RELATIONSHIP BETWEEN SEMEN TRAITS, MATING FREQUENCY AND PERCENTAGE OF EWES LAMBING MULTIPLES IN HIGH FERTILITY ROMNEY SHEEP

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SUMMARY

Semen from 10 rams singly mated to 50-80 ewes in the Waihora Selection Project in 1973, and 16 rams similarly mated in 1975, was subsequently collected. Two semen traits, percentage normal sperm and wave motion score, were significantly correlated with the percentage of ewes lambing multiples (% ELM/EL), the pooled correlations being 0.64 ($P < 0.01$) and 0.42 ($P < 0.05$), respectively.

Fifteen rams singly mated in 1973 were each assessed for serving frequency during a total of eight 1-hour sessions with 5 oestrous ewes in a pen. Tests were carried out during May-June and November-December. The mean number of serves per hour during the two periods was 6.5 and 2.8, respectively, indicating a seasonal effect ($P < 0.001$). The correlation between the mean pen mating frequency and % ELM/EL was not significant ($r = 0.18$).

Twenty rams were observed at the 1975 Waihora mating during morning, midday and afternoon periods. The mean number of serves per hour was 1.1, 1.2 and 1.8, respectively, indicating a diurnal rhthym in serving frequency ($P < 0.05$). The mean mating frequency was not significantly correlated with % ELM/EL ($r = 0.10$). Sixteen of these rams were subsequently tested for serving frequency in pens and small paddocks. Neither of these tests gave a significant correlation with mating frequency at the Waihora mating nor with % ELM/EL.

INTRODUCTION

There appears to be a direct ram effect on the multiple birth rate of the ewes to which they were singly mated in the Waihora high fertility selection flock (Hight *et al.*, 1975). For four consecutive years (1972-1975) the percentage of ewes lambing multiples (% ELM/EL) differed by about 25% between the individual rams ranking highest and lowest. The difference was significant in 1972. Vakil *et al.* (1968) have reported real differences between twin- and single-born rams in the mean litter size produced when mated to similar groups of ewes.

Semen traits and mating frequency for rams used at Waihora in 1973 and 1975 and their correlations with % ELM/EL are presented together with observations on diurnal and seasonal changes in mating frequency.

METHODS

Fifteen rams used for mating in the élite flock at Waihora in 1973 (Group 1) were subsequently transported to Whatawhata for studies of their pen mating behaviour. Ten of these 15 rams were trained for the artificial vagina and used for semen studies. Sixteen of the 20 rams mated at Waihora in 1975 (Group 2) were also assessed at Whatawhata for both semen quality and mating behaviour. Mating was also observed at Waihora for these 20 rams.

Semen Observations

Group 1

Semen collection by means of an artificial vagina was attempted from the 10 rams during 19 semen collection runs. There was an average of 17 collections per ram. Volume, wave motion score, absorbance (measured at dilution of 1 to 400 in a Spectronic 20 colorimeter) and percentage live sperm were measured for each ejaculate. Live sperm were identified by staining with nigrosin-eosin mixture. The percentage of normal sperm was counted on three ejaculates from each ram following staining with gentian violet. The most common abnormalities were returned tails and detached heads.

Group 2

Semen collection was attempted from the 16 rams during 17 semen collection runs. An average of 11 successful collections was made from each ram by direct recovery from the vagina of a spayed oestrous ewe after mating. This was achieved by applying slight suction to a glass tube of 300 mm length and 7 mm internal diameter (Hulet and Ercanbrack, 1962). Volume, wave motion score and absorbance were assessed for each ejaculate. The percentage of live sperm was recorded for seven ejaculates, and percentage normal sperm for eight ejaculates from each ram.

Pen Mating Tests

These were performed on the rams of Group 1 on four different occasions (November 1973, June 1974, December 1974 and May 1975) and on the rams of Group 2 on one occasion (August 1975). On each of these occasions two tests were carried out on each ram on two consecutive days. During each test

a ram was confined to a small pen (approximately 7 m^2) with five oestrous spayed ewes for one hour and the number of serves was recorded (Mattner *et al.*, 1971). A serve was distinguished by a marked pelvic thrust followed by a rest period. During the test the rams could see and hear the other rams copulating.

Waihora Mating

The mating activity of 20 Group 2 rams, joined to about 80 ewes each, was observed at Waihora during daylight hours over a period of 10 days (May 10 to 19). The day was divided into three 3¼-hour periods, morning, midday and afternoon. Each ram was observed once during each of these periods, making 60 observations in all. The number of serves was counted.

Small Paddock Mating Tests

Mating activity of Group 2 rams was recorded in August 1975 in small paddocks of about 0.25 ha. Each ram was enclosed with 5 oestrous spayed ewes for a period of three hours during which the number of serves was counted.

RESULTS AND DISCUSSION

Semen Observations

Measurements of semen traits are summarized in Table 1.

Least-squares analyses showed significant ram differences ($P < 0.001$) for all traits in both years, and collection run differences were evident for most traits. The repeatabilities indicate the extent to which measurement of a particular trait on one occasion correlates with estimates within the same group on later occasions (Turner and Young, 1969). Errors in measurement and the variability within individuals may both contribute to the low repeatability for a particular trait.

