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The effect of the duration and timing of flushing on the ovulation rate of ewes

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ABSTRACT

In each of 2 years Coopworth ewes were randomised to 8 groups which were offered 2 levels of herbage allowance (1.0 and 5.0 kg DM/ewe/d) from mixed pasture for varying periods during the 6 weeks prior to a synchronised mating. The ovulation rates of ewes fed at the lower allowance and then given the higher allowance for periods of 1 or 2 weeks prior to mating were not different from those fed continuously at the lower allowance.

Ewes offered 3 weeks at the higher allowance showed a 25% increase in ovulation rate irrespective of when in the 6 week period this was received. Thus a minimum carry over period of 3 weeks was obtained. A further 30% increase in ovulation rate was obtained when ewes were offered the higher allowance for the full 6 week period. The proportion of ewes lambing multiples was lower for those receiving < 3 weeks high level feeding than for those receiving at least 3 weeks (33.5% *v* 56.0%; $P < 0.001$), but there was no additional response to feeding at the high level for 6 weeks.

INTRODUCTION

The ovulation rate and subsequent lambing percentage of ewes can be increased by the provision of increased levels of nutrition for 6 weeks in the pre-mating period (Rattray *et al.*, 1978; 1980 a,b,c; 1981). However, because of the high levels of good quality feed that are required to obtain this flushing response, it is generally considered impossible or impractical for farmers to provide this level of feed for the full 6 week period in the autumn. This is due to both the effects of summer drought and grazing mismanagement. Data from trials on silage supplementation (Rattray *et al.*, 1980 a; Smith *et al.*, 1981 b) indicate that responses can be obtained with about 3 weeks of flushing. Shorter term responses to lupin supplementation have been reported by Lindsay (1976) but not with pasture (Coop, 1966). Because data on the flushing response obtained after various durations and timing of feeding relative to mating are essential for the optimum utilisation of a limited resource, the present experiment was carried out to provide some of this information.

EXPERIMENTAL

In each of 2 years (1981 and 1982) 400 mixed aged Coopworth ewes were fed at maintenance levels of pasture until the beginning of March when they were allocated to 8 groups and fed at either a high (5 kg DM/ewe/d) or low (1 kg DM/ewe/d) levels of pasture allowance for various periods over the following 6 weeks. Table 1 presents a summary of the pasture availability and grazing data and the feeding regimes are shown in Table 2. Grazing periods were 7 days each to coincide with treatment changes.

TABLE 1 Pasture data.

Feeding level	Year	Herbage Mass (kg DM/ha) pre grazing	post grazing	Herbage offered (kg DM/ewe/d)	Estimated intake (kg DM/ewe/d)	Utilisation (%)
High	1981	3125 (2544-3667)	2068 (1575-2700)	4.6 (3.93-5.45)	1.63 (1.38-2.34)	36.1 (26.3-56.2)
	1982	3781 (3300-4400)	2538 (1875-2976)	5.1 (4.71-5.57)	1.73 (1.32-2.03)	33.0 (23.6-43.1)
Low	1981	3112 (2325-4500)	675 (525-975)	0.97 (0.83-1.21)	0.75 (0.61-1.06)	77.1 (74.1-87.6)
	1982	1771 (1590-2030)	789 (620-900)	1.20 (0.96-1.45)	0.66 (0.53-0.85)	55.7 (44.6-65.2)

TABLE 2 Percentage of ewes with multiple ovulations (ovulation rate).

Treatment*	1981	1982	Mean
6L	38.0 (1.38)	52.2 (1.46)	44.8 (1.42)
5L 1H	28.0 (1.28)	64.0 (1.68)	46.0 (1.48)
4L 2H	36.7 (1.37)	55.1 (1.59)	45.9 (1.48)
3L 3H	49.0 (1.50)	79.2 (1.84)	63.9 (1.67)
2L 3H 1L	61.2 (1.78)	72.3 (1.70)	66.7 (1.74)
1L 3H 2L	54.0 (1.56)	83.3 (1.80)	68.4 (1.68)
3H 3L	56.0 (1.60)	75.0 (1.82)	65.3 (1.71)
6H	72.0 (1.86)	91.7 (2.21)	81.6 (2.04)

* Weeks of feeding at either the low (L) or high (H) allowance.

