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EFFECTS OF DIFFERENTIAL NUTRITION ON THE INCIDENCE OF OESTRUS AND OVULATION RATE IN BOOROOLA × ROMNEY AND ROMNEY EWES

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SUMMARY

Differential nutrition from April 4 in Romney and ½ Booroola ½ Romney ewes (B × R) 1½ years of age (n = 30) resulted in substantial liveweight differences. The number of oestruses was recorded until the end of the breeding season (September), with the number of ovulations being observed in each animal within a week of detection of oestrus. B × R ewes were observed in oestrus on average 6.40 times in comparison with 5.64 in Romney ewes ($P < 0.01$). There were significantly fewer oestruses in ewes subjected to Low Plane feeding (LP) than in the High Plane (HP) animals. Mean ovulation rates in HP and LP B × R ewes were 2.04 ± 0.07 and 1.96 ± 0.06 (NS), in comparison with values of 1.23 ± 0.03 and 1.04 ± 0.03 for HP and LP Romney ewes, respectively ($P < 0.01$). The results suggest that B × R ewes may not be as sensitive to nutritionally induced liveweight differences as are Romney ewes.

INTRODUCTION

The commonly accepted relationship of increasing incidence of multiple births with increasing ewe liveweight at mating has been the basis of sheep management advice for many years. Coop (1962) obtained a between-flock estimate of approximately 1.3% increase in twinning per kg increase in premating liveweight. Two components of the liveweight-twinning response were subsequently recognized — a static effect attributable to liveweight *per se*, and a dynamic effect as a result of a state of changing liveweight at the time of mating. Recent work reviewed by Allison and Kelly (1978) has suggested that the between-flock liveweight-litter size responses may be substantially greater than recorded by Coop (1962).

Within-flock liveweight-litter size relationships are generally less than between-flock responses, but still remain positive (Coop and Hayman, 1962; Hight and Jury, 1973). Allison *et al.* (1974) recorded that liveweight and litter size were associated in Merino

TABLE 1: MEAN LITTER SIZE WITHIN LIVEWEIGHT CLASSES (AND NUMBER/CLASS) OF LOCAL MERINO AND BOOROOLA CROSS 3- AND 4-YEAR-OLD EWES

Breed	*Premating Liveweight (kg)*					
	<39	*39-42.9*	*43-46.9*	*47-50.9*	*51-54.9*	*>50*
½ Booroola ½ Merino	2.09	1.88	1.80	1.65	1.46	2.00
	(23)	(91)	(141)	(128)	(56)	(15)
Merino	1.07	10.7	1.24	1.27	1.32	1.42
	(14)	(45)	(80)	(107)	(78)	50)

ewes 4-tooth and older, but not in 2-tooths whose twinning rate was approximately 5% and which did not increase with premating liveweight.

In contrast, Merino ewes of either half or three-quarter Booroola (high fecundity strain) blood do not show a positive within-flock relationship between premating liveweight and litter size. In fact, some significant negative relationships have been observed for 4-tooth and 6-tooth ½ Booroola ½ local Merino ewes observed at Tara Hills in 1976 and 1977 (Table 1). As a consequence, despite there being no information on the effects of differential nutrition on the reproductive performance of Booroola cross ewes, various industry advocates have interpreted the above results as indicating that ½ Booroola cross ewes are unlikely to respond to differing levels of nutrition. Clearly there is a need for critical information, and so the following experiment was carried out to compare the effects of two widely differing levels of nutrition on oestrous activity and ovulation rate of ½ Booroola ½ Romney (B × R) and Romney ewes.

EXPERIMENTAL

Sixty Romney and 60 B × R first cross ewes, 19 months of age, were used. The ewes were weighed on April 3 following a 24 hr fast, and the number of ovulations (OR) was determined by direct observation of the ovaries by laparoscope. Ewes were then allocated to two nutritional groups (n = 30) on the basis of approximately equal numbers of ewes per OR class (*i.e.*, 1, 2, 3 or 4, etc.) per breed group. From April 4 the pasture intake of one group was restricted (Low Plane — LP), whereas the other group were grazed on high quality pasture allowing *ad libitum* intakes (High Plane — HP). During winter, hay and hay plus grain was fed to the LP and HP ewes, respectively.