TABLE 1: ASSESSMENT OF SEMEN QUALITY

	Group 1 Rams[1]			*Group 2 Rams*[2]		
	Mean	*S.D.*	*Repeat-ability*	*Mean*	*S.D.*	*Repeat-ability*
Volume	0.63	0.19	0.50	0.42	0.19	0.24
Wave motion score	7.0	0.8	0.60	6.3	0.9	0.55
Absorbance	0.33	0.05	0.82	0.23	0.05	0.60
% live sperm	65	12	0.25	56	13	0.26
% normal sperm	79	9	0.44	81	8	0.43

[1] 10 rams; [2] 16 rams.

TABLE 2: CORRELATIONS OF SEMEN TRAITS WITH % ELM/EL

	Group 1 Rams[1]	*Group 2 Rams*[2]	*Pooled*[3]
Volume	0.21	0.03	0.10
Wave motion score	0.68*	0.32	0.44*
Absorbance	0.52	0.15	0.34
% live sperm	0.33	0.09	0.16
% normal sperm	0.86**	0.42	0.64**

[1] 10 rams; [2] 16 rams; [3] 26 rams.

The correlations of semen traits with % ELM/EL are shown in Table 2. The correlations of wave motion score and percentage normal sperm with % ELM/EL are significant for the Group 1 rams and for pooled data for both groups, but none of the other correlations are significant. Nevertheless, the correlations with the various semen traits rank in the same order in the two years. In both years the highest correlation was obtained for percentage normal sperm, followed by that for wave motion score. Similar results were obtained by Hulet *et al.* (1965) with correlations of about 0.4 between various morphological classifications and prolificacy. Dunlop *et al.* (1972) found a significant correlation between number of lambs born from a ewe's first artificial insemination and the wave motion score of the individual ejaculate.

The present study and those of Hulet *et al.* (1965) and Dunlop *et al.* (1972) indicate that relationships exist between some semen traits and litter size. It is unlikely that these semen traits affect embryo death, and the ram effect on litter size is more likely to act through an effect on fertilization rate.

Pen Tests of Group 1 Rams

The results of these tests are shown in Table 3. The mean serving frequency in winter (May-Jun.) was 6.5 serves/h while in summer (Nov.-Dec.) it was only 2.8 serves/h, indicating a

TABLE 3: PEN MATING FREQUENCY OF GROUP 1 RAMS[1]

	Nov. 1973		*Dec. 1974*		*Jun. 1974*		*May 1975*	
Replicate	1	2	1	2	1	2	1	2
Serves/hour	2.8	3.2	2.9	2.4	5.7	5.2	7.3	7.9
Correlation between replicates	0.72**		0.39		0.85**		0.13	

[1] 15 rams.

marked seasonal effect ($P < 0.001$). Whether these seasonal differences were due to environmental or to endogenous hormonal changes, or both, is unknown. Although there was a significant ram effect on the number of serves/hour ($P < 0.05$), there was also a highly significant ram × test interaction ($P < 0.001$), indicating that the rams do not rank in the same order from test to test, and the correlations between replicates within tests were sometimes low (Table 3).

The correlation between the mean ram mating frequency for all tests combined and the % ELM/EL was not significant ($r = 0.18$).

Pen and Paddock Observations on Group 2 Rams

Table 4 summarizes serving frequency observations in Group 2 rams. There were no ewes in oestrus during three of the observation periods at Waihora. This means that not every ram was assessed at the three times of day. A least-squares analysis (Table 4) showed the existence of ram differences ($P < 0.05$) and period differences ($P < 0.05$). The observations at Waihora showed an increase in serves/hour during the three hours before sunset. Cahill *et al.* (1975) have previously shown an increase in mating activity around sunrise and sunset whereas Hutchinson *et al.* (1964) and Blockey and Cumming (1970), working under cooler conditions, found an increase only around sunrise.

It can be seen that the mating frequencies observed in pens were three times as great as those observed in small paddocks or at Waihora. The correlations between the number of serves/hour at Waihora and that recorded in subsequent small paddock and pen tests at Whatawhata were not significant ($r = -0.33$ and -0.15, respectively). Similar poor relationships between pen tests and actual mating performance have been obtained by Kelly *et al.* (1975) for Romney and Cheviot rams and Cahill *et al.* (1975) for Corriedale rams. However, Mattner *et al.* (1971)

TABLE 4: MATING FREQUENCY OF GROUP 2 RAMS

	Waihora[1] *May 1975*			*Pen*[2] *August 1975*		*Small Paddock*[3] *August 1975*	
Period or replicate	Morning	Midday	Afternoon	1	2	1	2
Serves/hour	1.1	1.2	1.8	4.6	4.8	1.6	1.8
Correlation between replicates		—		0.80**		0.39	

[1] 20 rams; [2] 16 rams; [3] 16 rams.

found good relationships between libido tests and flock mating for Merinos.

The correlations of mating frequency at Waihora and in pen and small paddock tests with % ELM/EL were also small and not significant ($r = 0.10$, 0.19 and 0.08, respectively).

CONCLUSIONS

(1) Certain semen traits were related to the ability of rams to produce multiple births.

(2) The observed ram differences in mating frequency had a low repeatability and were not related to the multiple birth rate of the ewes to which they were mated.

(3) Seasonal and diurnal changes in mating frequency were evident.

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