

Spring and summer pasture feeding and ewe reproduction and wool growth

K.F. THOMPSON, J.R. SEDCOLE, D. O'CONNELL¹, K.G. GEENTY¹ and A.R. SYKES

Lincoln University, Canterbury

¹MAF Technology, Lincoln, Canterbury

Abstract

Effects of pasture feeding level during lactation and over summer on ewe wool growth and ovulation rate were assessed in 1983-84 and 1984-85. Two levels of pasture feeding (lactation high and lactation low) from parturition to weaning (10 weeks) produced 8 to 10 kg liveweight difference in ewe liveweight at weaning. Groups (n = 40) were offered pasture allowances of 0.8, 1, 1.4, 2 or 5 kg DM/ewe/day from weaning until after the third synchronised oestrus in April. Ewes on the lower allowances tended to reach a stable liveweight and those on 5 kg DM/ewe/day gained throughout. Other groups were offered low allowances during summer and then 5 kg DM/ewe/day after the first recorded oestrus. Mean dates for synchronised oestrus were 2 March, 19 March and 5 April. Ovulation rate increased by 0.15 corpora lutea/ewe ovulating at each successive oestrus, and increased by 0.047 corpora lutea/ewe ovulating for each kg increase in liveweight at oestrus. These effects accounted for 77% of the variation in ovulation rate between treatments across years. The effects of flushing, lactation or summer liveweight change were small and generally non-significant. Lactation feeding affected wool growth during lactation as well and had carryover effects through the summer when lactation low ewes grew 10% less wool irrespective of the level of summer feeding.

Keywords ewe, wool growth, ovulation rate, lactation, summer feeding, liveweight, flushing

Introduction

Of all stock categories the breeding ewe flock usually has the lowest priority for feed during summer and may suffer post weaning liveweight loss due to feed shortage or restricted intake while "cleaning up" pastures. Reproductive responses to liveweight and

liveweight change in the autumn pre-mating period have been extensively studied (e.g. Rattray *et al.* 1981; Rattray 1983; Kelly *et al.* 1983; Thompson *et al.* 1985) and the practice of flushing ewes pre-mating for improved lambing percentage is well established. The post-weaning period of ewe production has been neglected experimentally, although the practice of deliberately restricting ewe intake after weaning has been modified in recent years in recognition of the relatively high wool growing capacity of ewes in summer compared with that in other seasons (Hawker 1985). However, the effects of spring and summer nutritional pathways on ewe productivity have not been studied in detail and this experiment was undertaken to assess such effects on ewe ovulation rate, wool growth and liveweight change.

Methods

The experiment was conducted at the MAFTech Templeton research station during September to April of 1983-84 and 1984-85. To create different pathways of weight gain/loss between-parturition and weaning at ten weeks, two levels of pasture feeding (lactation high and lactation low) were imposed to generate an 8 to 10 kg difference in ewe liveweight by weaning. At weaning in late December, ewes within each lactation feeding group were allocated to summer pasture feeding groups (n = 40), balanced within feeding group for ewe liveweight, lambing date, number of lambs reared and ewe age. These groups were offered a pasture allowance between 0.8 and 5 kg DM/ewe/day for the summer period of 22 December 1983 to 12 April 1984 and 8 January to 10 April 1985. To produce a flushing effect for the second and third oestrus, additional groups were kept at a low feeding level over summer and then offered 5 kg DM/ewe/day pasture allowance after the first oestrus. Treatment groups within each year are shown in Table 1 and Figure 1.

Pastures were irrigated to ensure adequate pasture mass throughout the experiment. Pasture allowance treatments were achieved by subdividing a paddock with electric fences into treatment grazing areas; the size of each area depending on allowance treatment, pasture mass, grazing duration and number of ewes in a mob. Pasture mass was assessed by a double sampling technique using a weighted disc to

determine the sites for cutting quadrates (Kelly *et al.* 1983). Shifts to new grazing areas were made twice each week, so grazing periods were of 3 or 4 days. Pasture composition was determined from a subsample taken from the pasture collected for mass determination.

