

## Fertiliser nitrogen, how much is too much?

John Lucey, DAFWA Manjimup, 08 9777 0124, [john.lucey@agric.wa.gov.au](mailto:john.lucey@agric.wa.gov.au) .

What are we trying to achieve?

- Pasture will keep responding to nitrogen (N) up to very high levels, but what about cows, milk and profit?
- At what level of N application do we get best return from extra money spent?

To answer these questions we must also look at grazing management practices as the two are closely related.

- Are current grazing management practices appropriate for high N fertiliser rates?
- Can grazing management practices be modified to improve profitability at high N rates?

### The Greener Pastures Nitrogen Response Farmlets

The five N response farmlets have a gradual increase in stocking rate and fertiliser N applied. For example, Farmlet 1, with 1.25 milkers per hectare, receives no fertiliser N while Farmlet 5, at 2.25 milkers per hectare, receives 2 kg of fertiliser N per ha per day. By comparison, the W.A. industry average is now about 1.5 milkers/ha.

Table 1. The five N response farmlets – some basic facts.

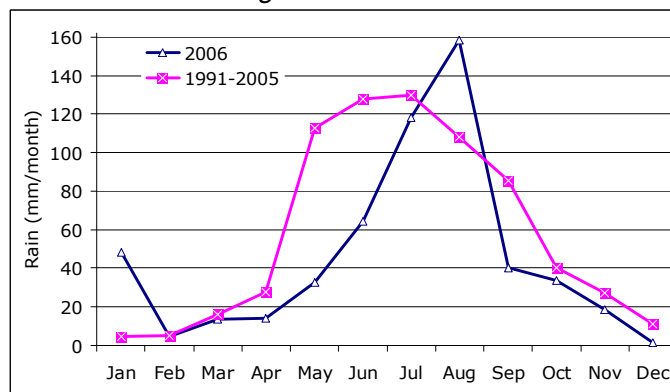
N response farmlet	Pasture area ha	Cows per farmlet	Stocking rate cows/ha	N fertiliser kg/ha/d	N fertiliser used if a 200-day growing season
1	15.8	20	1.25	0	0
2	13.8	20	1.50	0.5	100
3	11.6	20	1.75	1.0	200
4	10.2	20	2.00	1.5	300
5	9.0	20	2.25	2.0	400

\* All farmlets receive ~2.1 t DM concentrate per cow per year

### The 2006 season

The 2006 season had a late start and early finish as shown the rainfall graph below. The length of the growing season was about 165 days, which is 6-7 weeks shorter than a 'normal' growing season of 200-210 days at Vasse Research Centre.

Figure 1. Monthly rainfall for 2006 compared with 1991-2005 average for Vasse Research Centre.

