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A comparison of the effect of split and single applications of nitrogen fertiliser on dairy production

J.W. PENNO

Consulting Officer Service, Livestock Improvement, Stratford, New Zealand.

ABSTRACT

A short term grazing trial was conducted on a central Taranaki dairy farm to study the effects on milk production of regular light dressings of nitrogen fertiliser (N), when compared to a single heavy application. Fifteen paddocks were allocated to each of two treatments. Both treatments consisted of 50 kg N/ha applied as either a single heavy application (50 kg N/ha) on 10 September (50x1 treatment), or frequent light applications (10 kg N/ha), applied progressively from 10 September directly after the following 5 grazings (10x5 treatment). Grazing of the herd alternated between the two treatments with 6 paddocks of one treatment being grazed for 4 consecutive days. Total milksolids (MS) production data was obtained for days 3 and 4 of each grazing period.

Total net herbage accumulation from August to mid-January was similar for the two treatments even though there was a difference in the pattern of accumulation. The 50x1 treatment resulted in 28% higher net herbage accumulation between 22 September and 12 November. The 10x5 treatment resulted in 37% higher net herbage accumulation between 12 November and 11 January. Botanical composition of the pastures in September, November and December indicated the 50x1 treatment increased the ryegrass content in November.

Total MS production was 400 kg MS/ha between 1 October and 10 January for both treatments. The monthly MS production differences between the treatments were small.

The results show there to be no advantage in terms of MS production to light regular applications of nitrogen fertiliser when compared to a single heavy application.

Keywords: Nitrogen fertiliser, application method, pasture production, milksolids production, botanical composition.

INTRODUCTION

In recent years there has been an increasing use of Nitrogen fertiliser (N) by dairy farmers. Application methods have focused on overcoming short term feed deficits with strategic applications of 25-50 kg N/ha (O'Connor *et al.*, 1990).

In an attempt to provide an even supply of extra pasture the practice of applying light rates of N (10-15 kg N/ha) after each grazing throughout the year has emerged (Gazzard and Bint, 1992). The benefits of this system have been cited as enhanced clover performance, increased total dry matter (DM) production, digestibility and subsequent animal performance. The only data available describes extra production of 175 kg milksolids (MS)/ha over the season and a reduction of 1000 kg DM/ha as purchased supplementary feed when applications, totalling 440 kg N/ha, were made after every grazing (Holmes, 1982). This response is profitable under today's prices.

This experiment was designed to measure the effects on pasture, and subsequent performance of dairy cows grazing the pasture, resulting from regular light N applications when compared to a single application of N.

MATERIALS AND METHODS

The experimental site was a 64 ha dairy farm located near Tariki, Taranaki. The farm was on a Stratford yellow brown loam, of good fertility, annually receiving 750-1000 kg/ha 30% potassic super phosphate. Annual rainfall of 2000 mm is evenly distributed throughout the year.

Fifteen paddocks were allocated to each of two treatments ensuring the total grazing area of the two treatments was the same, and all areas of the farm were evenly represented in the two treatments. The average herbage mass on the treatment areas were the same at the start of the trial. All paddocks received 25 kg N/ha on 1 August, as Di-Ammonium-Phosphate, Potassium Chloride 50:50, and 25 kg N/ha as Urea on 20 August.

Both treatments received a total of 50 kg N/ha over the trial period. On 10 September all paddocks allocated to the single heavy N application treatment (50x1 treatment) received 50 kg N/ha as urea. Those paddocks allocated to the regular light N application treatment (10x5 treatment) began a regime of 10 kg N/ha applied as urea progressively to individual paddocks directly after each of the following 5 grazings. The grazing frequency was 20 days.

The 15 paddocks allocated to each treatment were separated into 10 smaller paddocks (1.3-2.3 ha) which were grazed during the day, and 5 larger paddocks (2.4-2.9 ha) of which half was grazed in any one night. Paddocks of each treatment were grazed in the same order throughout the trial. The grazing of the predominantly Friesian herd of 210 cows alternated between each treatment every 4 days. During each 4 day period they grazed 4 day paddocks and 2 night paddocks, with a fresh allowance of pasture being offered every 12 hours.

The volume and composition of the milk from the herd was obtained from the local dairy company. Treatment effects were based on data for days 3 and 4 of each 4 day grazing period, giving 28 data points for each treatment. Herbage mass on each paddock was measured at approximately 10 day intervals with a rising plate pasture meter using the equation kg DM/ha = 114 x Meter reading + 1260. The average herbage mass was adjusted for differences in measurement day relative to the grazing rotation. Net herbage accumulation rates were calculated from the increase in herbage mass on individual paddocks not grazed between successive measurements. A smooth curve was fitted with 95% confidence intervals for each treatment using a Bayesian smoother (Upsdill and Wheeler, 1992).

Pastures on each paddock were sampled in September, November and January directly before grazing for analysis of species composition.

