INFLUENCE OF HOGGET OESTRUS ON SUBSEQUENT EWE FERTILITY

R. W. MOORE, T. W. KNIGHT and D. WHYMAN
Whatawhata Hill Country Research Station, Hamilton

SUMMARY

The effects of high (H) and low (L) levels of nutrition both before the end of the hogget mating season (July 19) and from then until mating as two-tooths (July 19 to March 30) were studied in Romney sheep. Each of the 4 nutrition groups (HH, HL, LH and LL) consisted of about 90 animals. Mean liveweights following high and low levels of early nutrition were 36.8 kg and 23.6 kg, respectively, on July 19. In their first autumn 92 and 22%, respectively, of these hoggets exhibited oestrus. Pre-tupping two-tooth liveweights were: 49.5, 40.7, 46.8 and 37.3 kg for the HH, HL, LH and LL nutrition groups and mean ovulation rates during the first entire mating were 1.57, 1.22, 1.30 and 1.02, respectively. When the ovulation rates were corrected for two-tooth liveweight, the ovulation rate was higher by 0.17 ovulations ($P < 0.01$) in ewes which showed oestrus as hoggets. This difference in ovulation rate was due to a difference in the incidence of multiple ovulations. There was also an effect of hogget oestrus on the percentage of multiple births among ewes that lambed ($P < 0.05$) but no effect on the percentage of ewes lambing. The ewes which had shown hogget oestrus produced 1.00 lambs born per ewe while those that had not exhibited hogget oestrus produced 0.85 lambs ($P < 0.05$).

INTRODUCTION

Ewes that exhibit oestrus in their first year of life produce more lambs during their lifetime (Hight and Jury, 1976). This increase in lifetime production is correlated with the number of hogget oestruses (Ch'ang and Rae, 1972). However, it is not known if the occurrence of hogget oestrus is associated with increased ewe fertility independently of ewe liveweight, as sheep exhibiting oestrus are usually heavier as older ewes (Hight *et al.* 1973).

The object of the present study was to assess the significance of the occurrence of hogget oestrus independent of pre-mating liveweight in its effects on two-tooth reproduction.

METHODS

The 360 ewe lambs were culled from the Waihora sheep breeding scheme (Hight *et al.*, 1975) and from a Romney flock at Whatawhata. The animals were stratified on a liveweight basis within genetic groups and then randomly assigned into four nutritional treatments on December 16, 1975.

Nutritional regimes designed to achieve two different rates of growth (high and low) were imposed from weaning (December) to the end of the hogget oestrus season (mid-July) with the objective of achieving a high proportion of hoggets showing oestrus amongst the high group and few of the low group. The target weight for mid-July was 40 kg for the high group and 25 kg for the low group. The high group was then further divided so that one half reached a high two-tooth pre-mating liveweight (HH) and the other a low (HL). The pre-mating targets were 60 and 45 kg, respectively. The low group was also divided with the aim of growing one half (LH) to 60 kg and the other half (LL) to 45 kg. Most of the time the HH and LH groups were grazed together, as were the LL and HL groups.

The high groups were leniently grazed on hill country pastures with a high content of white clover. In contrast, the low groups were confined to small areas to restrict feed available. The sheep were weighed at two-weekly intervals from mid-December until the end of February 1977 and the amount of feed to be offered the next fortnight was assessed. The object was to keep each group as close as possible to linear growth to its target liveweight. Liveweights were subsequently recorded as two-tooths at pre-mating, post-mating, pre-lambing and at weaning.

In order to monitor hogget oestrus activity, 3% harnessed vasectomized rams were introduced to both nutritional groups on March 1, 1976. The crayons were changed and mating marks were recorded every 2 weeks. These rams were removed on July 19.

At the two-tooth mating 7 harnessed entire rams were singly mated to groups of ewes composed of equal numbers of the 4 nutritional treatments following a fortnight of teasing with vasectomized rams. Crayons were changed at fortnightly intervals and mating marks were recorded. Ovulation rates were recorded by endoscopy following the first mating by entire rams. Ewes apparently not mated by entire rams were endoscoped and any ovulations recorded at the end of mating. The number of lambs born and reared by each ewe was recorded.