Ewes were weighed directly off pasture at 10 to 14 day intervals during the experiment. Oestrus was detected throughout the experiment using harnessed vasectomized rams, with crayon marks being recorded at weekly intervals. All ewes were laparoscoped to record number of ovulations 3 to 7 days after the detection of oestrus. Observations were incomplete for one LP Romney ewe, and one HP and two LP B × R ewes were difficult to observe, and their data were discarded. The differential feeding regimes and observations were discontinued on September 4 when all ewes had become anoestrous

RESULTS

LIVEWEIGHT

The pattern of liveweight change is in Fig. 1. Maximum differences of 11 to 14 kg between the two nutritional groups were achieved 7 weeks after the commencement of differential nutrition, with substantial differences being maintained until the end of the experiment. Excluding the weight recorded on April 3, the mean liveweight (± SEM) for the LP group was 35.3 kg (± 0.5) and for the HP group it was 45.2 kg (± 0.4), the difference being highly significant ($P < 0.001$). There was no significant difference in liveweight between ½ Booroola ½ Romney and Romney ewes within the LP group, but the Romneys averaged 2.9 kg (± 0.6) heavier than ½ Booroola ½ Romney ewes in the HP group.

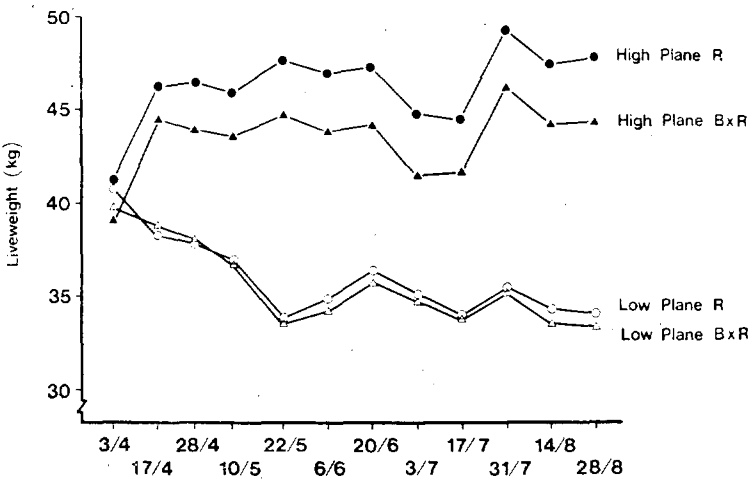

FIG. 1: *Changes in mean liveweight of the treatment groups.*

Incidence of Oestrus and Ovulation

In the first seven 17-day periods, 7 Romney ewes and 4 B × R ewes apparently displayed oestrus but were anovular. However, at the end of the breeding season (8th and 9th 17-day periods), 34 Romneys and 25 B × R ewes displayed oestrus without ovulating — a phenomenon undoubtedly related to the ewes going into anoestrum, as most of these ewes failed to display another oestrus. There were no significant effects of nutrition on the incidence of anovular oestrus.

The incidence of oestrus with ovulation (Table 2) was significantly different between the two nutritional groups and the breeds of sheep. The ewes on the restricted levels of feeding had fewer oestruses with ovulation than their counterparts in the HP group, the magnitude of the difference being 1.07 for the Romney ($P < 0.01$) and 0.52 for the B × R ewes ($P < 0.05$). Romney ewes had a mean (± SEM) of 5.64 (± 0.18) oestruses with ovulation, in comparison with 6.40 (± 0.13) in the B × R ewes ($P < 0.01$). There was a substantial decline in the incidence of oestrus in the LP Romney ewes during the third 17-day period (15 of 29 *vs* 24 of 28, $P < 0.05$), but the differences in the other periods were small and not significant.

TABLE 2: INCIDENCE OF OESTRUS WITH OVULATION AND MEAN OVULATION RATE

Breed of Ewe	*Plane of Nutrition*	*Mean No. of Oestruses/Ewe (± SEM)*	*Mean Ovulation Rate (± SEM)*
Romney	High	6.17 ± 0.20	1.23 ± 0.03
	Low	5.10 ± 0.26	1.04 ± 0.03
B × R	High	6.66 ± 0.19	2.04 ± 0.07
	Low	6.14 ± 0.18	1.96 ± 0.06

Ovulation Rate

Mean ORs per ewe prior to the start of differential nutrition (*i.e.*, on April 3) were 1.11 and 1.19 for the HP and LP Romney groups, and 2.43 and 2.52 for the HP and LP B × R groups, respectively. The pattern of change in mean OR is presented in Fig. 2 for each oestrous cycle from the commencement of the experiment. The mean ORs recorded during the period of differential nutrition are in Table 2, the difference between HP and LP Romney groups being significant ($P < 0.01$). Mean ORs in HP and LP B × R ewes were not significantly different.

