Nitrogen recovery in herbage from dung pats and urine patches applied at two different times during the growing season

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Introduction There is increasing pressure to increase nitrogen (N) use efficiency within agricultural systems, as loss of N to waterways and the atmosphere contributes to aquatic and terrestrial eutrophication, and to nitrous oxide emissions. Dairy cows typically excrete between 80 - 120 kg of manure N per animal year, and in intensively grazed pastures, urine N is the largest contributor to nitrate leaching (Di *et al.*, 2002). Understanding the efficiency with which grass swards take up N excreted by grazing dairy cows is a prerequisite to improving the efficiency of N use within grazing systems. The current study was designed to identify the proportion of N contained within 'urine patches' and 'dung pats' which is subsequently taken up by herbage during the growing season.

Material and methods Thirty-six circular grass plots (radius, 60 cm) were used in a 2 x 3 factorial design experiment (randomised block, n = 6). Treatments examined comprised two application dates; 1st May (M) and 13th August (A), and three organic N treatments; control (zero N: C), faeces N (2350 g faeces/plot: F), and urine N (2630 g urine/plot: U). On each application date (M and A), faeces or urine (as appropriate) were applied in the centre of the plot by simulated urination and defecation. Weights of faeces and urine applied were based on the average weights of 15 defecation/urination events recorded from grazing cows. In addition, all plots received inorganic fertiliser N on 1st May, and thereafter at 3 week intervals (50, 45, 35, 30, 25, 20 and 15 kg N per hectare, respectively). Total inorganic fertiliser N application was 220 kg/ha over the experiment. Plots with organic N applied in May and August were harvested eight times and three times respectively, following applications, thus simulating a rotational grazing system. Grass was cut to a height of 50 mm using Gardena shearers. Faeces and urine were analysed for total N. Herbage was analysed for oven dry matter (ODM) and total N. A repeated measures approach using the residual maximum likelihood procedure was used to analyze the data set.

Table 1 Effect of faeces/urine application and application date on herbage growth and N recovery during the first 9 weeks after application

Date	May application			August application			SED	N	Date	Int.
N treatment	C	F	U	C	F	U		treat.		
Herbage DM yield (g/m^2)	87.7	88.2	123.8	32.5	37.4	45.8	7.56	***	***	*
N content of herbage (g/kg DM)	31.2	32.7	39.6	31.0	32.9	35.7	1.47	***	ns	ns
Herbage N yield (g/m^2)	2.70	2.76	4.87	1.01	1.23	1.75	0.27	***	***	***
N recovered (%)	-	3.0	29.7	-	12.2	19.8	6.7	*	ns	ns

Results Nitrogen concentrations in urine and faeces, applied in May and August, were 9.16 and 4.81 g N per litre and 3.56 and 2.61 g N per kg fresh respectively. The application of urine increased ($P < 0.001$) herbage N yield and DM yield in the first 9 weeks after application by 80.3% and 41.2%, respectively, when applied in May, and by 73.3% and 40.1%, respectively, when applied in August (Table 1). The application of faeces had no significant ($P > 0.05$) effect on herbage N yield or DM yield. Application date had a significant ($P < 0.001$) effect on herbage DM and N yields, with yields being lower in August. Date of application had no significant effect on the percentage of N recovered or herbage N content. Following urine application on 1st May, herbage N and DM yields were significantly greater than the control for 15 weeks after application. Twenty-four weeks after organic N application (May), 43.8% of the N applied via urine, and 11.6% of the N applied via faeces had been recovered in the herbage (Figure 1).

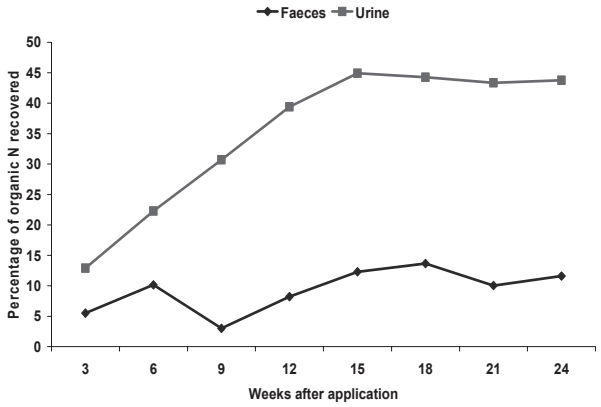

Figure 1 Percentage of N applied in faeces and urine on 1st May subsequently recovered in herbage

Conclusions Herbage DM and N yields were significantly increased with the application of urine to grass plots compared to the application of faeces. Also, a much higher percentage of the N available in urine (43.8%) was recovered by herbage than N available in faeces (11.6%).

References

Di, H. J., Cameron, K. C., and Silva, R. G. (2002) A lysimeter study of the fate of ^{15}N-labelled nitrogen in cow urine with or without farm dairy effluent in a grazed dairy pasture soil under flood irrigation. New Zealand Journal of Agricultural Research 45, 235-244.

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