Liveweights were recorded at 4- to 5-week intervals at the end of a grazing period immediately before shifting to a new paddock. Oestrus was **synchronised** by use of progestagen impregnated prids (1983/84) or sponges (1984/85) for 14 days. Mean dates of oestrus were 2 March, 19 March and 15 April in both years. Ovulation rate (corpora lutea/ewe ovulating) was assessed by laparoscopy 5-7 days after oestrus. Periodic wool growth was assessed for each ewe by partitioning the annual greasy fleece weight according to weight of wool harvested at approximately four weekly intervals from a **midside** patch.

Multiple linear regression was used to relate group mean ovulation rate to liveweight and liveweight change. This approach was selected as being the simplest and most appropriate for these data. Alternative statistical models such as log-linear (with the number of ovulations being levels of a factor) and **logit** (proportion of ewes ovulating) did not add to the description or interpretation of the data.

Table 1 Group mean ovulation rates for pasture allowance (kg DM/ewe/day) treatments at consecutive oestruses, for 1983-84 and 1984-85 years.

Lactation	Pasture allowance*	First oestrus	Second oestrus	Third oestrus
a) 1983-84				
H	0.8	1.44	1.44	1.68
H	0.8 - 5	1.39	1.66	2.15
H	2	1.80	1.98	2.00
L	0.8	1.13	1.26	1.44
L	0.8 - 5	1.09	1.63	1.82
L	1.4	1.46	1.39	1.75
L	2	1.42	1.57	1.81
L	5	2.03	2.08	2.39
b) 1984-85				
H	1	1.36	1.31	1.50
H	1 - 5	1.27	1.71	2.03
H	2	1.63	1.54	1.79
H	2 - 5	1.47	1.89	2.08
H	5	1.74	2.00	2.24
L	1	1.47	1.51	1.69
L	1 - 5	1.44	1.78	2.29
L	2	1.53	1.71	1.85
L	2 - 5	1.61	1.97	2.16
L	5	2.00	2.11	2.20

* Two numbers indicate a change in pasture allowance to 5 kg DM/ewe/day after the first recorded oestrus.