All ewes were treated with intravaginal sponges containing 60 mg medroxy-progesterone acetate such that the second oestrus following sponge withdrawal coincided with the completion of the 6 week feeding period. Ewes were entire mated (with 4% of rams) at this oestrus and their ovulation rate was determined by laparoscopy 10 days later. Ewe live weights (24 h fasted) were obtained at the commencement and conclusion of the 6-week feeding period. Subsequent lambing records were collected.

Statistical Analysis

Live-weight gain was analysed by least squares testing treatment, year and age of ewe effects and their interactions with initial live weight as a covariate. Ovulation and lambing data were analysed by fitting log-linear models to percent multiple response, testing also for association with live-weight gain.

RESULTS

Table 1 presents overall means and ranges, over the 6 week feeding period, for pre- and post-grazing herbage mass, offer, utilisation and estimated intakes, on a group basis, for each feeding level in each year.

Ovulation Rates

The ovulation rates and percentage of ewes having multiple ovulations (% EMO) are shown in Table 2.

The % EMO was influenced by the initial ewe weight and increased by 2% for each 1 kg increase.

There was a significant ($P < 0.001$) feeding treatment effect and most of the variation in this treatment could be accounted for by the fitting of a treatment group term, with treatments grouped according to the duration of high level feeding (viz < 3 weeks, 3 weeks, 6 weeks). This showed that 3 weeks of high allowance produced similar responses in ovulation rate irrespective of when in the 6 week period it was received. The predicted values from the analysis for % EMO were 34.3, 53.7, 69.2 for < 3H, 3H, or 6H respectively, indicating an additive effect of the additional 3 weeks feeding on ovulation. There was a significant ($P < 0.01$) effect of year with higher responses in 1982. There was no year × treatment interactions although there was a small, patternless year × ewe age interaction.

The fitting of live-weight gain over the 6 week period accounted for some of the treatment effect, but a significant component remained. Thus there was an effect of treatment over and above that associated with live-weight gain.

Live Weight and Live-weight Gain

Table 3 presents the means for initial live weight (kg) and live-weight gain (kg) for each treatment and year. There were significant effects of initial weight and a year × treatment interaction. Lighter ewes showed higher rates of gain. Gain was greater in 1982 than 1981 and this was most marked in the treatments that received the low feeding level in the first 3 weeks of the experimental period.

TABLE 3 Initial live weight and live-weight gain (kg).

Treatment	1981		1982		Mean	
	Initial	Gain	Initial	Gain	Initial	Gain
6L	45.9	-3.6	48.8	0.4	47.4	-1.6
5L 1H	45.8	-0.5	48.6	3.2	47.2	1.4
4L 2H	45.3	0.5	48.8	2.9	47.1	1.8
3L 3H	45.7	2.0	48.7	5.5	47.2	3.8
2L 3H 1L	45.8	0.1	49.1	1.9	47.5	1.0
1L 3H 2L	44.9	1.2	48.4	2.4	46.7	1.8
3H 3L	46.0	0.9	48.8	1.7	47.4	1.3
6H	45.9	6.5	47.2	7.1	46.6	6.8

TABLE 4 Conception rate to 1st cycle of mating (ewes lambing/ewes joined).

Treatment	1981	1982	Mean
6L	80.0	82.2	81.1
5L 1H	88.4	56.5	71.9
4L 2H	74.4	68.8	71.4
3L 3H	80.4	50.0	64.9
2L 3H 1L	87.0	84.0	85.4
1L 3H 2L	86.7	87.2	87.0
3H 3L	68.1	91.7	80.0
6H	81.3	68.2	75.0
Mean	80.7	73.7	77.1

Conception Rate

The conception rates to first cycle of mating are shown in Table 4. There was a significantly higher conception rate in 1981 than in 1982 (80.7% *v* 73.7%). There was an overall treatment effect ($P < 0.01$) and a treatment × year interaction. Examination of these effects show that there was no effect of treatment in

1981 but that in 1982 those treatments that received the high level in the last week of feeding had a significantly lower conception rate than those on the low level (60.8% *v* 86.3%).

Embryo Mortality

Partial failure of multiple ovulation was expressed as the percentage of ovulations that did not result in lambs from those multiple ovulating ewes that conceived to the first cycle of mating. The overall failure rate was 19.1% and there were no significant effects of treatment or year.