Statistical Analyses

The effects of early nutrition and hogget oestrus were confounded. Two separate sets of analyses were therefore carried out, the first classifying ewes into the four nutritional treatments

HH, HL, LH and LL, and the second by the presence or absence of hogget oestrus and late nutrition into the four sub-groups, oestrus-high late nutrition (OH), oestrus-low late nutrition (OL), no oestrus-high late nutrition (NH) and no oestrus-low late nutrition (NL). Ovulation rate and lambing rate data were analysed in a factorial form in the above two sets with differences being tested by chi square.

To analyse two-tooth ovulation rate, corrected for differences in pre-mating liveweight, regression equations were calculated with ovulation rate as the dependent and pre-mating liveweight as the independent variable. This was done first within the four different nutritional treatments, HH, HL, LH and LL, and then within the four sub-groups, OH, OL, NH, NL. The effects of early and late nutrition were assessed from the differences among intercepts and the effects of the occurrence of oestrus and late nutrition were tested similarly. The regression of lambing rate on pre-mating liveweight was not significant.

Number of lambs born and reared (both on 0, 1, 2 basis) were analysed by least-squares.

RESULTS

Liveweight changes of the four nutritional groups are shown in Table 1. The liveweight targets were not completely realized, and an effect of early nutrition was still evident at the two-tooth pre-mating liveweight (2.9 kg, $P < 0.001$), post-mating (2.3 kg, $P < 0.01$) and pre-lambing (1.3 kg, $P < 0.05$) but was no longer significant at weaning.

Hogget Oestrus

Early nutrition influenced ($P < 0.001$) the occurrence of hogget oestrus, with 92% (156/170) of the high group showing oestrus compared with only 22% (38/172) of the low group.

TABLE 1: MEAN LIVEWEIGHTS OF EWES ON THE FOUR NUTRITIONAL TREATMENTS (kg)

	Date	*HH*	*HL*	*LH*	*LL*
Start	16-12-75	20.3	20.3	20.5	20.5
Cross-over	19-7-76	36.7	36.8	23.8	23.5
Pre-mating	28-3-77	49.5	40.7	46.8	37.3
Post-mating	25-5-77	47.8	40.2	45.5	37.4
Pre-lambing	25-7-77	49.5	42.8	47.9	41.3
Weaning	25-11-77	47.8	44.8	46.3	44.9

TABLE 2: EFFECT OF EARLY NUTRITION ON SEASONAL DISTRIBUTION OF HOGGET OESTRUS[1]

Group	*26/14*	*10/5*	*24/5*	*7/6*	*21/6*	*5/7*	*19/7*
High	4.1	11.2	50.0	71.2	57.1	20.6	2.9
Low	0.0	1.7	9.3	15.7	4.7	0.6	0.0

[1] Percentage marked in the fortnight ending on the date given.

The effect of early nutrition on the seasonal distribution of oestrus is shown in Table 2. The first hoggets to show oestrus did so during the fortnight ending April 26 and the peak incidence of oestrus occurred between May 10 and June 21.

Ewe hoggets on a high level of early nutrition reach puberty at a mean age of 261 days, whereas those on a low level did so at 272 days ($P < 0.001$). The ewes on a high level also reached puberty at a higher liveweight (34.4 kg versus 27.3 kg, $P < 0.001$).

Two-tooth Reproduction

The effects of the nutritional treatments on the various parameters of two-tooth reproduction (uncorrected for two-tooth premating liveweight) are shown in Table 3. While early nutrition had no effect on the percentage of ewes ovulating it had a highly

TABLE 3: EFFECT OF NUTRITIONAL TREATMENTS ON TWO-TOOTH REPRODUCTION

	HH	*HL*	*LH*	*LL*	*Early H-L*[1]	*Late H-L*[1]
Ewes joined	81	79	83	80		
Ewes ovulating/ewes joined (%)	99	95	98	91	2	5*
Ewes ovulating multiples/ewes ovulating (%)	55	27	32	12	19***	24***
Ewes present at lambing	72	70	78	73		
Ewes lambing/EP (%)[2]	88	76	88	67	9	16***
Ewes lambing multiples/ewes lambing (%)	29	15	19	6	9†	13*
Lambs reared/lambs born (%)	73	80	85	77	—5	1
Lambs born/EP	1.13	0.87	1.05	0.73	0.11†	0.29***
Lambs reared/EP	0.82	0.70	0.90	0.56	0.03	0.23**

[1] Mean difference between high and low nutrition groups.
[2] EP = ewes present at lambing.
†$p < 0.1$

significant effect on the incidence of multiple ovulations. Similarly, early nutrition affected the incidence of multiple births but not the percentage of ewes lambing. There was no effect of early or late nutrition on lamb survival (lambs reared/lambs born). The least-squares analyses of lambs born and lambs reared showed a significant effect of late nutrition but early nutrition was significant only at the 10% level for lambs born and non-significant for lambs reared. The interactions between early and late nutrition were not significant in any of the above analyses.