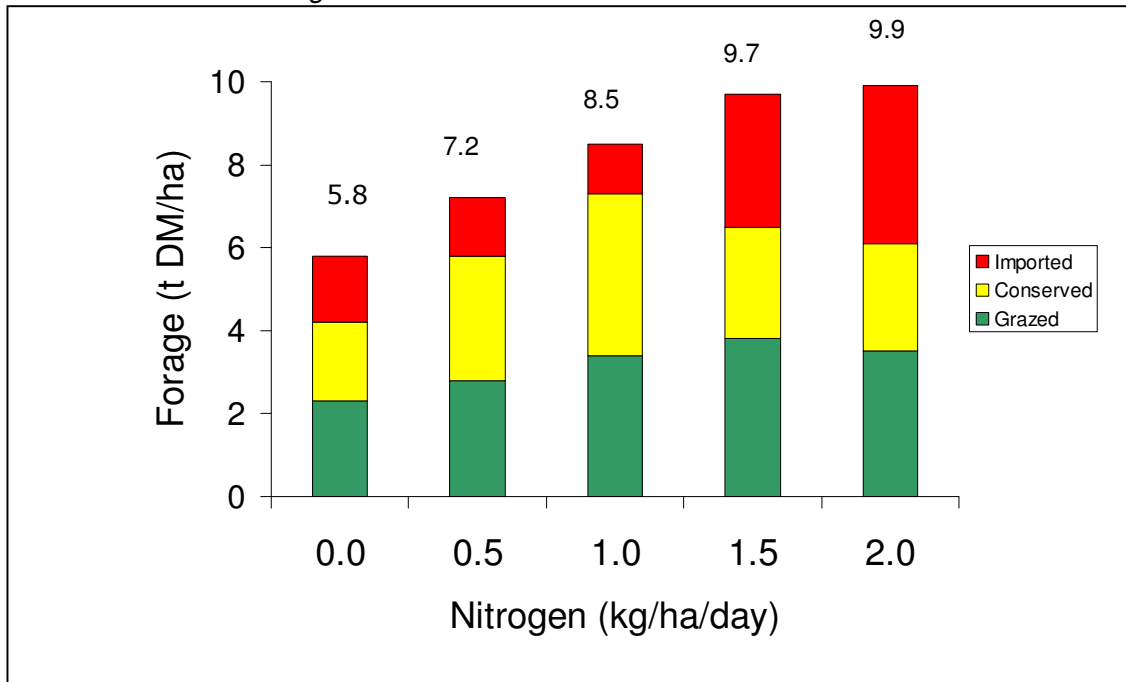


### Pasture Utilisation

Total pasture utilisation (tonnes dry matter per ha) peaked at 1 kg/ha/day N fertiliser and then declined (see Figure 2; bottom + middle sections in each column). Pasture grazed directly (bottom section in each column) was maximised at 1.5 kg/ha/day, although the increase in pasture yield for the additional nitrogen is very marginal. Pasture conserved as silage (middle section) was maximised with Farmlet 3.

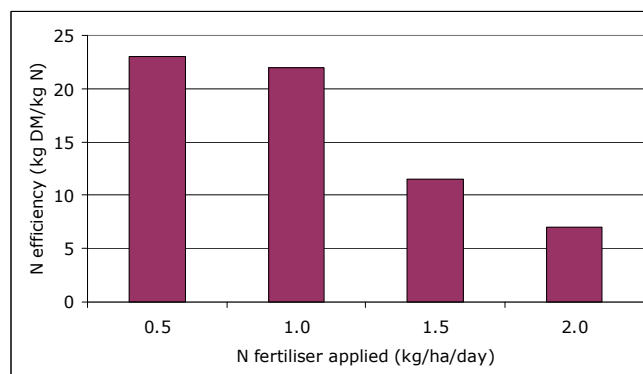
The top section in each column in Figure 2 shows the amount of forage that had to be imported to meet feed demand. This was particularly high for farmlets 4 and 5, but was about 1.5 t DM/ha for farmlets 1-3 also. This is partly due to the very late break of season experienced at Vasse in 2006.

Figure 2. Pasture utilised for each of the N farmlets.



The pasture N efficiency (kg total pasture DM used per kg of total fertiliser N applied) is shown in Figure 3.

Figure 3. Pasture N efficiency for the 5 N farmlets.



## Milk Production

Milk production per cow was not significantly different between farmlets (Table 2). On the other hand, milk production per hectare increased considerably as N fertiliser nitrogen application and stocking rate increased. Farmlet 5 shows a diminished response, as the additional fertiliser N is not being converted into additional milk at the same rate.

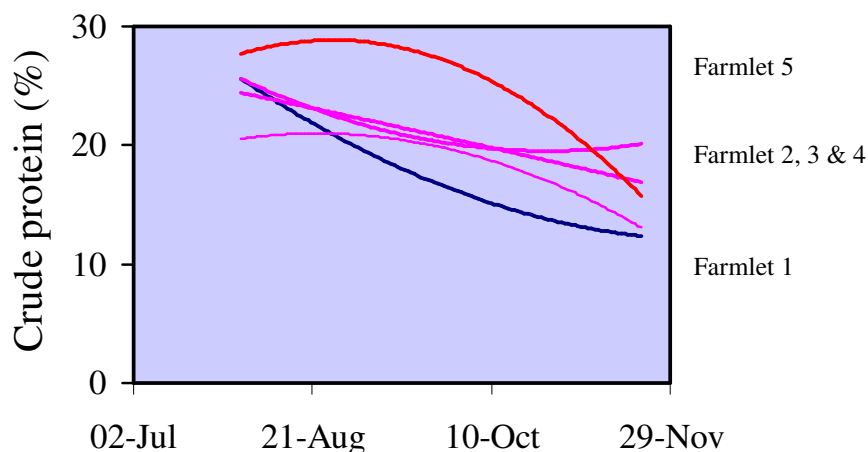
Table 2. Milk production and composition for the nitrogen farmlets.