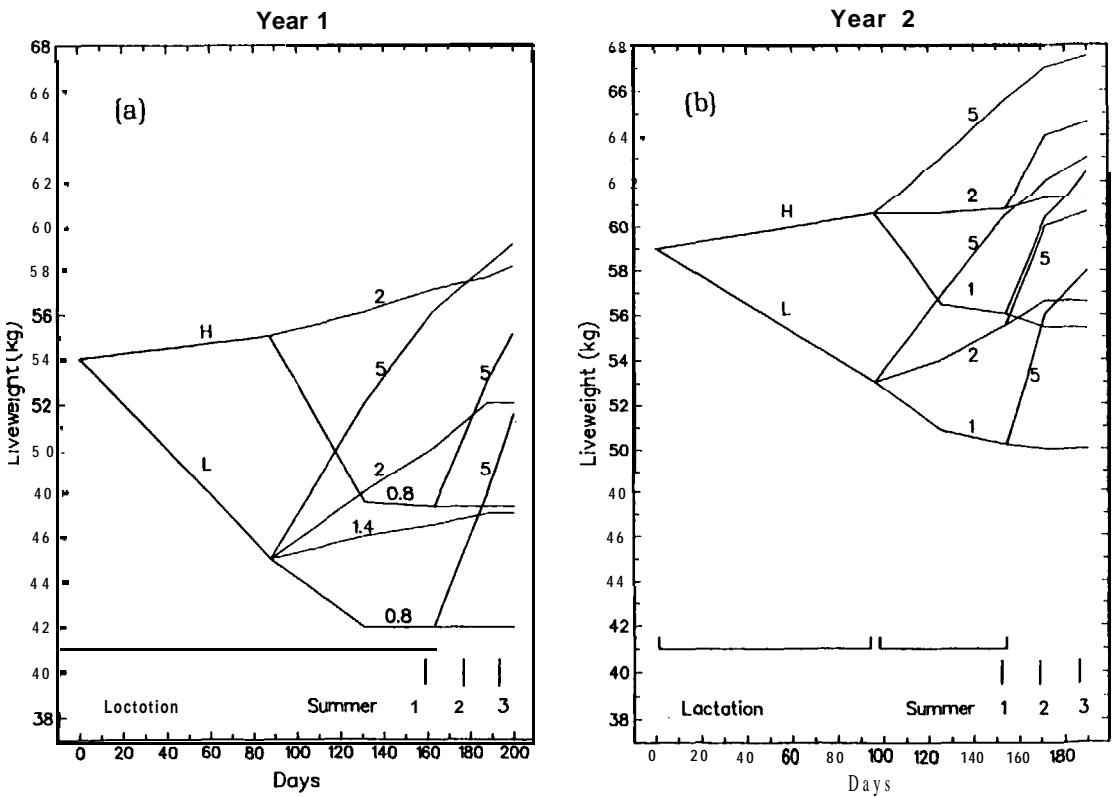


Figure 1 Patterns of ewe liveweights for (a) Year 1 and (b) Year 2. Treatments are indicated with lactation high (h) and lactation low (l) and summer pasture allowance by a number. Mean date of oestrus is indicated by 1, 2 and 3 for the first, second and third oestrus accordingly.

Results

Pastures and liveweight

Pasture mass varied from 2.4 to 4.5 t DM/ha, with dead material ranging from 15% to 30% and clover content from 10% to 15%. Initially liveweight responded to pasture allowance treatment but as the experiment progressed those groups on low and medium allowances tended to reach a stable liveweight while those on 5 kg DM/day gained liveweight throughout (Figure 1). Groups changed from a low allowance during summer to 5 kg DM/ewe/day in the autumn had rapid liveweight gains after the change in pasture allowance.

Fecundity

The lactation low groups on the lowest summer feeding levels had the lowest liveweights in the autumn (42 kg year 1; 50 kg year 2) and had 15 to 20% non-ovulating ewes, particularly at the first oestrus. In other groups the level of non-ovulating ewes was generally below 5% (i.e. less than 2 ewes per group). Ovulation rate increased from first to the third oestrus, increased with pasture allowance and was higher for the high lactation groups (Table 1). The effect of these factors on ovulation rate was studied by regression analysis (Table 2). Ovulation rate increased from the first to the third oestrus by 0.15 to 0.17 corpora lutea/ewe for each oestrus. Liveweight at oestrus had the greatest influence on ovulation rate, accounting for 43% of the variation in ovulation rate between treatments. The effects of flushing or spring or summer liveweight change were relatively small and generally non-significant. The significant models were (standard errors of the coefficients are in parenthesis):

Across years: Ovulation rate = $-0.36 (0.18) + 0.172 (0.027) ON + 0.0314 (0.0032) LWO$ $r^2 = 0.76$

Within year: Ovulation rate = $-0.69 (0.12) + 0.150 (0.018) ON + 0.04687 (0.0028) LWO - 0.302 (0.037) YEAR$ $r^2 = 0.89$

where ON = oestrus number; 1, 2 or 3; oestrus 1 occurred on 2 March.

LWO = liveweight at oestrus; kg.

YEAR = year; 1 = 1983/84 and 2 = 1984/85

Wool

Wool growth was influenced by both the current feeding level and past feeding level (Table 3). Wool growth rate was about 5 g/day (50%) higher on 5 kg DM/ewe/day than on the lowest allowances ($P < 0.001$). Lactation feeding level affected wool growth with lactation high groups growing 0.15-0.3 kg more fleece than lactation low. Lactation feeding also had a significant carry-over effect on subsequent wool growth, with lactation high ewes growing a further 0.15-0.2 kg more wool during the summer than lactation low ewes.

Table 2 Variation (%) accounted for by each factor when all factors are included in the model for the regression between ovulation rate (corpora lutea/ewe ovulating) and oestrus (1, 2, 3), liveweight at oestrus (kg), year difference, liveweight gained (kg) in flushing (3 weeks before oestrus), lactation or summer.

