ECONOMICS OF NITROGEN USE IN DAIRYING

D. A. L. BUXTON
Farm Advisory Officer, MAF, Hawera

Abstract

During the last 10 to 15 years, the use of fertiliser N at low rates on New Zealand dairy farms has become more popular. There are many ways in which fertiliser N can be used to increase pasture and milkfat production. Five of those options are analysed, viz.

1. High rates of N.
2. Bridging a spring feed deficit.
3. Increasing stocking rate.
4. Earlier calving.
5. More cow condition.

Research work is finding the best times and rates of application of N. The extra pasture produced must then be utilised to maximise milkfat responses.

Trials have shown that the use of high rates of fertiliser N (> 80 kg N/ha) is unlikely to be profitable on N.Z. dairy farms. N used to enable more cows to be wintered, and then milked in early spring, appears to be very profitable, due to better utilisation of later spring-autumn pasture growth. The other three options are also profitable, but the increase in total farm milkfat production is only 3 to 4%.

The options need to be tested more thoroughly with models and grazing experiments.

INTRODUCTION

New Zealand dairy pastures have traditionally relied on legumes and organic matter mineralisation to provide the majority of nitrogen for plant growth. While high rates of fertiliser nitrogen application to pastures in some overseas countries has been common place for half a century or more, in New Zealand such practices have been considered uneconomic.

During the last 10 to 15 years the use of fertiliser nitrogen on dairy pastures to provide extra feed during the winter-spring period, has increased dramatically. It is commonplace to find dairy farmers using low rates of fertiliser nitrogen (20-30 kg N/ha) over parts of their farm in July-August, in an endeavour to bridge an early spring feed shortage. The use of nitrogen in autumn to boost autumn-saved pasture and in mid spring on hay and silage paddocks to increase conservation yields is also gaining in popularity. Dairy farmers are now not asking advisers "if" they should use nitrogen, but "when" it should be used.

With the cost of fertiliser nitrogen in the form of urea remaining about 40% of the current milkfat price, and with many more nitrogen research results available, farmers are now asking if they can use more nitrogen to increase production and profit.

ECONOMICS OF USING FERTILISER NITROGEN

For nitrogen to be used profitably on dairy farms two factors have to be considered:

- (a) pasture response to both time and rate of application.
- (b) utilising the extra pasture growth to increase milkfat production.

While considerable research effort has gone into measuring pasture responses to nitrogen, much more is needed, especially on times of application to sites with varying soil type, rainfall, altitude and pasture. At this stage, Thomson and Roberts (1982) suggest that in Taranaki it is best to:

- (a) at low altitudes, apply nitrogen in April and late July-September.
- (b) at high altitude (300m), apply nitrogen August-October.
- (c) use about 25 kg N/ha in spring and up to 75 kg N/ha in autumn.

With the time and rate of application known, we now ponder if and how we can use nitrogen boosted pasture economically.

I will attempt to analyse five different ways of using nitrogen on dairy farms:

- (1) High application in several months of the year.
- (2) July-August applications to overcome a feed shortage.
- (3) July-August applications to carry more cows.
- (4) July-August applications to calve cows earlier.
- (5) April application to increase cow condition.

I. High nitrogen application (greater than 80 kg N/ha).

While Holmes (1982) and Bryant (1982) both report that their respective trials at Massey (1971-74) and Ruakura (1980-81) did not produce an economic return to high rates of N, it is possible that in both trials, a much higher milkfat response could have been obtained from each kg N applied, if rates of application were reduced and/or application times chosen to obtain better responses.

However, it seems that our high fertility dairy farm soils have adequate N or only marginal N deficiencies for most of the year. Large increases in pasture dry matter production are not likely to be produced from adding high rates of N over several months of the year. At best, current research results would suggest reasonable pasture responses (10 kg DM/kg N or better) at low altitudes can be obtained from an application of up to 75 kg N/ha in early April followed by two 25 kg N/ha applications in late winter-early spring. If this total application of 125 kg N/ha produced an extra 1250 kg DM/ha, then we can only expect an 8% to 10% lift in annual pasture production from high rates of N. Converted into milkfat, even at 100% utilisation, this extra dry matter is only going to give about 54 kg/ha more production.