RESULTS

Spring weather conditions were cool and wet. The mean soil temperature (10 cm) was 0.8 °C below average, and mean sunshine hours were 141 hours less than the ten year average. Rainfall over the trial period was 81 mm more than average (Table 1).

TABLE 1: Meteorological data for central Taranaki over the trial period.

Month	Rainfall (mm)	Soil temp (°C 10 cm)	Sunshine (hrs)
August	295	6.4	129
September	136	7.8	112
October	219	9.8	119
November	111	13.6	171
December	203	14.9	140

The net herbage accumulation rates are in Figure 1. Net herbage accumulation from 28 August to 11 January was 5331 kg DM/ha and 5147 kg DM/ha for the 50x1 and 10x5 treatments respectively. The 50x1 treatment produced an extra 552 kg DM/ha (21%) from 28 August to 12 November and the 10x5 treatment grew an extra 737 kg DM/ha (37%) from 12 November until 11 January. Net herbage accumulation of the 50x1 treatment was significantly higher ($P < 0.05$) through October, and significantly lower ($P < 0.05$) through December, than the 10x5 treatment.

The difference between the residual herbage mass and the average herbage mass at the start of the trial was 250 kg DM/ha emphasising the feed shortage at that time. Average herbage mass remained at the same level on the 10x5 treatment for six weeks (Figure 2). In contrast the 50x1 treatment herbage mass increased quickly after treatment and by 2 October was 412 kg DM/ha higher than the 10x5 treatment paddocks. The herbage mass of the 1x50 paddocks was significantly higher than the 10x50 paddocks from early October until early December.

There was no significant difference in milk production or milk composition between the treatments at any time. Between 1 October and 12 January the 50x1 and 10x5 treatments produced 403 and 400 kg MS/ha respectively. The pattern of production (Figure 3) was similar to that of pasture production. However the magnitude of variation was very small. The 50x1 treatment produced an extra 472 kg MS between 23 September and 11 November and the 10x5 treatment produced 528 kg MS more between 11 November and 12 January.

FIGURE 1: Net herbage accumulation resulting from 50 kg N/ha applied 10 September (50x1), and 5x10 kg N/ha applied between 10 September and 18 December (10x5).

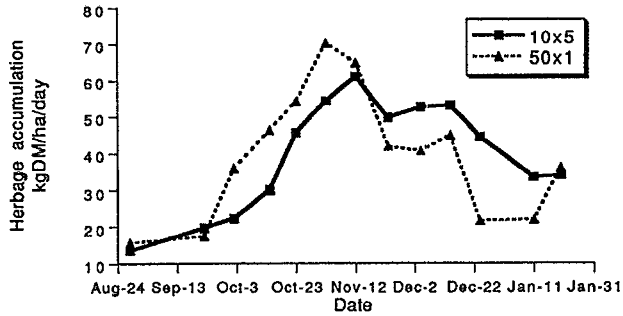


FIGURE 2: Average herbage mass resulting from 50 kg N/ha applied 10 September (50x1), and 5x10 kg N/ha applied between 10 September and 18 December (10x5) treatments, measured at the mid point of each rotation.

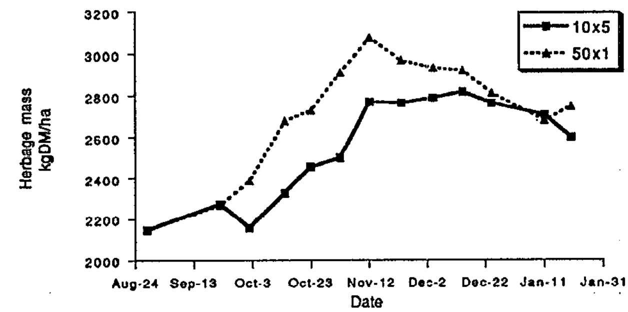
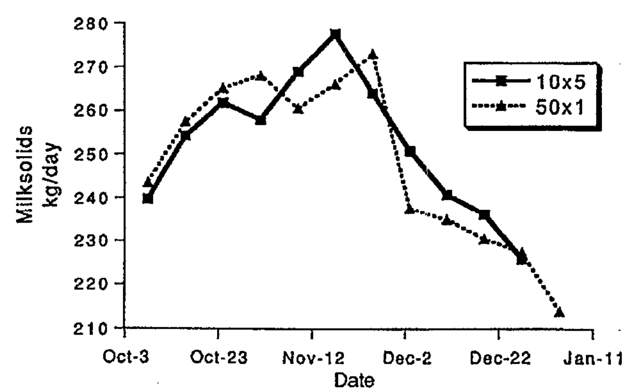


FIGURE 3: Daily milksolids production resulting from cows grazing paddocks of treatments 50x1 and 10x5.



The Ryegrass content of the 50x1 treatment increased by 27% between the September and November samplings (Table 2). There was a corresponding decrease in the content of other grasses. Otherwise differences between the treatments were small (Table 2).