Oestrus	34
Liveweight at oestrus	43
Year	13
Flushing	<1
Lactation	<1
Summer	1
Unexplained	9
	100

Model: Ovulation rate = $a + b * \text{oestrus} + c * \text{liveweight at oestrus} + d * \text{year} + e * \text{flush} + f * \text{lactation} + g * \text{summer}$.

Table 3 Wool growth (g/day) during lactation and summer for ewes on high or low lactation feeding and on constant pasture allowance during the summer.

	Lactation	Summer pasture allowance (kg DM/ewe/day)			
		0.8	1	2	5
Year 1					
Low	9.6	9.1	N/T	12.9	15.5
High	12.2	10.0	N/T	14.7	N/T
sed	0.22	0.38		0.38	
Year 2					
Low	11.9	N/T	10.1	12.8	15.1
High	12.9	N/T	10.9	14.1	15.9
sed	0.19		0.43	0.43	0.43

N/T = no treatment

Discussion

Feeding of breeding ewes over summer depends on the availability of feed and production responses farmers believe will result from changed feeding levels. Results from this experiment show that any feed restriction will decrease wool growth, whereas reproductive performance is associated mainly with the liveweight at oestrus irrespective of how that liveweight was reached.

The major influence of liveweight at oestrus on ovulation rate and the relatively-minor influence of the nutritional pathway to that liveweight (be it by flushing or lactation or summer nutrition) agrees with the conclusions of Morley *et al.* (1978). This approach, termed Model 1 here, reflects the ideas of Coop (1966) who identified the separate components of liveweight at mating, which he termed a static liveweight effect, and a flushing or "dynamic" effect due to improved nutrition in the pre-mating period. Our results appear to be in conflict with common wisdom and practice which emphasise flushing ewes in the pre-mating period for high reproductive performance. However, the emphasis on flushing has been encouraged by results such as those of Rattray *et al.* (1981) and Thompson *et al.*

Table 4 Partial regression coefficients for two models of ovulation rate as the dependent variable, and liveweight and flushing.

Independent variable	Model 1		Model 2	
	LWO	Flush	LWPF	Flush
Between flocks				
This experiment				
Across years	0.030	ns	0.034	0.059
Within years	0.047	ns	0.047	0.058
Smith et al. 1985				
Within years	0.036	ns	0.035	0.046
Kelly & Johnstone 1982				
Across years			0.032	0.034
Within flocks				
Kelly et al. 1983				
Across years	0.027	0.009		

LWO = liveweight at oestrus (kg).

Flush = liveweight changes (kg) in the 3 to 4 week period immediately before oestrus

LWPF = liveweight pre-flushing at the start of the flush period.

(1985) who used liveweight pre-flushing (rather than liveweight at oestrus) and liveweight change in the pre-mating period as explanatory variables. This approach is termed Model 2. Both models have been used in the analysis of our and other data and provide results which are similar between experiments, although they differ between models (Table 4). Use of Model 1 indicates that liveweight at oestrus has the major influence on ovulation rate and flushing is of relatively minor importance whereas the use of Model 2 indicates that both pre-flushing liveweight and flushing have significant effects on ovulation rate. However, it should be noted that with Model 2 the flushing effect includes a static liveweight effect, simply because ewes will be heavier as a consequence of the improved nutrition. Therefore it is possible to draw different conclusions, depending on which model is used for analysis of results.

Our results suggest that with pasture feeding it is of little importance how a particular mating liveweight is reached; the ovulation rate will be associated largely with that liveweight. Much of the flushing response on ovulation rate previously observed is likely to be due to increased liveweight at oestrus rather than the benefits from a rising plane of nutrition in the pre-mating period.

Farmers are more interested in numbers of lambs born than in ovulation rate and it is possible that the small, non-significant flushing effect on ovulation rate recorded here may combine with a positive effect on embryo survival to cause an increase in lambing rate. Until proven otherwise this possibility cannot be overlooked.

The increase in ovulation rate of 0.15 corpora lutea/ewe (i.e. 15%) for each later oestrus is consistent with other observations (Averill 1959; Thompson et al. 1985). In autumn, therefore, if both liveweight and pasture feed supply are low, mating

ewes later by one oestrous cycle (two and a half weeks) is likely to give an increase in ovulation rate similar to that of about 3 kg liveweight gain before the earlier mating.

