

## Nitrogen fertiliser use in early lambing systems

G.W. SHEATH, C.J. BOOM and R.W. WEBBY

*Whatawhata Research Centre, MAF Technology, Private Bag 3089, Hamilton*

### Abstract

Nitrogen fertiliser was applied in June 1990 to early-August lambing systems and production was compared with traditional September lambing. Nitrogen (30 kg N/ha) increased pasture growth rates by 3-4 kg DM/ha/day and increased production by 210 kg DM/ha during July-September inclusive. Nitrogen responses were greatest in south-facing paddocks; least on easy contoured paddocks; and did not differ between "resident" pastures and "improved" pastures that had been oversown with new pasture cultivars 5 years before. Compared with traditional September lambing, early-August lambing (plus N) resulted in 20% fewer lambs at weaning; 2.4 kg heavier lamb weaning weights; similar ewe weaning weights; and similar bull live weights in January. While N applications to earlier lambing systems reduced the differences in ewe and bull weights previously recorded between the lambing date treatments, it was not a profitable strategy. Assessment of pasture response to N (30 kg N/ha) was repeated in 1991. Nitrogen increased production by 260 kg DM/ha and responses were similar for all paddock and pasture types.

**Keywords** nitrogen fertiliser, early lambing, hill country

### Introduction

Earlier lambing is an option available to farmers for producing heavier lambs. For 3 years the production of early versus late lambing systems were compared in hill country farmlets at Whatawhata (Sheath *et al.* 1990). In summary, early August lambing was less profitable than traditional September lambing.

Nitrogen (N) application in June was seen as a strategy to counteract the greater feed deficits created by earlier lambing. In dairying, earlier calving plus N has increased cow production and condition (Roberts & Thomson 1989); and in hill country large pasture and animal responses have been reported (Lambert &

Clark 1986). The objective of the experiment reported in this paper was to use N fertiliser in early lambing systems to improve July-August pasture growth and to eliminate poorer ewe and bull weights that had previously been experienced relative to September lambing. The response of pasture and animal production to N fertiliser was measured in 1990 and a repeat assessment of pasture response was made in 1991.

### Experimental detail

The trial consisted of a 2 x 2 factorial with 3 replicates (as described by Sheath *et al.* 1990), with treatments comparing pasture improvement and lambing date. During the third week of June 1990, all paddocks in each of the early lambing farmlets received 30 kg N/ha as urea.

### Stock policies

The 12 self-contained farmlets (5-6 ha) carried Romney x Coopworth ewes (9.2/ha) and Friesian bulls (0.9/ha). Six early-lambing (EL) farmlets had a mean lambing of the second week in August while the six late-lambing (LL) farmlets had a mean lambing of the second week in September.

Lambs were all weaned on 15 November and the heaviest were retained on the farmlets at 6/ha until disposal on 16 January. Lamb weaning dollar values were calculated on potential prices at the time of weaning while sales values were those actually received.

Bulls were placed on farmlets in November as 3-month weaners, and were disposed of at 18-20 months of age.

### Farmlet structure

The farmlet land area consisted of 2/3 steep land (>15° average slope) and 1/3 easy land (<15°). Within the six improved farmlets the steep land had been oversown 4 years previously with 'Ellett' ryegrass, 'Grasslands Wana' cocksfoot, 'Grasslands Tahora' and 'Prop' white clovers and 'Mount Barker' and 'Tallarook' sub-clovers. The improved farmlet easy land had been

oversown with 'Grasslands Marsden' ryegrass 1 year previously. Pasture composition was assessed during September 1990 using a 5 mm ring presence/absence technique (Table 1).

**Table 1** Species composition of paddocks in early lamb farmlets in September, 1990. (percentage frequency with 5.0 mm sampling ring).

|                 |          | Paddock type |              |              |
|-----------------|----------|--------------|--------------|--------------|
|                 |          | Easy contour | North aspect | South aspect |
| <b>Ryegrass</b> | Resident | 77           | 55           | 45           |
|                 | Improved | 77           | 50           | 52           |
| <b>Browntop</b> | Resident | 25           | 31           | 33           |
|                 | Improved | 8            | 26           | 22           |
| Poa spp.        | Resident | 29           | 14           | 9            |
|                 | Improved | 38           | 18           | 18           |
| Other grasses   | Resident | 12           | 29           | 34           |
|                 | Improved | 4            | 20           | 22           |
| Cocksfoot       | Resident | 0            | 3            | 1            |
|                 | Improved | 0            | 10           | 15           |
| White clover    | Resident | 32           | 18           | 19           |
|                 | Improved | 38           | 18           | 27           |