N response farmlet	Milk volume l/cow	Fat content %mv	Protein content %mv	Fat + protein kg/cow	Fat + protein kg/ha
1	7,320	4.06	3.28	537	671
2	7,141	4.12	3.45	541	819
3	7,566	4.05	3.31	557	960
4	7,874	4.06	3.29	579	1158
5	7,166	4.11	3.42	539	1211

## Pasture Protein Levels

Farmlet 1 pasture crude protein levels were below that required for lactating dairy cows for part of the season. Farmlets 2, 3 and 4 have higher pasture protein concentrations, which are suitable for lactating cows. Farmlet 5 has pasture protein levels well over what is required by the cow for most of the season. Excessive protein results in an energy cost to the cow for excreting excessive protein in the urine, which reduces milk production. Excessive protein can also reduce fertility and reduce body condition.

Figure 4. Pasture crude protein concentrations for the Nitrogen Response Farmlets.



## Summary

- Apply fertiliser N at 0.5 – 1.0 kg/ha/day. Increase to 1.0 – 1.5 kg/ha/day tactically as you need extra feed, such as in spring and autumn.
- Nitrogen applied at 2 kg/ha/day has resulted in reduced production through dietary imbalance for the cow and poorer pasture utilisation.

## The Path to High Pasture Use

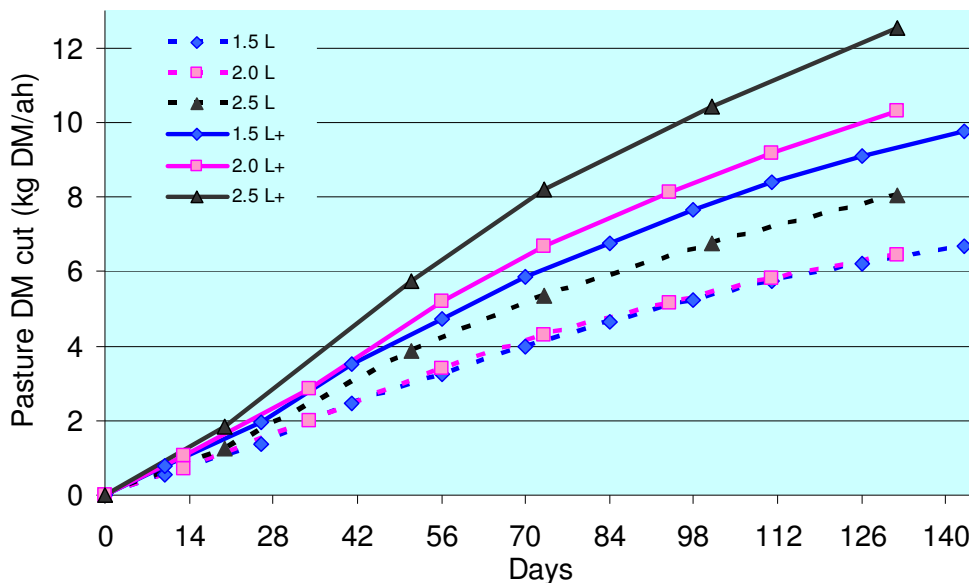
Does grazing management have to change with high nitrogen application?

In the summer/autumn of 2007 we conducted a trial at Vasse Research Centre with irrigated perennial ryegrass grown in pots. This trial allowed us to have a close look at the relationship between rotation length (cutting interval) and N fertiliser application rate. The trial lasted 140 days and included 6 treatments combinations.

- N fertiliser applied (after each cutting) at 1 or 2 kg/ha/day and...
- Ryegrass cut when it reached 1.5 leaves per tiller or 2.0 leaves or 2.5 leaves

Grass cut at 1.5 leaves per tiller was cut 10 times in 140 days (mean interval 14 days). Grass cut at 2.0 leaves per tiller was cut 7 times in 140 days (mean interval 20 days). Grass cut at 2.5 leaves per tiller was cut 5 times in 140 days (mean interval 28 days). At each cutting we measured pasture production and quality and at the end of the experiment we measured root weight and tiller density.

Figure 5. Cumulative production for irrigated perennial ryegrass plants cut at 1.5, 2.0 and 2.5 leaves with N fertiliser applied at 1 kg (dotted lines) or 2 kg (solid lines) per ha per day.



