FERTILISER NITROGEN USE ON NORTHLAND PASTURES; PASTURE RESPONSES IN AUTUMN

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ABSTRACT

Pasture growth responses to autumn applications of fertiliser N in Northland are highest (10 to 13 kg DM/kg N) around the natural peak of autumn flush in April. Responses are halved if fertiliser applications are delayed until mid-May.

Early calved dairy herds and systems for providing cattle and sheep for out-of-season killing would benefit from improved autumn pasture growth. However, variable and sometimes very low responses to autumn applications occur, as they do in other areas of New Zealand. A better scientific understanding is required so that farmers can avoid applying N when poor responses are most likely.

Additional Keywords: out-of-season meat production, seasonal response, nitrogen fertiliser efficiency

INTRODUCTION

Relatively large, lean lambs produced during October and November would be valuable for cutting and marketing (N.Z. Meat Board, pers. comm.) and may reduce killing charges by spreading the seasonal pattern of kill (Taylor, 1982). Lambs born in autumn in regions with mild winters may achieve these targets. Rumball (1980) suggested that lambing one quarter of a ewe flock in autumn and the remainder in spring should give a better match between animal requirements and seasonal pasture growth at Kaikohe in Northland. However, lambing a higher proportion of ewes in autumn would put increasing pressure on autumn feed supplies. Winter finishing of beef cattle in Northland for the chilled export trade also puts pressure on autumn and early winter feed (Taylor and Clarkson, 1982).

Fertiliser nitrogen can be used to boost pasture growth but autumn responses are considered lower and more variable than those in early spring (O'Connor, 1982). This paper describes a series of small plot trials to measure N use efficiencies over the early to late autumn period at several sites in Northland.

TIME OF APPLICATION

The seasonal responsiveness of ryegrass, white clover dairy pasture at Kaiwaka in Northland to fertiliser nitrogen is similar to that of sheep pasture in the Manawatu (Fig. 1). Nitrogen causes a more sharply defined autumn flush with peak efficiencies (kg DM/kg N) over the autumn occurring in April at Kaiwaka and a few weeks later in the Manawatu. Ryegrass, sub-clover pasture on the exposed coastal Karikari Peninsular in Northland also showed peak autumn efficiencies in April (Fig. 1). It was not practical to measure nitrogen responses through the whole year on this latter site because of extreme summer droughts.

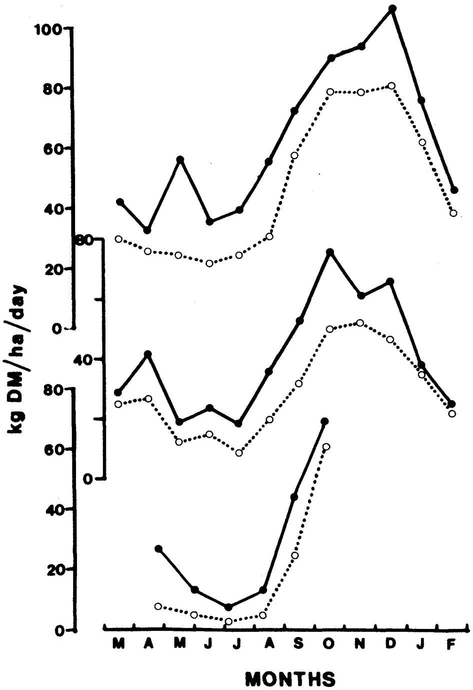

Figure 1: Seasonal patterns of pasture growth in kg DM/ha/day with (solid line) and without (dotted line) regular moderate nitrogen fertilizer applications. Sites were Palmerston North (Ball and Field, 1982) at the top; Kaiwaka, Northland (Armstrong, 1982) in the middle and Karikari Peninsular, coastal Northland at the bottom.

Further trials to measure N use efficiencies over the autumn period on a wider range of soil types were run in Northland in 1979. Full details of these sites and of trial design and weather during the trials are given in Taylor and Clarkson (1982). Average N use efficiencies were 11.7, 8.1 and 4.8 kg DM/kg N from application of 50 kg N/ha as urea on 9th April, 17th May and 21 June respectively. However, monthly rainfall patterns differed from the average during the trial. Rainfall was high in March and very high in June but lower than average over the intervening April-May period. Nitrogen use efficiencies reported by Armstrong (1982) over 3 years on a Kaiwaka dairy pasture were 14, 6 and 8 kg DM/kg N in the months April, May and June respectively.

SITES AND SEASONS

Pasture responses to autumn applications of fertiliser N are considered to be variable over much of New Zealand (O'Connor, 1982). A wide variety of soil types, pasture species and aspects exist in Northland so one might expect a substantial variation in autumn nitrogen responses. Table 1 shows the variation obtained on different sites from N applications made in April and May, 1979 (Taylor and Clarkson, 1982).

TABLE 1: Autumn fertiliser N use efficiency on different sites in Northland* (kg DM/kg N).

