Short term pasture response to a proprietary liquid fertiliser

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Abstract

The short term response of pasture herbage mass and chemical composition to the proprietary liquid fertiliser Nitrosol® was measured in two experiments. In autumn 1994, control plots (no fertiliser) were compared with Nitrosol®, urea or diammonium phosphate (DAP)-treated plots. Nitrosol® was applied at the manufacturer's recommended rate (1 kg N/ha) and at 24 kg N/ha. Urea- and DAP- treated plots also received those fertilisers at rates at 24 kg N/ha. Herbage accumulation in the six weeks immediately following fertiliser application was monitored. In late winter 1995 a second experiment was conducted, similar to the first, but including only four treatments: control, Nitrosol® at the recommended rate and at 32 kg N/ha, and urea at 24 kg N/ha. Measurements taken in Experiment 2 included tiller core samples, absence frequency measurement of tiller density, dry weight samples, herbage accumulation measures and herbage chemical analysis by NIR spectroscopy. No statistically significant dry matter response to Nitrosol® at the normal rate was detected in either experiment. Nitrosol® at high rates produced a response consistent with N-level applied as in earlier experiments. Unlike the response to urea, tiller density and the protein:carbohydrate ratio of herbage was unchanged following application of Nitrosol® at the high rate.

Additional key words: *liquid fertiliser, protein:carbohydrate ratio, tiller density*

Introduction

Low analysis liquid fertilisers continue to be available to the industry through various outlets. Generally, at recommended rates of application they supply low amounts of the major plant nutrients, but are claimed to have compensatory benefits, such as growth regulators for enhanced effectiveness of the major nutrients supplied, or improvement in herbage nutritive value. For example, Nitrosol® concentrate has an N:P:K rating of 8:3:6, and at the manufacturer's recommended rate of application would supply a little over 1 kg N/ha, but also contains trace amounts of two plant growth regulators, gibberellic acid and triacontanol. The manufacturer claims that Nitrosol® applied to pasture improves the balance between protein energy and fibre by stimulating the production of carbohydrates (sugars/energy), and that the associated improvement in feed quality will result in healthier stock and increased production. Through company literature, farmers who have used the product support these claims.

By contrast, conventional wisdom maintains that the performance of a fertiliser can be predicted from its nutrient content (Feyter *et al.*, 1989). These authors measured the effect of four liquid fertilisers, Maxicrop®, N-Fix®, Response®, and Plant Plasma® and two solid fertilisers Natumix® and Wright's Mix® in a series of three trials over two years. They found that none of the liquid fertilisers significantly affected pasture production.

Given this background, and the vigorous company advertising at the time of this trial, we were interested in whether or not there was a 'quality' and/or 'growth' response to applications of Nitrosol®. This paper reports short term herbage accumulation responses from two student experiments carried out at Massey University in autumn 1994 and late winter, 1996, respectively, and herbage chemical composition data from the second of these experiments.

Materials and Methodds

Both experiments were conducted on an Ohakea silt loam soil type. In Experiment 1, four replicates of six treatments were applied to plots in a randomised complete block (RCB) design in late March 1994, as shown in Table 1. The paddock used for the experiment was a mixed ryegrass - white clover pasture grazed by sheep. Plots were grazed evenly by a large mob of sheep a few days prior to application of treatments. Herbage dry matter accumulation was measured by difference between quadrat cuts taken on 31 March and 22 April, and standing herbage above 40 mm height measured in a single lawnmower cut on 6 May.

In Experiment 2, four replicates of four treatments were applied on 4 August 1995, as shown in Table 2, using a RCB design. Quadrat cuts and core samples to measure tiller population density were collected 46 days after application of treatments. The absence frequency method (Neuteboom *et al.*, 1992) was used to measure spatial distribution of tillers within the sward. This method involves measuring distances from a series of random reference points to the nearest tiller or shoot of the species of interest, in this experiment perennial ryegrass. Fifty random reference points per plot were defined using a point analysis frame. Herbage samples were ground after drying and sent to Intelact Nutrition Ltd, for Near Infrared Reflectance (NIR) analysis of herbage chemical composition.

Table 1. Treatments applied in experiment 1, autumn 1994.

Treatment	Description
Control	Water only applied
Nit_{lw}	Nitrosol® applied at recommended rate of 15 litres concentrate in 100 litres water/ha
Nit_{hw}	Nitrosol® applied at recommended rate of 15 litres concentrate in 500 litres water/ha.
Nit_{24N}	Nitrosol® at 300 litres of concentrate per hectare in 500 litres water /ha
$Urea_{24N}$	Urea at 5.23 g/m^2 (24 kg N/ha)
DAP_{24N}	DAP at 13.3 g/m^2 (24 kg N/ha)

Table 2. Treatments applied in Experiment 2, spring 1995.

Treatment	Description
Control	Water only applied
Nit_{rec}	Nitrosol® applied at recommended rate of 19 litres concentrate with approx. 100 litres water/ha
Nit_{32N}	Nitrosol® applied at 400 litres concentrate in 500 litres water/ha.
$Urea_{32N}$	Urea at 6.96 g/m^2 (32 kg N/ha)

Results

Experiment 1

The quadrat measurement of difference in herbage mass, and lawnmower measurement of standing herbage mass, both indicated a similar pattern of response across treatments, but the lawnmower method had a much lower standard error. For the latter, Nit_{24N} and DAP_{24N} treatments produced more herbage than Nit_{lw} and Nit_{hw} treatments ($P < 0.05$), with control plots being intermediate (Fig. 1).

