by NH_4NO_3 and slurry manure applied at different rates (of mineral N) and with different methods.