Grass Challenge *for dairy farmers*

Challenge Note 1B - Evaluating the Efficiency of Nitrogen Use

Contents

1. The Importance of Fertiliser in Milk Production

The major cost in producing grass for either grazing or silage is inorganic (purchased) fertiliser. The cost of fertiliser and it's application makes up 28% and 65% of the total cost of silage and grazed grass respectively.
This cost in turn influences the cost of producing a litre of milk. Expenditure on fertiliser must be seen as an investment requiring the best return in terms of grass and milk production.
While the major nutrients required for plant growth are nitrogen, phosphorus and potassium, the greatest response comes from nitrogen provided phosphorus and potassium levels are adequate.

2. Fertiliser Nitrogen Use and Stocking Rate as a Measure of Efficiency

Efficient fertiliser use will give a good grass growth response per kg of fertiliser applied and this will support a higher stocking rate.

Efficiency is measured by comparing the amount of nitrogen sown with farm stocking rates.

High stocking rates can also be obtained from feeding high levels of concentrates as part substitute for grass or silage. High stocking rates in comparison to fertiliser nitrogen use must also be assessed against the annual milk from forage per cow or per hectare.

Example calculation of efficiency of fertiliser use

A farmer has 80 cows and 40 herd replacements (20 less than 1 year & 20 1 - 2 years) on his 42ha farm. Last year he applied:

- 6 tonnes of 27 : 6 : 6 on 23.5 hectares of 1st cut silage in addition to one application of slurry in late winter;
- 6 tonnes of 24 : 6 :12 on 18 hectares of 2nd cut silage;
- 3 tonnes of 24 : 6 :12 on 12 hectares of 3rd cut silage;
- On all his grazing area for both dairy cows and heifers he applied 15 tonnes of 26 : 4 : 4 and 12 tonnes of 27 : 0 : 0.

The farmer uses this information and the attached worksheets to calculate his average fertiliser nitrogen use.

Example 1: *Farm stocking rate calculation*

Stock Type	Cow Equivalents (CE/head) (A)	Average stock numbers over the year (B)	Cow Equivalents (A X B)
Cows	1.0	80	80
Bulls	1.0		
Cattle over 2 years	1.0		
Cattle 1 – 2 years	0.6	20	12
Cattle less than 1 year	0.4	20	8
Ewe & Rams	0.2		
Lambs	0.1		
	TOTAL (C)		**100**

Land Available	Hectares
Owned	40
Conacre	2
TOTAL (D)	**42**

Farm Stocking Rate = Total Cow Equivalents (C) ÷ Land Area Available (D)

= 100 ÷ 42

= 2.4 CE per hectare

Example 1 continued: *Annual nitrogen fertiliser applied per hectare*

Fertiliser Ratio (N : P : K)	Tonnage applied for silage	Tonnage applied for grazing	Total tonnage of fertiliser (T)	Kilograms of nitrogen per tonne (N)	Total kilograms of nitrogen applied (T X N)
20 :10 :10				200	
24 : 6 : 6				240	
22 : 4 : 14				220	
24 : 6 : 12	*6 + 3*		*9*	240	*2160*
25 : 5 : 5				250	
26 : 4 : 4		*15*	*15*	260	*3900*
27 : 6 : 5				270	
27 : 6 : 6	*6*		*6*	270	*1620*
27 : 0 : 0		*12*	*12*	270	*3240*
25 : 3 : 5				250	
21 : 0 : 0				210	
21 : 0 : 14				210	
22 : 4 : 14				220	
20 : 5 : 15				200	
46 : 0 : 0				460	
	Total kilograms of nitrogen applied				***10,920***

Nitrogen use per ha = Total kilograms of nitrogen applied ÷ Total area farmed

Nitrogen use per ha = 10,920kg ÷ 42ha

= 260kg

Results

From the worksheets the farmer calculates his annual average stocking rate to be 2.4 CE per ha and his average annual fertiliser nitrogen use to be 260kg per ha. To assess how efficient his use of fertiliser is, he compares it with his stocking rate using the comparison table overleaf.

Table 1: *Fertiliser nitrogen requirements to maintain stocking rates for grazing livestock*

Stocking Rate (ce/ha)	Nitrogen Requirements (kg/ha)
1.4	70
1.5	90
1.6	110
1.7	130
1.8	150
1.9	170
2.0	190
2.1	210
2.2	230
2.3	250
2.4	270
2.5	290

(Source: Farm Business Data 2004)

Conclusion

The farmer calculates that his average fertiliser nitrogen use of 260kgN per ha is below the target average fertiliser nitrogen use of 270kgN per ha for his stocking rate of 2.4 CE per ha. From this he can conclude that he is making efficient use of his purchased fertiliser (assuming meal-feeding level is appropriate).

3. Reasons for High Nitrogen use Per Hectare

a) Inappropriate timing and application of fertiliser: Fertiliser may have been applied when the grass growth response was poor for example, late winter / early spring or late autumn.
Fertiliser may also have been applied during very dry conditions with insufficient moisture to allow effective utilisation for grass growth. The opposite may be true for fertiliser sown during very wet conditions with excess leaching occurring.

b) Inappropriate timing and application of slurry / manure: The full benefits of slurry and manure may have been lost if they were applied when conditions were not suitable. As a result more inorganic fertiliser needs to be applied to supply the nutritional demands of the crop grown.

c) Soil pH too high or low: Soil pH may be unsuitable for a good grass growth response to fertilisers. The ideal pH for most soil is 6.2.

d) Lower productive soil type: The type of soil may limit grass growth. Deep peaty soils are more productive in comparison to shallow sandy soils, which are prone to leaching. The most productive soil type is a deep loam.

e) Poor sward quality: Perennial ryegrass rich swards are more productive than swards with a low percentage of ryegrass. These poorer swards may have a high content of weed grasses especially at higher nitrogen application rates.

f) Poor grassland management for example, overgrazing or under grazing: Results in a poor grass growth response from fertiliser and poor grass utilisation by stock.

Note: *Excessive levels of phosphate and potash fertiliser are damaging to the environment by reducing water quality. This is seen as an avoidable cost to the farm business.*

4. How to Improve the Efficiency of Nitrogen Use:

- Appropriate timing and application of fertiliser;
- Appropriate rate and application of slurry and manure;
- Good sward quality;
- Good grassland management;
- Ideal soil pH;
- Ideal soil type;
- Good use of clover;
- High use of purchased feeds - grazed grass and silage may have been part substituted for purchased feed reducing stock dependence on grass and silage. In other words extra stock can be kept by buying in purchased feed thus increasing the farm-stocking rate in relation to the fertiliser nitrogen sowed.