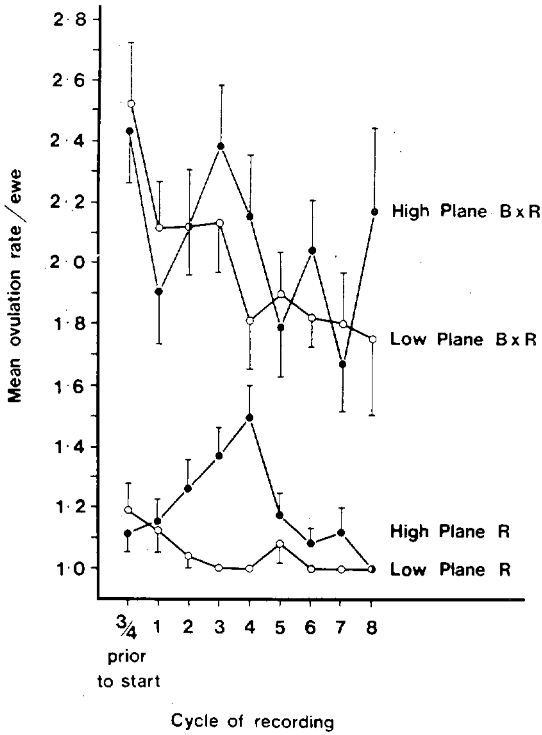

FIG. 2: *Within-group mean ovulation rate per ewe at successive oestrous cycles.*

The pattern of change in OR showed marked differences between breeds. In the HP Romney ewes the OR increased to a peak value of 1.50 at the fourth oestrous cycle and declined after that time, whereas the incidence of multiple ovulations in the LP ewes was rare and showed no seasonal trend. The pattern of change in the B × R ewes was irregular, but showed a general decline as the season progressed.

The distribution of the number of ovulations at each observation differed slightly between the two nutritional groups in the B X R ewes. In 192 observations on HP ewes, 34.4, 32.8, 27.6 and 5.2% were 1, 2, 3 and 4 ovulations, in comparison with 28, 48.8, 22.6 and 0.6% of 168 observations, respectively, in LP ewes.

DISCUSSION

Undernutrition resulted in a decrease in the incidence of oestrus in both breeds, an effect consistent with other reports (*e.g.,* Hafez, 1952). There was a suggestion that the effect may have been smaller in the B × R ewes than in their Romney counterparts, but the limited number of ewes precluded any definitive analysis. It is important to note that this experiment began after the start of the breeding season and did not measure the time of onset of oestrus. In other trials at Invermay, B × R ewes have exhibited oestrus approximately 5 days earlier than Romney ewes run with them, although there is a possibility that social facilitation (R. A. S. Welch, pers. comm.) may have caused the real difference to be underestimated.

It is readily apparent that the OR in Romney ewes was markedly affected by level of nutrition with the resultant changes in liveweight, the responses being consistent with other published work (Allison, 1968; Cumming, 1972). In contrast, no such marked effect of nutrition on OR was evident in the B × R ewes. Although very low liveweights were evident in the LP animals, the mean OR did not fall below 1.75 throughout the period of observations. This, together with the negative within-flock relationship for Booroola × Merino ewes (Table 1), gives support to the contention that these animals may not be as sensitive to liveweight and nutrition as our "local" breeds, which have a lower natural OR. There is also some indication that this may be the case with high-fecundity Finnish Landrace crosses (J. P. Hanrahan, pers. comm.). The small change in the distribution of OR is interesting and shows that the non-significant decline in OR in the LP B × R ewes was primarily due to a reduction of the number of observations where 4 and 3 ovulations were recorded. These data, however, relate to repeated observations on a small number of ewes. However, any management technique which could reduce the incidence of ewes with 4 or 3 ovulations would also reduce the number of ewes with 4 or 3 lambs, this being desirable from a management point of view. More research is necessary to clarify effects of flushing and of liveweight change on the OR of Boorola cross ewes and also on the distribution of OR. A high-fecundity ewe relatively insensitive to variations in premating nutrition and the resultant liveweight change would be an attractive proposition in industry.

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