A cutting interval of 2.5 leaves (cutting every 28 days on average) greatly increased total pasture production at both N fertiliser rates, compared to cutting every 1.5 leaves or every 2.0 leaves. Grazing at or below 2 leaves greatly reduced production, particularly at the lower N fertiliser rate.

Sugar levels in ryegrass increased with leaf stage, providing more rapidly fermentable energy to the rumen. Protein levels declined with leaf stage. Rate of N fertiliser had no influence on protein or sugar levels (Table 3).

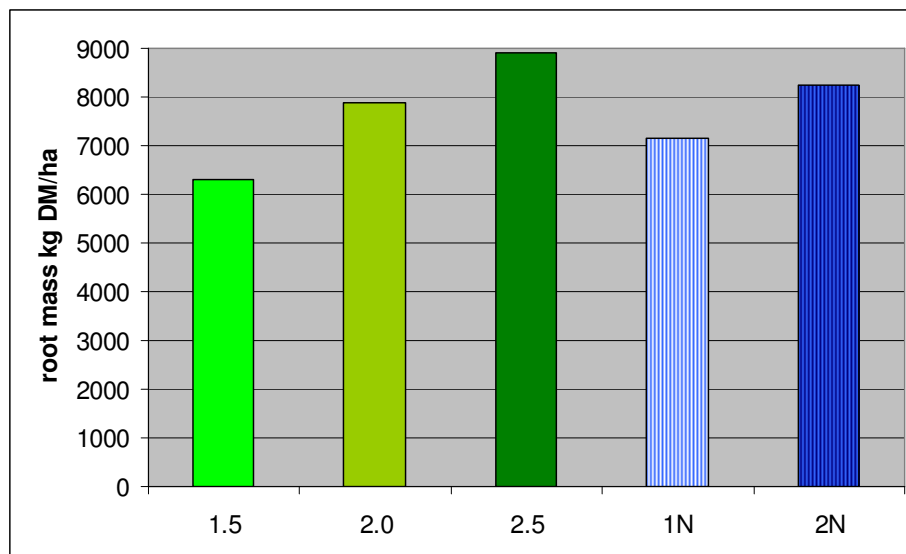
*Table 3. How cutting interval (leaf stage) and N fertiliser rate influenced protein and sugar content of perennial ryegrass.*

	Leaf stage at cutting			N fertiliser rate	
	1.5L	2.0L	2.5L	1N	2N
Pasture protein %	16	15	13	14	14
Pasture sugar %	10	12	14	12	12
Protein:sugar ratio	1.7	1.1	1.0	1.1	1.2

If pasture is cut/grazed before the 2.0 leaf stage the ratio of protein to sugar is very unbalanced compared to the needs of the cow (optimum ratio about 1.0-1.2; a higher ratio indicates there is not enough rapidly fermentable sugar to allow rumen microbes to use pasture protein). This results in wasting of protein, which must be excreted in the urine. This costs energy to the cow to process the excess protein, which reduces production and/or body condition, and may also have a negative effect on fertility.

Cutting at an early leaf stage retards root development (Figure 6), so plants are left with reduced ability to access water and nutrients. Higher rates of nitrogen also resulted in greater root mass. This is probably a result of similar levels of plant sugars in the ryegrass nitrogen treatments so root development was not slowed in either.

*Figure 6. Root mass at 140 days at 3 cutting frequencies for irrigated perennial ryegrass and at 2 rates of N fertiliser application.*



### Pot Trial Implications

- Use leaf stage to time grazings for maximum pasture use and milk production.
- Optimise pasture production & quality for the cow by grazing at 2.5 – 3.0 leaves.
- Graze earlier ONLY where 3 leaf-grazing wastes grass.
- What about canopy closure? If canopy closure is common before 2.5 leaves, reduce the amount of fertiliser N used, but do NOT speed up your rotation.
- High fertiliser N & fast rotations create nutritionally imbalanced pasture that is bad for cows and reduces production.

## **Conclusions**

- Pasture utilisation maximised at about 1 kg N fertiliser per hay per day, but rotation speed/leaf stage is a key factor that determines what will be achieved. Grazing at an earlier leaf stage can counteract benefits from fertiliser N.
- Increase pasture use through your grazing management skills, not through expensive use of HIGH levels of fertiliser N.
- Avoid canopy closure by reducing N fertiliser, and NOT by reducing rotation length. High N fertiliser combined with N fertiliser N use is bad news for cow nutrition and health, bad for the environment and bad news for your hip pocket