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FERTILISATION RATE OF EWES MATED TO HIGH AND LOW PROLIFICACY ROMNEY RAMS

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SUMMARY

Ten high prolificacy (W) rams were compared with 10 low prolificacy (C) rams in their ability to fertilise randomly allocated Romney ewes. Ewes remained with the rams for a period of approximately 12 hours beginning 0 to 12 hours after the onset of oestrus. Mated ewes were killed 2 to 4 days later. Ewes from which only one cell ova were flushed were classified as unfertilised, while ewes with at least one cleaved ovum were classified as fertilised. The W rams fertilised 67% (29/43) of the single-ovulating ewes while the C rams fertilised 51% (25/49), and the W rams fertilised 87% (62/71) of the multiple-ovulating ewes while the C rams fertilised 65% (42/65). The W rams were more successful in fertilising both types of ewes ($P < 0.05$). Overall the rams were more successful in fertilising multiple-ovulating ewes (76%) than single-ovulating ewes (59%) ($P < 0.05$).

Ten percent (8/78) of the fertilised twin-ovulating ewes where both ova were found had one fertilised and one unfertilised ovum (incomplete fertilisation). There was no difference between the two types of rams in the percentage of incomplete fertilisations.

INTRODUCTION

Previously differences have been found between rams from the Ruakura high and low prolificacy selection lines in success in fertilising artificially inseminated multiple-ovulating ewes (Moore and Whyman, 1980). There was no difference between these lines in the ability to fertilise single-ovulating ewes.

In the present trial rams from different high and low prolificacy sources were compared in their ability to fertilise ewes by copulation.

Differences in the ability to fertilise the three types of twin-ovulations are reported for both experiments.

MATERIALS AND METHODS

The high prolificacy source (W) was the Waihora sheep improvement programme (Hight *et al.*, 1975) and the low prolificacy source (C) a control of the Whatawhata selection experiment (Hight, 1978).

Ten each of W and C rams were joined on April 24 with 35 ovariectomised ewes, 7 of which had oestrus induced at any one time to give the rams an opportunity to deplete their sperm reserves before and throughout the experiment. A group of 300 4½ to 5½ year-old Romney ewes were joined with 3% vasectomised rams at 1800 h on

May 1. The mated ewes were drafted off at 0700 and 1800 h from May 2 to May 23. They were then divided into groups of 1 to 5 and joined with one of the harnessed fertile rams for a period of 12 h. Ewes were inspected for marks when the fertile ram was removed, if there was none hand-mating to a different ram in a pen was attempted. W and C rams were used alternatively and within ram groups the rams were used in rotation. There were 275 ewes mated both by vasectomised and fertile rams.

All ewes were killed 2 to 4 days after the onset of oestrus and the number of corpora lutea was recorded. The oviducts of each ewe were flushed with saline (9 g NaCL/l). When fewer ova were recovered than the number of corpora lutea, the uterine horns were flushed.

Ewes from which one or all of the ova recovered were cleaved were classified as 'fertilised', while those from which all were uncleaved were classified as 'unfertilised'. Twin-ovulating ewes from which one of the recovered ova was cleaved and the other not, were further classified as 'incompletely fertilised'.

RESULTS

W rams were more successful in fertilising both single and twin ovulations than C rams ($P < 0.05$) and both types of rams were more successful in fertilising multiple ovulations than single ovulations ($P < 0.05$) (Table 1).

TABLE 1: FERTILISATION RATES (NO. OF EWES FERTILISED/TOTAL NO. CLASSIFIED) FOR EWES MATED BY RAMS OF HIGH (W) OF LOW (C) PROLIFICACY

	Single Ovulation				*Multiple Ovulation*			
	W		*C*		*W*		*C*	
No. of rams	10		10		10		10	
Total (%)	29/43	(67)	25/49	(51)	62/71	(87)	42/65	(65)
Significance:	Type of ovulation		$\chi^2_1 = 4.6^*$					
	Type of ram		$\chi^2_1 = 6.4^*$					
	Interaction		$\chi^2_1 = 1.0$ n.s.					

Fertilisation rates for the three different types of twin ovulations are given in Table 2. Analysis revealed that while there was a difference in fertilisation rates between the two types of rams ($P < 0.01$) there was no difference between the three types of twin-ovulations and no interaction.

Eight percent (8/96) of the twin-ovulating ewes where both ova were found were incompletely fertilised. There was no difference between the two types of rams in the percentage of incomplete fertilisations.