### Pasture measurements

Nitrogen response was determined within the early-lambing farmlets. In each of these 6 farmlets, 3 paddocks were selected to measure the response to N application (1 easy, 1 north facing steep and 1 south facing steep). Four pairs of 2 m x 2 m plots were placed in each paddock. Within each pair N was applied to one plot and omitted from the other. Cages were placed on these plots and pasture growth was measured for 3 time periods (28/6-9/8; 9/8-6/9; 6/9-1/10) using a calibrated capacitance probe. Where cage placement did not coincide with grazings of these indicator paddocks, measurement areas were trimmed to residuals of 700, 900 and 1050 kg DM/ha for the 3

regrowth periods respectively. Except for period 1 these levels approximated the actual grazing residuals that occurred in the total farmlets.

Average pasture cover was determined for both early- and late-lambing farmlets in May, August and November. Pasture mass in all paddocks was estimated using a calibrated visual assessment technique.

Assessment of pasture response to N was repeated in 1991. In the third week of June, the N treatment was rerandomised and applied (30 kg N/ha as urea) to one plot and omitted from the other. Pasture growth was measured as described above for the periods 27/6-8/8 and 3/8-5/9.

### Climate

Climatic data for winter-spring of 1990 and 1991, and long term averages, are given in Table 2.

## Results and discussion

### Animal production

In previous years of this experiment (Sheath *et al.* 1990) lambing during early August, rather than early September, resulted in:

- \* 15-30% fewer lambs born per ewe lambing
- \* 530% fewer lambs weaned per ewe mated
- \* 2.0-2.5 kg heavier average lamb weaning weight
- \* 2.0-4.0 kg lighter ewe weaning weight
- \* 10-20 kg lighter bulls at slaughter

In this 1990 experiment, relative lambing performance was already established by the time urea (30 kg N/ha) was applied to EL farmlets. As in previous years, lambing performance was 20% lower for EL farmlets (Table 3). Ovulation rates of cross-bred ewes can be expected to be

**Table 2** Climate data for Whatawhata Research Centre (N.Z. Met. Service site C75801). Data in parenthesis are 1952-1990 averages.

|                                    |      | May    | Jun   | Jul   | Aug   | Sep    | Oct    |
|------------------------------------|------|--------|-------|-------|-------|--------|--------|
| Rainfall (mm)                      | 1990 | 40     | 150   | 195   | 319   | 110    | 160    |
|                                    | 1991 | (149)  | 147   | 251   | 247   |        |        |
|                                    |      |        | (158) | (166) | (157) | (130)  | (140)  |
| Air temperature (°C)               | 1990 | 12.0   | 8.7   | 10.0  | 10.4  | 9.8    | 13.8   |
|                                    | 1991 | 11.1   | 9.5   | 7.9   | 11.0  |        |        |
|                                    |      | (11.8) | (9.7) | (8.9) | (9.9) | (11.5) | (13.1) |
| Number days grass minimum <-1.0 °C | 1990 | 3      | 11    | 4     | 5     | 14     | 3      |
|                                    | 1991 | (5)    | (9)   | 17    | 2     |        |        |
|                                    |      |        | (9)   | (11)  | (8)   | (4)    | (2)    |
| 10 cm soil temperature (°C)        | 1990 | 11.1   | 8.4   | 8.5   | 9.1   | 9.0    | 13.6   |
|                                    | 1991 | 9.9    | 8.2   | 6.4   | 9.4   |        |        |
|                                    |      | (11.2) | (9.1) | (7.8) | (8.8) | (10.7) | (13.2) |

Table 3 Animal performance for early and late lambing farmlets.