The source and type of birth (multiple versus single) composition were not significantly different in the oestrous and non-oestrous hoggets. The effects of hogget oestrus and late nutrition are shown in Table 4. The incidence of multiple ovulations was significantly higher in the ewes that showed hogget oestrus than in those that did not. Similarly, ewes which showed hogget oestrus and lambed produced a higher proportion of multiple births.

TABLE 4: EFFECT OF THE OCCURRENCE OF HOGGET OESTRUS AND OF LATE NUTRITION ON TWO-TOOTH REPRODUCTION

	OH	*OL*	*NH*	*NL*	*O-N*	*H-L*
Ewes joined	96	91	68	68		
Ewes ovulating/ewes joined (%)	99	95	97	91	3	5*
Ewes ovulating multiples/ewes ovulating (%)	55	27	27	10	22**	22**
Ewes present at lambing	87	82	63	60		
Ewes lambing/EP (%)[1]	90	74	86	68	5	17***
Ewes lambing multiples/ewes lambing (%)	31	13	13	7	12*	12*
Lambs reared/lambs born	76	78	84	80	—5	1
Lamb born/EP	1.18	0.84	0.97	0.74	0.15*	0.29***
Lambs reared/EP	0.91	0.66	0.82	0.59	0.08	0.24***

[1] EP = ewes present at lambing.

There were no differences in the slopes of the four regression equations of ovulation rates on pre-mating liveweight for the HH, HL, LH and LL groups and the pooled regression coefficient was 0.023 ovulations per kg ($P < 0.01$). The effect of early nutrition was significant at the 10% level. There was no effect of late nutrition.

There were also no differences in the slopes of the four regression equations of ovulation rate on pre-mating liveweight for the OH, OL, NH and NL groups. The occurrence of hogget oestrus was associated with an increase of 0.17 ovulations per ewe ($P < 0.01$). The effect of late nutrition was not significant.

DISCUSSION

There was more than a 4-fold difference in the incidence of oestrus between groups receiving high and low levels of early nutrition. This study confirms previous reports (McGuirk *et al.*, 1968; Burfening *et al.*, 1971) that high levels of early nutrition increase the occurrence of hogget oestrus.

This study also supports the findings of Wiggins (1955), Hulet *et al.* (1969) and Hight and Jury (1976) that a high level of early nutrition and its associated hogget oestrus can have an effect on the subsequent reproduction of the ewe, at least up to the two-tooth lambing. The increase in two-tooth ovulation rate (independent of pre-mating liveweight) was due to an increase in the number of multiple ovulations and not to an increase in the proportion of ewes ovulating. There was also an effect of hogget oestrus on the incidence of multiple births, when uncorrected for pre-mating liveweight, but not on the proportion of ewes lambing. Hight and Jury (1976) found significant effects on both of these components of lamb production.

Late nutrition had 2 to 3 times the effect of early nutrition or hogget oestrus on lambs born when the data were not corrected for pre-mating liveweight. There was no effect of early nutrition or hogget oestrus on lambs reared owing to the tendency for the ewes with high early nutrition or hogget oestrous to have lower lamb survival.

In a similar cross-over nutritional trial, Drew *et al.* (1973) found that the winter growth rate of hoggets had no effect on the subsequent lambing performance as two-tooths, provided that the ewes were at the same pre-mating liveweight. Because the ewes entered the trial during the hogget oestrous season (mid-May) at a liveweight of 30 kg, their early nutritional treatments may have been imposed too late to have much effect on hogget oestrus or two-tooth reproduction.

ACKNOWLEDGEMENTS

We wish to thank Dr D. L. Johnson for the statistical analyses and M. Pearce, S. Blaich, Mrs Susan Rowe and Miss Rosalie East for technical assistance. Special thanks are due to A. G. Barnes who looked after the sheep during the period of differential nutrition.

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