TABLE 2: FERTILISATION RATES (NO. OF EWES FERTILISED/TOTAL NO. CLASSIFIED) FOR THE THREE TYPES OF TWIN-OVULATIONS FOR EWES MATED BY RAMS OF HIGH (W) OR LOW (C) PROLIFICACY

	Type of twin ovulation†					
	2/0		*0/2*		*1/1*	
	W	*C*	*W*	*C*	*W*	*C*
No. of rams	9	9	9	7	10	9
Total (%)	17/18 (94)	13/17 (76)	12/15 (80)	7/14 (50)	29/34 (85)	21/36 (58)
Significance:	Type of twin-ovulation	$\chi^2_2 = 4.3$ n.s.				
	Type of ram	$\chi^2_1 = 11.8^{**}$				
	Interaction	$\chi^2_2 = 0.1$ n.s.				

†2/0 two ovulation on left ovary 0/2 two on right 1/1 one on each

DISCUSSION

There have been numerous reports (Turner, 1969; Bradford, 1972) of rams directly affecting the prolificacy of the ewes to which they are mated and suggestions that the rams' effect on litter size is correlated with the prolificacy of their female relatives (Vakil *et al.*, 1968; Burfening *et al.*, 1977; Moore and Whyman, 1980).

The ram effect cannot be explained by a direct effect of paternal DNA giving rise to a blastocyst with 2 inner cell masses, though such monozygotic twin embryos were observed by Rowson and Moor (1964). Monozygotic twin sheep are quite rare. Some estimates of twin pairs which are monozygotic (from the frequencies of the different sex combinations) are 0% (Johannson and Hansson, 1943; James, 1976) and 0.7% (Skjervold, 1979).

Bradford (1972) suggested that rams may contribute to variation in the litter size of their mates through differences in the fertilizing capacity of their semen or in the pre-natal survival of their offspring. There are two possible ways in which fertilising capacity could affect litter size. There could be ram genotype differences in the frequency of incomplete fertilisation, however this did not occur either in the previous trial (Moore and Whyman, 1980) or in the present trial.

The 8% incomplete fertilisation rate in the present trial would explain about half the percentage of partial failure of multiple ovulation observed by Kelly and Knight 1979. Previous determinations of incomplete fertilisation following natural mating (as a percentage of fertilised ewes) were 2.4% (I. D. Killeen, pers. comm.) and 6.4% (Restall *et al.,* 1976).

The second possibility is that there may be a difference between the two types of rams in their ability to fertilise multiple-ovulating ewes but no such difference in ability to fertilise single-ovulating ewes. Such a type of ram x type of ovulation interaction was observed in the previous trial (Moore and Whyman, 1980). An examination of the relative abilities of the H and L rams to fertilise the three types of twin-ovulations in that experiment is given in Table 3. While the type of ram x type of twin-ovulating ewe interaction was not significant the data suggest that most of the difference between the rams may lie in the ability to fertilise the bilateral twin-ovulations.

TABLE 3: FERTILISATION RATES (NO. OF EWES FERTILISED/TOTAL NO. CLASSIFIED) FOR THE THREE TYPES OF MULTIPLE-OVULATIONS FOR EWES INSEMINATED WITH SEMEN FROM RAMS OF HIGH (H) OR LOW (L) PROLIFICACY (Data from Moore and Whyman, 1980)

	Type of twin ovulation†					
	2/0		*0/2*		*1/1*	
	H	*L*	*H*	*L*	*H*	*L*
No. of rams	3	3	3	4	3	4
Total (%)	4/6 (67)	5/8 (63)	10/12 (83)	6/9 (67)	14/21 (67)	4/19 (21)

Significance: Type of twin-ovulation $\chi^2_2 = 5.59$*
0/2 v 2/0 $\chi^2_1 = 0.30$ n.s.
1/1 v (0/2, 2/0) $\chi^2_1 = 5.29$*
Type of ram $\chi^2_1 = 6.40$*
Type of ovulation x type of ram interaction $\chi^2_2 = 1.7$ n.s.

†See Table 2.

There were two major differences between the two trials, one was the source of the high and low prolificacy rams and the other the method of insemination. In the previous trial the dosage of spermatozoa was controlled, differences between ram types are presumably due to some aspect of semen quality which could have led to differences in fertilisation rates only in the bilateral twin-ovulations.

In the present trial numbers of services during the fertile mating period were not recorded and the spermatozoa dose rates completely uncontrolled. A combination of quality and quantity differences may have led to the fertilisation differences in all types of ovulations. These differences would only lead to differences in litter size under special circumstances (e.g. ewes that failed to conceive at their first mating had a lower ovulation rate at their second).

However, the differences observed in the present trial suggest that the use of rams from a high prolificacy source could lead to a smaller percentage of barren ewes and a more concentrated lambing. Furthermore the higher fertilisation rates shown for twin-ovulating ewes could explain their lower rates of failure to lamb observed by Kelly and Allison (1976).

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