|                         | Early lamb<br>plus Nitrogen | Late lamb | SED <sup>a</sup> | Significance <sup>b</sup> |
|-------------------------|-----------------------------|-----------|------------------|---------------------------|
| Lambs                   |                             |           |                  |                           |
| Lambs born/ewe lambing  | 1.39                        | 1.55      | 0.06             | .                         |
| Lambs weaned/ewe mated  | 0.95                        | 1.17      | 0.07             | .                         |
| Lamb weaning weight(kg) | 20.2                        | 17.6      | 0.5              | ..                        |
| \$ sale value/ha        | 156                         | 161       | 10               | N S                       |
| Ewe Liveweights(kg)     |                             |           |                  |                           |
| 3/5/90                  | 52.3                        | 53.1      | 0.7              | N S                       |
| 16/11/90                | 45.5                        | 45.9      | 0.3              | N S                       |
| 15/1/91                 | 50.6                        | 51.1      | 0.7              | N S                       |
| Bull Liveweights(kg)    |                             |           |                  |                           |
| 17/5/90                 | 223                         | 225       | 6.4              | N S                       |
| 1/8/90                  | 280                         | 286       | 6.9              | N S                       |
| 29/11/90                | 417                         | 426       | 11.7             | N S                       |
| 9/1/91                  | 455                         | 458       | 9.4              | N S                       |
| \$ sale value/ha        | 461                         | 496       | 6                | .                         |

<sup>a</sup> standard error of the difference

<sup>b</sup> significance level : \* P<0.05; . P<0.01

lower for February/March compared with April matings. Average lamb weaning weights in EL farmlets were again 2.4 kg heavier. This would have been a consequence of greater age and less twinning. Ewe weaning weights were similar for both lambing date treatments. The 2-4 kg liveweight disadvantage that was recorded in previous years disappeared with the application of N to EL farmlets. Similarly, differences in bull liveweights at slaughter were not recorded in this experiment.

These results indicate that the application of 30 kg N/ha was able to counter-balance extra feed deficits created by lambing 1 month earlier; and was able to negate any animal liveweight disadvantages. They reinforce the importance of early lactation feeding in influencing ewe performance (McCall et al. 1986). Note, however, that N application would not be expected to counter the lower lambing levels that result from earlier mating.

### Farmlet response to nitrogen

Application of N to EL farmlets was seen as a means of overcoming greater feed deficits, and of avoiding very low pasture covers during early lactation that would limit actual regrowth. It was recognised that the response of current pasture growth during August-September would be inadequate to achieve these objectives; therefore N was applied in late June. It was expected that a strict winter rotation would accumulate extra winter feed and transfer it into early lactation.

The overall pasture response to N in 1990 (Table 4) was 7 kg DM/kg N. This response was very similar

to the 9 kg DM/kg N measured in the following year. While these values are at the lower end of the response range reported by O'Connor (1982), they are of a similar magnitude to those reported by Ledgard et al. (1983) at the same location. The transfer of extra feed into August was achieved. Compared with previous years, EL farmlets had greater pasture cover than LL farmlets (Table 5). However, absolute cover levels of both treatments were still low, and once ewes were set stocked in EL farmlets, pasture covers declined to 700-750 kg DM/ha. In 1990, July was warmer than normal, August was very much wetter and September much colder than the long term mean (Table 2). These conditions would have provided a good test of the impact of N response and feed transfer.

Filling feed gaps and maintaining pasture cover at levels that allow the full expression of potential pasture growth, both seem essential for any system to fully benefit from N applications. The indirect benefits of N that occur via cover maintenance must play a major part in high response values (25-30 kg DM/kg N) recorded in other self-contained farmlets (Lambert & Clark 1986; Hoglund & Pennell 1989). In this experiment extra feed was transferred into early lactation, but once ewes were set-stocked and intake was unrestricted, pasture cover could not be maintained. The approach of applying N across the total farm area to overcome early lactation feed deficits seems wrong. More effective use of N may have occurred if it had been applied to paddocks designated for cattle and a greater proportion of the farm area then allocated to ewes. Pasture cover would be better maintained by this

Table 4 Pasture growth rates (kg DM/ha/day) as influenced by nitrogen, pasture improvement and paddock type in early lambing farmlets.