Soil Type	Application date	
Temperate grasses and clover	April 9	May 17
Konoti clay (rolling)	9.9	7.9
Waiotira clay (wet)	9.4	4.0
Basalt volcanic (dairy pasture)	21.1	22.6
Andesitic semi-volcanic	1.5	6.0
Peaty sand (with pan)	11.1	3.5
Kikuyu present in sward		
Sand (no pan)	17.0	4.7

*50 kg N/ha applied to sheep pastures (unless noted) in 1979 and response measured in 2 cuts over 10 weeks.

It is clear that autumn nitrogen responses vary in Northland as they do in other districts. The largest response of above 20 kg DM/kg N from both April and May applications was obtained on a ryegrass dominant dairy pasture on basalt-derived soil. A May application to the other 5 sites produced an average response of only 5.2 kg DM/kg N. Pasture response to the April application was generally higher, especially from the kikuyu site. This was expected because large urine responses are seen on kikuyu swards during autumn and early autumn growth of this species is known to be high (Goold, 1979). The very low N response on the andesite-derived soil was not expected. It was initially put down to excessively close grazing of the sward immediately prior to N application because longer regrowth on the same site gave a normal N response when urea was applied one month later. However, Rumball (pers. comm.) this year has also recorded very small responses to March and April N applications to a basaltic soil at Kaikohe while a good N response was obtained on a neighbouring clay soil.

Ball and Field (1982) have reported rapid and major changes in levels of available soil nitrogen when autumn rains follow a summer dry period. When the soil first becomes adequately moist, they postulate that a rapid growth of soil microflora utilise any mineralised N so pasture responses to fertiliser N would initially be high. Available N levels rise 3 to 4 weeks later when microbial growth slows because of an exhausted carbon source and reducing temperatures so fertiliser N responses would then be low. There are no data from Northland soils on autumn patterns of microbial growth and decay but the rate of some N transformations does differ in these soils. Steele (1982) has reported very low nitrification rates in a Wharekohe silt loam at Kaikohe and high rates in a neighbouring Kiripaka volcanic soil. Whether this could affect fertiliser N responses in autumn is unknown. Low N responses have been reported on many soils other than those of volcanic origin in other parts of the country (Ball and Field, 1982; O'Connor, 1982).

The limited trial data available from Northland suggests that autumn N responses will generally be maximised if N is applied in April when soils have rewetted following the summer. Pasture rate of growth trials on several sheep properties during 1982 showed that this timing coincided with the natural peak of the autumn flush. Autumn N applications to volcanic soils cannot be recommended until the large variations measured in these trials are better understood. In swards dominated by the sub-tropical grass kikuyu, good responses to autumn nitrogen are evident in March and April (Goold, 1979).

TABLE 2: Fertiliser N responses* on a peaty sand at Karikari Peninsular. Monthly rainfall in mm from Kaitaia aerodrome in parentheses.

	April	May	June	July
1979	11.1	3.5	3.2	
	(82)	(116)	(352)	(182)
1982	11.9	6.4	6.7	
	(127)	(58)	(117)	(158)
1983	13.4	7.8		
	(221)	(58)		

*Marginal efficiency in kg DM/kg N measured in 2 cuts over 10 weeks after applying 50 kg N/ha in the months shown.

As winter approaches, falling temperature and light levels reduce pasture growth rates and the ability to respond to fertiliser N. Wet winter soils can also cause losses through denitrification and leaching (Steele, 1982). Some idea of the extent to which this can happen is shown in Table 2 where 3 years' data was obtained from the same site; a peaty sand on Karikari Peninsular that could become waterlogged after heavy rain. In these trials, an almost

3-fold increase in April rainfall may have slightly increased the efficiency of an April N application but the very wet June in 1979 apparently halved the efficiency of both the May and June applications. Early winter temperatures in 1979 were slightly above normal on this site. Less nitrogen may be lost in winter from soils where temporary immobilisation can occur (Steele, 1982).

GENERAL

The fertiliser used in these trials was urea because, over the last 3 years, around two thirds of the N applied by Northland farmers has been as urea. Volatilisation is one additional form of loss that can occur when using urea in contrast to most other nitrogen fertilisers. On dry soils, Carren *et al.,* (1982) have measured losses of up to 40% from applied urine by this route. In sub-tropical grass pastures, high losses of nitrogen from autumn applications of urea resulted when a week of dry weather followed fertiliser application to a moist soil (Catchpoole *et al.,* 1983). In our trials, no attempt was made to apply urea immediately prior to or during rain. However, in the extensive series of MAF trials reported by O'Connor, lime ammonium nitrate was used as the N source and considerable variation in autumn responses was still evident. Nitrogen responses have been measured by mowing in these trials with two cuts made over a 10 week period. Grazing animals could increase effectiveness by recycling of nitrogen (Ball and Field, 1982).

The N.Z. Dairy Board gathered information on the seasonal pattern of fertiliser use by factory supply dairy farmers in their 1980/81 Cow Census. Of the 900 or so Northland farmers that replied, only 4% applied N in autumn and 17% in spring. Farmers will only use autumn N if pasture responses are assured. The underlying cause of variable autumn responses must be better understood so guidelines can be developed for farmers which will allow them to avoid wasting money.

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