The 125 kg of N will cost \$146 and 54 kg of milkfat will return \$154. The conversion efficiency of winter-spring feed to milkfat may be better than the 23:1 efficiency factor I have used, however even at better conversion efficiencies, the profit from high N usage is not likely to be encouraging.

2. Overcoming a Spring Feed Shortage with N.

For this and the other three nitrogen use situations the calculations are

based on the following hypothetical dairy farm:

40 effective hectares.

Medium to high fertility, free draining low altitude soils.

Milking 120 cows, 3.0/ha, heifers grazed off.

Calving 25 July to 15 September.

Annual milkfat production 500 kg/ ha.

Annual pasture production 13 500 kg DM/ha. 85% utilisation.

Assume that, for whatever reason, there is going to be a shortage of feed on this farm from mid August to mid September, and that nitrogen is being considered to provide extra feed. Using the following parameters:

12 kg DM/ kg fat production only, not maintenance.

100% utilisation of extra feed grown.

N costing \$1.17/kg N (\$538/t urea applied).

N response of 10 kg DM/ kg N.

then, 1.2 kg N costing \$1.40 would produce an extra 1 kg of milkfat returning \$2.85

or, on **our** 40 ha farm, 1 tonne of urea spread over 17-18 ha would cost \$538/t applied, and the extra fat would return \$1090 (plus any carry over effect).

Net return: \$550 (appendix 1A)

But, dairy cows can compensate in two ways during a feed shortage.

(a) graze lower.

(b) convert body fat to milkfat.

By grazing lower, say half the feed shortfall could probably be found.

If cows calve in good condition probably little milkfat production is lost due to a temporary feed shortage. Dairy cows can tolerate a mild feed shortage for up to five weeks without causing long term depressions in milk production.

3. Spring Application of N to Carry More Cows.

Using the same hypothetical farm, and the wish to carry 10 more cows, and assuming the following parameters:

Winter feed requirement (mid May-mid August) 5 kg DM/cow/day.

, Spring feed requirement (mid August-mid September) 12 kg DM/cow/day.

then, the extra winter-spring feed required would be:

5 kg x 90 days x 10 cows = 4000

12 kg x 30 days x 10 cows = 3600
7600

7600 kg DM at 95% utilisation during the winter would require 8000 kg DM extra growth.

This could be obtained from 1.7 t urea applied to say 30 ha. The extra feed required from mid September onwards is assumed to come from better feed utilisation.

The urea would cost \$915 and the return from the 10 extra cows would be \$2975.

Net return approximately: \$2000 (appendix 1B)

Some people would argue that the extra 10 cows could be carried simply by calving the whole herd eight days later. But this would mean a loss of 8 x 130 cows x 0.7 kg fat/ cow/ day = 730 kg fat or \$2000 worth, which is over double the cost of the urea.

4. Spring Applications of N to Enable an Earlier Calving.

Cow milking days can either be increased by milking more cows or by milking the same cows longer. The latter tends to be more acceptable by farmers for various reasons.

Once again if we take our hypothetical 40 ha farm and calve the herd 10 days earlier and maintain the same spread of calving, we would need 2.4 t of urea, costing \$1290. The earlier calving would give an extra 840 kg fat or \$2400.

Net return approximately: \$1100 (appendix 1 C).

A similar calculation could be done with an autumn application of N and carrying more autumn saved pasture into the winter. The returns would be a little better if we assume a better pasture response to N.

5. April Application of N to Increase Cow Condition.

Recent research in New Zealand and Australia has clearly demonstrated that there is a positive relationship between cow condition at calving and production in early lactation (Rogers *et al.*, 1979; Grainger, 1980; MacMillan and Bryan, 1980). Victorian studies have shown that for an extra 30 kg liveweight at calving (one “condition score”) 8-10 kg more milkfat/cow can be expected in the ensuing lactation, providing the cows are *fully fed*. A cow would need to consume 150-180 kg more dry matter to gain one condition score.