|                                    | All paddocks | Resident paddocks | Improved paddocks | Easy contour | North aspect | South aspect |
|------------------------------------|--------------|-------------------|-------------------|--------------|--------------|--------------|
| 1990                               |              |                   |                   |              |              |              |
| Period 1 (28 June - 9 August)      |              |                   |                   |              |              |              |
| Nitrogen                           | 26.1         | 24.8              | 27.3              | 28.2         | 24.1         | 25.9         |
| No nitrogen                        | 22.3         | 21.9              | 22.6              | 25.2         | 22.3         | 19.2         |
| SED                                | 0.8          |                   | 2.3               |              | 2.7          |              |
| Significance                       | ***          |                   | NS <sup>a</sup>   |              | .a           |              |
| Period 2 (9 August - 6 September)  |              |                   |                   |              |              |              |
| Nitrogen                           | 18.6         | 16.3              | 20.9              | 18.9         | 18.2         | 18.8         |
| No nitrogen                        | 15.6         | 14.8              | 16.5              | 18.5         | 16.7         | 11.7         |
| SED                                | 1.0          |                   | 2.1               |              | 2.1          |              |
| Significance                       | **           |                   | N S               |              |              |              |
| Period 3 (6 September - 1 October) |              |                   |                   |              |              |              |
| Nitrogen                           | 37.0         | 36.6              | 37.5              | 40.6         | 39.9         | 30.5         |
| No nitrogen                        | 39.1         | 39.7              | 38.5              | 48.9         | 36.6         | 31.9         |
| SED                                | 1.9          |                   | 6.1               |              | 4.7          |              |
| Significance                       | N S          |                   | N S               |              | N S          |              |
| 1991                               |              |                   |                   |              |              |              |
| Period 1 (27 June - 8 August)      |              |                   |                   |              |              |              |
| Nitrogen                           | 21.9         | 19.6              | 24.2              | 26.1         | 22.1         | 17.6         |
| No nitrogen                        | 16.5         | 14.7              | 18.3              | 20.6         | 16.2         | 12.8         |
| SED                                | 0.8          |                   | 3.2               |              | 2.7          |              |
| Significance                       | ***          |                   | N S               |              | N S          |              |
| Period 2 (8 August - 5 September)  |              |                   |                   |              |              |              |
| Nitrogen                           | 30.7         | 30.0              | 31.3              | 43.2         | 26.7         | 22.2         |
| No nitrogen                        | 28.8         | 28.0              | 29.6              | 42.6         | 23.1         | 20.6         |
| SED                                | 0.8          |                   | 1.7               |              | 2.3          |              |
| Significance                       | ***          |                   | N S               |              | N S          |              |

<sup>a</sup> statistical significance of Interactions

Table 5 Average pasture cover (kg DM/ha) for early and late lambing farmlets.

|      |                | May  | August | November |
|------|----------------|------|--------|----------|
| 1987 | Early lamb     | 1320 | 841    | 980      |
|      | Late lamb      | 1310 | 910    | 1250     |
|      | Significance   | N S  | **     | ..       |
| 1988 | Early lamb     | 1840 | 740    | 1420     |
|      | Late lamb      | 1940 | 980    | 1490     |
|      | Significance   | N S  | .      | N S      |
| 1989 | Early Lamb     | 1820 | 890    | 2090     |
|      | Late lamb      | 1840 | 920    | 2170     |
|      | Significance   | N S  | N S    | N S      |
| 1990 | Early lamb + N | 1050 | 920    | 1520     |
|      | Late lamb      | 1030 | 800    | 1480     |
|      | Significance   | N S  | .      | ..       |

approach. Use of low N rates across large areas of the farm seems more sensible for autumn applications where extra feed is used within winter rotations to improve stock carrying capacity.

### Land class response to nitrogen

While N was applied to all paddocks in each EL farmlet, pasture growth responses differed between paddock type in 1990 (Table 4). Steep south-facing paddocks were the more responsive during the first two growth periods; and easy contoured paddocks experienced growth rate depressions during the third growth period. In 1991, responses were similar for the 3 paddock types.

It is generally considered that greater responses to N fertiliser will occur on easier contoured ryegrass pastures and or warmer aspects (Ledgard *et al.* 1983). This did not occur in these experiments. It is possible that there is an optimum temperature for maximising N response that takes into account the relative effect of temperature on soil N supply and plant growth itself. During the warmer-than-normal July 1990, pasture growth may have been most restricted by soil N supply and this restriction would have been greatest on colder

southerly paddocks. Hence N response was greater in these paddocks. However, where lower-than-normal temperatures are experienced, as in July 1991, the direct effect of cold on pasture growth itself and the ability of pasture to respond to N will be most severely felt in southerly paddocks.

The context within which these response patterns were measured must be remembered. Pastures in these **farmlets** were very well developed (Table 1) and winter temperatures were not low by New Zealand standards (Table 2). The general rule that easier contouredryegrass pastures and/or warmer aspects are more responsive to N fertiliser is not challenged. Nevertheless, on well developed hill land in the warmer areas of the North Island it can be expected that southerly paddocks will be as responsive to N fertiliser as any other paddock type.