Experiment 2

For the period of observation, response to urea was 21 kg DM/kg N ($P = 0.02$), compared with the control treatment, and response to Nit_{32N} was 13 kg DM/kg N (NS) (Table 3). DM yield for the Nit_{rec} treatment was again slightly less than the control, but not significantly so. DM yield for Nit_{32N} was significantly greater than for Nit_{rec} ($P = 0.03$). Urea significantly increased tiller density compared with all other treatments ($P < 0.04$, Table 3). Tiller density on Nit_{rec} and Nit_{32N} treatments was only slightly greater than for the control, and these differences did not come close to being significantly different ($P = 0.53$ and 0.86, respectively). Tiller weight did not differ from the control in any of the three

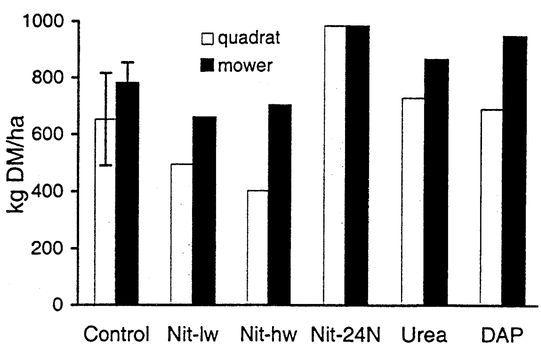

Figure 1. Experiment 1, autumn 1994. Herbage accumulation (kg DM/ha) for a 22 day period commencing seven days after fertiliser application (quadrat) and herbage harvested by lawnmower cut six weeks after fertiliser application (mower). SE bars shown for control treatment are valid for all treatments and represent 2x standard error of mean.

fertiliser treatments, although tiller weight for the Nit_{32N} treatment was significantly greater than for Nit_{rec} (P=0.02).

Statistical significance for absence frequency data was tested by subjecting the mean distance (mm) for each plot and the ordinary linear regression slope of the absence frequency diagram (Neuteboom *et al.*, 1992) to analysis of variance. No statistically significant differences in sward structure were detected (Table 3).

Urea tended to decrease herbage carbohydrate (P = 0.06) and increase protein concentration (P = 0.05) relative to control, and therefore increased protein:carbohydrate ratio (P = 0.04, Table 4). Other measures of herbage chemical composition were not significantly affected by any of the treatments.

Discussion

With respect to short-term herbage accumulation, the two experiments produced consistent results, and confirmed the earlier findings of Feyter *et al.* (1989) with other brands of liquid fertiliser. In both experiments, Nitrosol® at the manufacturer's recommended rate showed a non-significant tendency to yield depression when compared with the control. When analysed using a linear mixed effect model (G.C. Arnold, pers. comm.), this yield difference averaged over both experiments was 157 kg DM/ha, SE = 98 kg DM/ha, t = 1.60, P = 0.14. Nitrosol® applied at a rate to supply the same amount of elemental nitrogen as a dressing of urea gave a short term dry matter response similar to that of urea. However, the response obtained using the high rate of Nitrosol® did not have the same growth characteristics as the urea response. Urea increased tiller density and herbage protein:carbohydrate ratio, whereas Nitrosol® tended to increase tiller size rather than tiller density and did not increase herbage protein:carbohydrate ratio. In this experiment the absence frequency method did not detect differences in sward structure.

Although this experimental work was limited in scope and did not measure longer term responses or animal production responses, the different characteristics of the Nitrosol® and urea responses were interesting and possibly warrant follow up research.

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Table 3. Herbage mass, tiller population density, and absence frequency data for Experiment 2.

Treatment	Herbage mass (kg DM/ha)	Tiller density (tillers/m^2)	Tiller weight (mg/tiller)	Mean distance to nearest tiller (mm)	Slope of absence frequency line
Control	2321	4132	56	7.2	-0.087
Nitrec	2125	4646	46	8.7	-0.068
Nit_{32N}	2734	4420	62	8.7	-0.083
$Urea_{32N}$	2997	5856	51	7.4	-0.076
S.E.	123.3	259	6.8	0.8	0.007
P	0.003	0.005	0.022	0.415	0.280

Table 4. Chemical analysis of herbage obtained by NIR spectroscopy.

Treatment	ADF	NDF	Lipid	Dig	ME	CHO	Protein
Control	27.26	46.90	3.76	75.11	11.19	12.61	3.76
Nit_{rec}	27.40	46.51	3.78	76.19	11.35	12.45	3.78
Nit_{32N}	27.36	47.03	3.80	76.05	11.33	12.10	3.80
Urea	27.81	47.77	3.90	76.16	11.35	10.81	3.90
S.E.	0.38	0.55	0.05	0.34	0.05	0.43	0.05
P	0.747	0.472	0.234	0.14	0.14	0.060	0.234

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