Taking our hypothetical farm and applying 2 t of urea in early April, costing \$1076, we could expect an extra 600 kg or \$1710 in return.

Net return, approximately: \$630 (appendix 1D).

If cows’ are not fully fed after calving, the milkfat response to better condition at calving is likely to be halved (MacMillan and Bryant, 1980), and in these circumstances our net return would be a loss of \$220.

Summarising the five options of using N on dairy farms, we have the following comparison of returns:

		<i>kg fat/kg N</i>	<i>Net return</i>	
			<i>\$/kg N</i>	<i>\$/40 ha farm</i>
1. (a)	High Rates Ruakura & Massey Trials	0.25	• 0.46	
(b)	High Rates Theoretical calculation	0.43	+ 0.06	320
2.	Feed Shortage	0.83	+ 1.20	550
3.	Carry More Cows	1.92	+ 2.56	2000
4.	Earlier Calving	0.78	+ 1.02	1100
5.	More Condition	0.65	+ 0.69	630

CONCLUSION

It seems at present that high rates of N on high fertility, white clover-ryegrass pastures are not a profitable option. Using N to carry more cows appears to be the most profitable way of using N to increase dairy production however this assumes getting "something for nothing" for six months of the year; i.e., better utilisation of what already is being grown. The other three options considered are less profitable but still worth considering for small production increases; in the order of 3-4% of total farm production.

All the options considered, and others, need to be more thoroughly analysed with models and tested. with grazing experiments. N responses in cutting trials can differ to responses in grazing trials. Animal responses are likely to produce another set of results again because of the effects of changes in pasture composition, utilisation, pasture quality and feed conversion.

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APPENDIX 1: NET RETURN FROM FOUR METHODS OF STRATEGIC USE OF FERTILISER NITROGEN.

A. To overcome a spring feed shortage by application in early August.

1 t urea	= 460 kg N
at a 10:1 response	= 4600 kg DM
at a 12:1 feed:fat conversion	= 383 kg fat
: 30 days	= 12.7 kg fat/day
: 120 cows	= 0.1 kg fat/cow/day
i.e., an increase from 0.7 to 0.8 kg fat/cow/day	
Cost of 1 t urea:	\$538/t applied
Value of extra 383 kg fat:	\$1090
Net return	\$ 552

B. application in early spring to enable 10 more cows to be carried.

10 cows	x 150 kg fat/cow	= 1500 kgfat	
1500 kg fat	x \$2.85/kg		\$4275
less extra costs:	Feed	10	
	Shed, Electricity	10	
	An. Health, Breeding	20	
	Interest	40	
	Replacement	<u>50</u>	
		130	10 = 1300
	Gross Margin of 10 cows:		\$2975
	Cost of 1.7 t urea		\$ 915
	Net return		\$2060

C. To enable earlier calving.

Daily feed requirement for milk production only in early lactation = 8 kg DM/cow
At 90% utilisation, 9 kg DM/cow is required.

120 cows x 10 extra milking days	= 1200 cow milking days
	x 9 = 10800 kg DM
at 10:1 response	= 1080 kg N required
	= 2.4 t urea on say 40 ha.
1200 extra cow milking days at 0.7 kg fat/cow/day	= 804 kg fat (21 kg/ ha).
840 kg fat x \$2.85/kg	= \$2400
less cost of 2.4 t urea	= \$1290
Net return	\$1110

D. Application in April to enable an increase in cow condition and subsequent increase in milkfat production.

2 t urea	= 920 kg N
at a 11:1 response	= 10000 kg DM
: 120 cows	= 84 kg extra DM/cow
	= 0.5 extra condition score
at best, this would give	5 kg more milkfat.
120 cows x 5 kg	= 600 kg x \$2.85 = \$1710
less cost of 2 t urea	= \$1076
Net return	\$634