### Pasture type response to nitrogen

The introduction of new pasture cultivars into existing hill pastures was considered as a means of improving winter-early spring feed supply, especially for EL farmlets. To date, no animal production advantages have been achieved through these introductions (Webby *et al.* 1990). In this 1990 experiment there was an opportunity to assess whether pasture development affected the level of N response. While there was a tendency for greater N responses in improved pastures, any development x **N interactions** were not statistically significant. The same result also occurred in 1991. However, the composition of the improved and the well managed resident pastures differed mainly in cocksfoot and low fertility grasses (see Table 1).

### Nitrogen response measurements

Estimates of dry matter response to N were determined within EL farmlets. As indicated by low error estimates, the approach of paired plots within variable hill paddocks, and the use of a capacitance probe to indirectly measure small changes in dry matter, was valuable. Any concern with the N response data centres on the overestimation of absolute pasture growth during period 1. This was a consequence of trim residuals being 200 kg **DM/ha** higher than actual post-graze levels. Post-pre paddock estimates were 8 kg **DM/ha/day** lower than the N trial estimates.

### Economic outcome

While early lambing plus N produced heavier lambs and achieved similar ewe and bull weights, the per hectare returns were still \$20 less than for LL **farmlets**

(Table 3). Fewer lambs for sale in the EL **farmlets** was the major disadvantage. There was also the additional cost of N. At current prices that ranged from **\$1.20/kg** N (Bulk; fixed wing) to \$1 50/kg N (bagged; helicopter), the use of N to help create more profitable early lambing systems **cannot** be recommended. With the stock policy employed in the early lambing systems, N responses would have had to be 14-18 kg **DM/kg** N to break even with increased costs, and then this response would have needed to be predominantly expressed as increased bull weights. Reported responses to the use of N are highly variable, but such high response requirements cannot reliably be expected in hill lands.

If N is to be considered, then its more likely use is to improve winter carrying capacity, so that ultimately, feed can be used more effectively during periods of abundance. A consensus view is required on the means of achieving full benefits of N application in a sheep and beef system.

### Conclusion

Early lambing strategies increase feed deficits in early lactation and lead to poorer ewe and cattle performance. Application of N in late winter can negate these disadvantages, but it is not a strategy that proved economically acceptable in this experiment.

### ACKNOWLEDGEMENTS

Thanks to B. **Carlson** for technical work and B. Dow for statistical analyses.

### REFERENCES

- Hoglund, J.H.; Pennell, C.G.L. 1989. Autumn nitrogen fertiliser in a **dryland** sheep system. *Proceedings of the NZ Grassland Association* 50: 135-138.
- Lambert, M.G.; Clark, D.A. 1986. Effects of late-autumn nitrogen application on hill country pastures and sheep production. *Proceedings of the NZ Grassland Association* 47: 21 1-215.
- Ledgard, S.F.; Brier, G.J.; Gillingham, A.G.; Sheath, G.W. 1983. Influence of some soil and pasture components on the growth of hill country pastures II. Response to nitrogen fertiliser. *NZ journal of experimental agriculture* 11: 25 1-256.
- McCall, D.G.; Smeaton, D.C.; Wadams, T.K. 1986. Lambing date, ewe live weight and pasture mass effects on ewe and lamb performance during lactation. *Proceedings of the NZ Society of Animal Production* 46: 129-1 32.
- O'Connor, M.B. 1982. Nitrogen fertilisers for the production of out-of-season grass. In Nitrogen

---

Fertilisers in New Zealand Agriculture (P.B. Lynch ed.) pp. 65-76. *NZ Institute of Agricultural Science*.

Roberts, A.H.C.; Thomson, N.A. 1989. Use of nitrogen fertiliser for intensive dairy production. In **Nitrogen** in New Zealand Agriculture and Horticulture (Ed. R.E. White & L.D. Currie). Massey University.

Sheath, G.W.; **Webby**, R.W.; Pengelly, W.J.; Boom C.J. 1990. Finishing lambs in steep hill country. *Proceedings of the NZ Grassland Association* 51: 181-186.

**Webby** R.W.; Sheath, G.W.; Boom C.J., 1990. Performance of new pasture cultivars in a hill country finishing system. *Proceedings of the NZ Grassland Association* 51: 151-156.