
VOLUME 62 2002

Animal production from hill country: effect of fertiliser and grazing management

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ABSTRACT

Animal production was measured in a grazing experiment on North Island hill country from 1975 to 1981. Two grazing managements, set stocked and rotationally grazed sheep, were compared at 'maintenance' fertiliser (LF) and 'high' fertiliser (HF).

Stocking rate increased from 6.3 to 11.3 ewes/ha and 7.3 to 15.1 ewes/ha on LF and HF respectively with no decline in per animal production. HF gave 30% more wool/ha and 36% more weaned lamb weight/ha as a result of the increased stocking rate. There were no fertiliser x management interactions.

Management effects were inconclusive. At lower stocking rates set stocking increased ewe mating live weight, increased lambing percentage, increased lamb weaning live weight and hence increased weaned lamb weight/ha. However, at the highest stocking rate rotationally grazed ewes lost less live weight in late pregnancy and had higher lamb weight/ha.

INTRODUCTION

Fertiliser inputs and grazing management are some of the more easily manipulated management options on hill country farms. Interest in these options has intensified in recent years as fertiliser prices have risen rapidly, and efficient electric fencing systems have developed. This paper reports some of the effects of different fertiliser and grazing management policies on animal production.

EXPERIMENTAL

Soils, pastures, animals, climate and experimental procedures are described by Grant *et al.* (1978). Information on herbage accumulation rate, botanical and diet composition and ewe live weight is given by Clark *et al.* (1982) and Lambert *et al.* (1982). Only results applying to the set stocked sheep (SSS) and rotationally grazed sheep (RGS) managements at the high (HF) and low (LF) fertiliser treatments, 650 and 125 kg superphosphate/ha/annum respectively, are presented here.

RESULTS

The well documented increases in herbage accumulation rate from superphosphate application in hill country (Suckling, 1975) were considered sufficient to justify different stocking rates being used to harvest the extra herbage (Table 1). Managements within fertiliser levels had the same stocking rates.

Wool

The progressive increase in wool production/ha (Table 2) can be explained almost entirely by increased stocking rate. The significant effect of fertiliser in all years reflects the higher stocking rate on HF. Grazing management had no effect on total wool production. Total wool production per ewe was unaffected by fertiliser or grazing management although HF gave higher ($P<0.05$) yield/ewe from December to March (second shear) in 1979/80 and 1980/1. Wool was offered as separate lots from each treatment group at auction but no importance price differences occurred in any year.

Lamb Weaning Weight

The components of lamb weaning weight/ha were: lambing percentage, stocking rate and weaning weight/lamb. Again increased stocking rate on HF is an important factor in the significant effect of fertiliser on total lamb weaning weight/ha in all years (Table 3). The other factor was weaning weight/lamb which was higher on HF in 1975/6 ($P<0.10$) and 1977/8 ($P<0.05$) than on LF.

TABLE 1 Stocking rate (s.u./ha) 1975/81

Fertiliser rate	1975/6	1976/7	1977/8	1978/9	1979/80	1980/1
High	7.3	8.1	10.5	12.1	13.7	15.1
Low	6.3	7.2	8.4	9.0	10.3	11.3

In 1975/6 and 1976/7 weaning weight/ha was greater for SSS than for RGS because of a greater weaning weight/lamb ($P<0.05$) in 1975/6 and an increased lambing percentage ($P<0.1$) in 1976/7. Weaning weight/lamb was also higher in 1977/8 ($P<0.01$), and 1978/9 ($P<0.1$), but weaning weight/ha was unaffected.

Lambing Performance

In 1976/7 SSS had a higher lambing percentage ($P<0.1$) than RGS, and a higher mating weight, 54.6 *v* 50.0 kg ($P<0.01$) (Table 4). In 1981/2 RGS had a higher lambing percentage ($P<0.1$) than SSS. There was no difference in number of lambs born on each treatment, but fewer lambs died in RGS.

Regression equations relating LB (no. lambs born × 100/no. ewes mated) and LT (no. lambs tailed × 100/no. ewes mated) to ewe mating live weight (LW) (April) are given below. Within-year regressions on a farmlet basis were calculated for 1976/80 and subsequently pooled because no significant differences occurred.

$$LB = -3.9\ (\pm 26.7) + 2.2\ (\pm 0.50)\ LW \quad r = 0.58\ (P<0.001)$$

$$LT = -12.0\ (\pm 31.4) + 1.6\ (\pm 0.59)\ LW \quad r = 0.40\ (P<0.01)$$

DISCUSSION

Fertiliser and Stocking Rate

On the HF treatment superphosphate increased Olsen P values from 9 in 1975 to an average of 14 for 1976/80, whereas the LF treatments were maintained at 9 (Lambert *et al.*, 1982). Absolute legume production and N fixation increased on HF, as did subsequent annual herbage accumulation rate, independently of seasonal rainfall (Lambert *et al.*, 1982).