Lambing

The proportion of ewes lambing multiples (% ELM) of those lambing to the first cycle of mating are shown in Table 5.

There were significant effect of years ($P < 0.001$) and treatment ($P < 0.001$) but no year × treatment interaction. The partitioning of the treatment effect into treatment groups (as for % EMO) again accounted for the majority of the variation. However while the treatments with 3 weeks high feeding had higher % ELM than those with < 3H, there was no additional increase due to 6H treatment. The mean % ELM over both years were 33.5, 55.4 and 58.8 for < 3H, 3H and 6H treatment groups respectively.

TABLE 5 Percentage of ewes lambing multiples to 1st cycle.

Treatment	1981	1982	Mean
6L	38.9	43.2	41.1
5L 1H	26.3	30.8	28.1
4L 2H	28.1	32.4	30.3
3L 3H	41.7	54.2	46.7
2L 3H 1L	60.0	69.1	64.6
1L 3H 2L	33.3	70.7	52.5
3H 3L	43.8	63.6	55.3
6H	55.3	63.3	58.8
Mean	41.2	55.0	48.0

DISCUSSION

That a carry over period of at least 3 weeks exists following a 3-week flushing period is of considerable importance. Provided the majority of a flock mate in the first cycle then flushing could cease at the time of ram introduction. This carry over response confirms that suggested by Wallace (1951), Coop (1966) and indicated in the silage feeding trials of Rattray *et al.* (1980 a). The need for a minimum feeding period of 3 weeks is an equally important finding. This again confirms the indications obtained by Coop (1966) that better pasture feeding in the latter stages of the oestrous cycle had little effect. These results differ from the findings of Lindsay (1976) and Oldham (1980) who reported a marked response in ovulation rate with as little as 6 days of supplementation with lupin grain. These workers also reported a rapid decline in the response once the lupin supplement was removed. Similar short term responses have been obtained with substantial changes in the protein-energy ratio of a given quantity of pelleted feed (Smith *et al.*, 1981 a). This dichotomy of responses to improved nutrition may reflect changes in the quality of the diet on one hand and changes in quantity on the other.

The increased ovulation rates obtained with short term feeding of high protein supplements have generally been independent of any live-weight changes. While those obtained with longer (6 week) periods of pasture flushing have shown high correlations with the increase in live weight (Rattray *et al.*, 1981). In the present experiment there were significant treatment effects over and above those associated with live-weight change. This indicates that live-weight change may be a much less sensitive indicator of nutritional changes than is ovulation rate and that significant correlations between the 2 end points only exist following longer term treatments. Examination of the 4 groups receiving 3 weeks of high level feeding in the present experiment provides an example of the disassociation of ovulation rate and live-weight change. These groups had similar ovulation rates but markedly different changes in live weight over the period of the experiment.

The differences between years in overall response can possibly be explained by the better climatic conditions for pasture growth in 1982. This however cannot explain the lowered conception rate obtained in that year which appears to be associated with the nutrition level of the mating group. Ewes on either the high or low level of feeding in the last week of treatment were joined as 2 groups with rams for that week and were maintained on that level of feeding for a further 3 days. While an effect of poor ram libido or semen quality is the most likely explanation this is difficult to visualise when 200 ewes are joined as a group with 8 rams.

The lack of treatment effects on partial failure of multiple ovulations indicate once again the insensitivity of this parameter of embryonic loss to changes in pre-mating nutrition.

The requirement for a minimum of 3 weeks high level feeding and the carry over for at least 3 weeks was also seen in the number of lambs born per ewe lambing or proportion of ewes lambing multiples. This also reflected the between years difference in ovulation rate. However the additive effect on ovulation rate of the extra 3 weeks high feeding shown by the additional response of the 6H group was not reflected in additional lambs born. The increase in ovulation rate with increased periods of high feeding is similar to that reported for silage (Rattray *et al.*, 1980 a) but there is little available data on the effects of duration of treatment on lambing performance.

This experiment indicates a minimum requirement for 3 weeks of high level feeding immediately prior to ram introduction to obtain a flushing response and that this will give a 3-week carry over period. This should be sufficient to produce an increase of about 20% in lambs born provided a high proportion of the ewes conceive in the 1st cycle. However further experimentation is required to determine the maximum length of carry over in response to feeding and of the benefits to be gained from increasing the duration of flushing.

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