Wool growth, by contrast, was affected by lactation and summer nutrition (Table 3). An intake restriction during lactation not only restricted wool growth during lactation but continued to restrict wool growth for the summer period irrespective of pasture allowance. These carry-over effects were apparent for the four months of summer feeding and are consistent with the observations of Butler-Hogg (1984) on **hoggets**. While liveweight at mating may be gained by short term feeding, wool growth in contrast is affected to a considerable extent by the level of spring and summer nutrition and any restriction will result in reduced wool growth and fleece weight.

These results can be used to assist the planning of feed allocation and summer management of flocks. However, pasture management should also be considered. Clean up grazings, often deemed necessary to control pasture in summer-wet environments, invariably use ewe flocks as these usually constitute a large mob of low priority stock. There is little evidence that the increased green leaf pasture mass that may result (Korte *et al.* 1982) will overcome the production penalties to stock which have been subjected to restricted intakes while cleaning up swards (Rattray 1983).

To conclude, we have shown that liveweight at oestrus is the major factor contributing to ovulation rate and that the lactation or summer nutritional pathway to this liveweight is relatively unimportant. Nevertheless restricted nutrition, either during lactation or after weaning, has a marked, deleterious carry-over effect on wool growth.

REFERENCES

- Averill, R.L.W. 1959. Ovulatory activity in mature Romney ewes in Otago. *NZ journal of agricultural research* 2: 575-583.
- Butler-Hogg, B.W. 1984. Growth patterns in sheep: wool growth during weight loss and subsequent compensatory growth. *Journal of agricultural science, Cambridge* 102: 105-109.
- Coop, I.E. 1966. Effects of flushing on reproduction performance of ewes. *Journal of agricultural science, Cambridge* 67: 305-323.
- Hawker, H. 1985. Effects of season and nutrition on wool growth. In Wool production Seminar, June 1985, Pub. New Zealand Wool Board, pp 4 (1-16).
- Kelly, R.W.; Johnstone, P.D. 1982. Reproductive performance of commercial sheep flocks in South Island districts. 2. Relationships between ovulation rate, liveweight, mating, and lambing performances. *NZ journal of agricultural research* 25: 519-523.
- Kelly, R.W.; Thompson, K.F.; Hawker, H.; Crosbie, S.F.; McEwan, J.C. 1983. Liveweight, ovulation rate and wool growth responses of light and heavy ewes. *NZ journal of experimental agriculture* 11: 219-224.

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- Korte, C.J.; Watkin, B.R.; Harris, W. 1982. Use of residual leaf area index and light interception as criteria for spring-grazing management of a **ryegrass**-dominant pasture. *NZ journal of experimental research* 25: 309-3 19.
- Morley, F.H.W.; White, D.H.; Kenney, P.A.; Davis, I.F. 1978. Predicting ovulation rate from liveweight in ewes. *Agricultural systems* 3: 27-45.
- Ratray, P.V. 1983. Interactions between feed quality, feed quantity, bodyweight and flushing. *Proceedings of the Sheep and Beef Cattle Society of the New Zealand Veterinary Association: 21-34.*
- Ratray, P.V., Jagusch, K.T.; Smith, J.F.; Winn, G.W.; **Maclean, K.S.** 1981. Effects of genotype, liveweight, pasture type and feeding level on ovulation response in ewes. *Proceedings of the NZ Society of Animal Production* 41: 174-1 82.
- Smith, J.F.; **Maclean, K.S.**; McGowan, L.T.; Potts, I.R. 1985. Effects of ewe liveweight on the level of the response to steroid immunisation. *Proceedings of the NZ Society of Animal Production* 45: 184-187.
- Thompson, K.F.; Crosbie, S.F.; Kelly, R.W.; **McEwan, J.C.** 1985. The effect of liveweight and liveweight change on ewe ovulation rate at 3 successive oestrous cycles. *NZ journal of agricultural research* 28: 257-462.