TABLE 2 Total wool yield (kg/ha) 1975/81

Fertiliser	Low		High		Difference
Grazing	RGS	SSS	RGS	SSS	Fertiliser
1975/6	38.4	40.0	49.1	47.4	**
1976/7	39.6	38.4	45.4	44.1	†
1977/8	49.0	47.0	60.8	61.6	**
1978/9	55.3	58.2	74.8	79.2	***
1979/80	65.5	65.5	85.4	88.0	***
1980/1	68.5	68.6	95.3	97.3	***

† $P<0.1$

Management and fertiliser × management not significant.

TABLE 3 Lamb weaning weight (kg/ha) 1975/82.

Fertiliser	Low		High		Difference	
Grazing	RGS	SSS	RGS	SSS	Fertiliser	Management
1975/6	128	167	179	217	**	*
1976/7	113	150	142	207	**	*
1977/8	165	199	238	283	*	
1978/9	229	267	321	380	*	
1979/80	271	284	344	364	*	
1980/1	287	285	378	420	†	
1981/2	265	203	354	329	**	†

† $P<0.1$

Fertiliser × management not significant.

TABLE 4 Lambing performance[1] 1975/8

Fertiliser	Low		High		Difference
Grazing	RGS	SSS	RGS	SSS	Management
1975/6	81.3	88.3	91.0	91.1	
1976/7	79.8	96.0	78.4	112.3	†
1977/8	81.5	86.9	88.5	91.9	
1978/9	88.3	95.2	93.4	99.2	
1979/80	95.3	101.8	92.9	109.4	
1980/1	100.0	100.2	97.8	97.8	
1981/2	96.9	68.9	91.5	80.9	†

[1]Lambs tailed x 100/ewes mated

† $P<0.1$

Fertiliser and fertiliser × management not significant.

Wheeler (1962) suggested that grazing experiments should be stocked at 3 rates to allow rate × treatment interactions to be assessed. Such a design was not feasible in this experiment. An alternative approach was used; stocking rate was increased at both fertiliser levels with time but at a faster rate in the HF treatment. This approach is similar to that used by farmers in developing hill country. Stocking rates on grazing management treatments within fertiliser levels were kept the same because there was little evidence for increased annual herbage accumulation rate as a result of grazing management.

Standing herbage mass and ewe live weight were monitored throughout the experiment (Clark *et al.*, 1982); differences between the fertiliser treatments were small. Significant differences were few in individual animal performance, which did not decline with increased stocking rate. This suggests that the magnitude of the stocking rate increases were correct and accurately reflect the response to fertiliser in animal production.

The increase in stocking rate on the LF treatment from 6.3 s.u./ha in 1975 to 11.3 s.u./ha in 1980 is of considerable importance in times of high fertiliser costs. Increased stocking rate progressively reduced the area of rank herbage with no legume that spent the autumn and winter at zero or negative accumulation rates, and therefore increased the effective grazing area.

The increases in weaning weight/lamb in 1975/6 and 1977/8 on HF occurred when the difference in legume content of the fertiliser treatments was greatest. The greater feeding value of legumes compared to grasses may explain this increase. The increased wool/ewe at second shearing in 1979/80 and 1980/1 cannot be attributed to differences in legume content, because although more legume was grown on HF, the proportions relative to stocking rate were the same.

Grazing Management

Rotational grazing did not greatly increase animal production. McMeekan (1960) argued that benefits to controlled grazing will occur only at high stocking rates. Recently, Robinson and Simpson (1975) reviewed work that indicated maximum benefits from rotational grazing at the 'optimum' stocking rate for animal production. Obviously such an optimum varies widely both within and between years. At higher or lower stocking rates set stocking gave better animal production. Their own experiment suggested gains from rotational grazing during short critical periods for pasture growth. These results and ours strongly support Wheeler's (1962) suggestion that rotational management systems provide equal opportunity for both favourable and adverse responses in animal production.

The increased weaning weight/lamb and the increased summer ewe live weight (Clark *et al.*, 1982) in SSS occurred at a time when grazing pressure was low. Rattray and Jagusch (1978) and Hodgson (1981) have shown clearly that grazing ewes and lambs respond to increased herbage allowance and pasture height. On this basis RGS ewes and lambs should have grown faster. Differences in legume content were insufficient to explain the effect. The most likely explanation is the greater decline in digestibility of RGS pasture as dead matter and stem built up during summer.

This explanation is supported by the fact that the greatest differences occurred in the first 2 years of the experiment when standing herbage mass in summer was much higher than in later years when pastures were shorter with more green leaf and less dead matter.

CONCLUSIONS

Large increases in animal production were obtained from the high fertiliser rate but economic evaluation must await present work on a greater number of fertiliser options and will depend on fertiliser and product prices. Stocking rate had a critical role in determining animal production at both fertiliser levels. In periods of surplus pasture at low grazing pressures SSS will equal or better RGS for animal production. In periods of pasture deficit at high grazing pressures RGS may increase animal production. Pasture-animal interactions make grazing management responses difficult to predict, unlike those from fertiliser and stocking rate.

ACKNOWLEDGEMENTS

We thank R. W. Brougham for facilities and advice, D. A. Grant for experimental design and initiation, M. C. Guy, N. Evans, N. Dymock, G. Gilbertson and R. Redmayne for skilled stockmanship and data collection.

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