TABLE 2: Mean values for botanical composition (%) of the two treatments on three occasions.

Treatment	Species	September	November	January
10x5	Ryegrass	55	53**	53
	White Clover	8	9**	16
	Other Grass	29	29	22
	Weed	4	5	3
	Dead material	3	4	6*
50x1	Ryegrass	52	66**	54
	White Clover	8	6**	4
	Other Grass	33	22	19
	Weed	4	2	3
	Dead material	2	4	10*

Treatment 10x5 = 10 kg N/ha applied 5 times, 50x1 = 50 kg N/ha applied once.

DISCUSSION

In the month preceding the start of trial 50 kg N/ha was applied to the entire trial area. This presumably had some influence on the herbage accumulation rates in the early stages of the trial. However the treatments did cause a variation in the monthly herbage accumulation rates. The heavy applications of the 50x1 treatment resulted in significantly higher herbage accumulation rates through October, and pastures of the 10x5 treatment grew significantly more through December. The extra herbage accumulation of the 10x5 treatment through December alone would account for a 9 kg DM/kg N response from the total of 50 kg N applied. This response is 5 kg DM/kg N higher than the responses obtained from previous N trials at this time of year in Taranaki (Roberts and Thompson, 1989). This effect had disappeared by mid January when the response to the last N applications of early December would be expected to diminish. The subsequent advantage from continued treatment of regular light applications of N will require further investigation.

The small variation in milksolids production between the treatments, at times when the difference in herbage accumulation was large, suggests much of the extra herbage was not eaten by the cows. This is in contrast to previous work where extra herbage produced using N was converted to milk solids at a rate of 19 kg DM/kg MS produced (Holmes, 1982). There are several factors which need to be considered when discussing the reasons for this. At the start of the trial period the herd went through a period of underfeeding caused by the low levels of available herbage mass in late August and September. By mid-October the herd was low in body condition (condition score 3.5-4). There was also a large range in the genetic merit of the herd. For these reasons the herd was only producing around 1.3 kg MS/cow through much of the trial period, even at times when herbage allocation was plentiful. The higher herbage mass which resulted from the treatments may have had some effect on production later in the season.

The clover content of the 10x5 pastures were higher than in the 50x1 treatment in November and December. The lower clover levels of the 50x1 treatment in November are in part due to proportionally higher ryegrass growth and a small absolute decrease in clover production. The increase in ryegrass production was visually apparent and made up the majority of the elevated levels of dead material in the 50x1 pastures at the conclusion of the trial.

The 10x5 treatment was more expensive in time and running costs as the entire farm was dressed five times with urea to gain the same net result. However it did provide a more even supply of feed. A management policy of this farm was to make no supplements. This presumably allowed the average herbage mass on the paddocks of the 50x1 treatment to reach levels during October and early November that reduced subsequent pasture quality.

CONCLUSIONS

Because of the nature of this trial and its design, the conclusions drawn are specific to this situation. Many of the perceived advantages of regular light applications of nitrogen fertiliser were not apparent in this trial. The two treatments did result in differences in monthly herbage accumulation. These differences were absorbed by the changes in herbage mass on the farm, and resulted in the variation between treatments in milksolids production being small. At the end of the trial period there was no difference between the treatments in total pasture or milksolids production.

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REFERENCES

Gazzard, J; Bint, M. 1992. Experience with nitrogen - Is it feed or fertiliser? *Proceedings of the Ruakura Farmers Conference 44*:84-86.

Holmes, C.W. 1982. The effect of fertiliser nitrogen on the production of pasture and milk in dairy farmlets: 1971-74. *Proceedings of the New Zealand Grasslands Association 43*: 58-63.

OConnor, M.B., 1982. Nitrogen fertiliser for the production of out of season grass. In: *Nitrogen Fertilisers in New Zealand Agriculture*. Ed. P.B. Lynch, New Zealand Institute of Agricultural Science, Wellington. pp 273.

O'Connor, M.B; Ledgard, S.F; Feyter, C. 1990. Using nitrogen fertiliser effectively in intensive dairying systems. *Proceedings of the Ruakura Farmers Conference 42*: 19-22.

Roberts, A.H.C.; Ledgard, S.F.; O'Connor, M.B.; Thompson, N.A. 1992. Effective use of N fertiliser - Research and Practice. *Proceedings of the Ruakura Farmers Conference 44*:77-83.

Roberts, A.H.C.; Thompson, N.A. 1989. Use of nitrogen fertiliser for intensive dairy production. In: *Nitrogen in New Zealand Agriculture and Horticulture, Ed White, R.E. and Currie, L.D. Fertiliser and Lime Research Centre, Massey University. Occasional report 3*: 42-53.

Upsdill, M.P.; Wheeler, D.M. 1992. Flexi 2.0 Bayesian smoother. *Reference Manual New Zealand Pastoral Agricultural Ltd.*