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EWES AND TEASER BREED EFFECTS ON REPRODUCTIVE BEHAVIOUR AND PERFORMANCE

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SUMMARY

Dorset, Finn × Romney and straightbred Romney vasectomized rams were joined 10 weeks prior to mating with ewes sired by nine breeds of rams. Dorset rams stimulated onset of seasonal oestrus about 3 weeks earlier than teasers of the other two breeds; however, the earlier onset of oestrus had no effect on either ovulation rate at the first oestrus after start of mating or conception rates to mating with entire rams. Dorset × Romney and Booroola × Romney F₁ ewes exhibited first seasonal oestrus about 1 week earlier than other breeds. There were no teaser × ewe breed interactions observed.

Ovulation rate at the first oestrus following the start of mating varied considerably over ewe breeds and ages. Finn F₁ ewes had a mean ovulation rate of 2.09, with little variation among the three ages present. Booroola F₁ ewes, represented by only 1½-year-olds, were very similar to Finn cross ewes of the same age but showed a markedly higher proportion of single and triple ovulations (and hence fewer twin ovulations) than the Finn crosses. Straightbred Romney ewes had the lowest mean ovulation rate for all three age groups. Finn F₁ ewes had the highest conception to first mating (82%) and the lowest proportion barren (3%), while Romney ewes had poorest conception (62%) and most barren (15%). Twin-ovulating ewes had a 5% higher conception rate to first mating than did single ovulators. Among ewes conceiving to twin ovulations, the number of foetuses present shortly before parturition ranged from 1.71 per ewe for Romney to 1.93 for Finn F₁ ewes.

The cumulative effect of ovulation rates, conception rates and litter size produced proportions of foetuses to ewes ranging from 97% for Romney ewes to 192% for Finn F₁ ewes. There was a high proportion of barren ewes among the Booroola crosses, but the high litter size of pregnant ewes produced a mean "lambing" percentage of 153%, second only to the Finn cross.

INTRODUCTION

Successful commercial sheep production is highly dependent on good lambing percentages, both for sale of market lambs and for production of sufficient potential replacements to allow selection of productive sheep for the next generation. It is also important that the timing and concentration of lambing be suited to the particular management and feed production capabilities

available. The lambing pattern is of course determined in large part by timing of joining, the proportion of ewes cycling at that time, and the conception rate to first mating. The number of lambs eventually produced is affected by conception rate, variation in ovulation rate immediately preceding conception, fertilization rate of multiple ovulations, and by survival of embryos to produce live lambs at birth.

The low heritability estimates for most reproductive traits indicate that only a small proportion of the observed phenotypic variation within populations is attributable to genetic causes. Between populations, however, there are well-recognized breed differences for various reproductive traits, both in the male and in the female. It is through utilization of these breed differences that commercial sheep producers can most quickly alter the reproductive performance of their flock and accordingly increase net returns to their enterprise. The changes implemented might be aimed at earlier or more concentrated lambing, increased litter size, better lamb survival to weaning, or a combination of these effects. Meyer and Clarke (1978) have previously demonstrated the large between-breed differences in lamb survival due to the genotype of the lamb alone. It is the purpose of this paper to examine reproductive aspects for the same array of breed crosses, and in addition the effects of different teaser breeds on the reproductive performance of these ewes when exposed for an extended period pre-mating.

DESIGN

As a part of the evaluation of so-called "exotic" sheep breeds, a total of 1330 1½-, 2½- and 3½-year-old (2-, 4- and 6-tooth) ewes, all born to Romney dams and out of nine local and imported sire breeds, were randomized within breed, sire and age into three equal groups. The three groups were independently run with harnessed vasectomized (teaser) rams of either Romney, Finn × Romney (F × R) or Dorset breeding at 2 rams per 100 ewes for 10 weeks prior to the initiation of mating with fertile rams in late March. Mating marks were recorded weekly. From late March all ewes were combined into a single flock with harnessed teasers of mixed breed, and the marked ewes were removed twice daily for pen mating to randomly pre-assigned rams. Following the start of mating, ovulation rate (OR) was recorded via laparoscopy at each oestrus for 1100 of the ewes, pre-selected so as to equalize numbers as much as possible over breeds and ages.

Because of diagnosis of scrapie in the purebred parental flock at Mana Island, the programme was terminated and all ewes were slaughtered 1 week before lambing was due to commence. At slaughter each ewe was autopsied to determine the number of foetuses present in each uterine horn, and both ovaries were examined to estimate the OR at the oestrus of conception. The autopsy provided a unique opportunity to determine lamb numbers without the complications of mismothering or dead lambs of unknown parentage. It also allowed for ovarian examination and counting of corpora lutea (CL), although the necessity for prior removal of the near-term lambs from the uterus to better allow ovary examination may have biased the CL count since the number of foetuses present was known for each ewe at the time her ovaries were examined.

RESULTS

PRE-MATING OESTROUS BEHAVIOUR

As shown in Fig. 1, apart from Dorset- and Booroola-cross ewes being 1 to 2 weeks earlier, ewe breeds demonstrated relatively small differences in onset of seasonal oestrus. Teaser breed, however, had a very marked effect on initiating seasonal mating behaviour (Fig. 2), with Dorset rams inducing oestrus in considerably more ewes by the midpoint of the teaser trial. Romney teasers produced the slowest effect, while $F \times R$ rams were in-

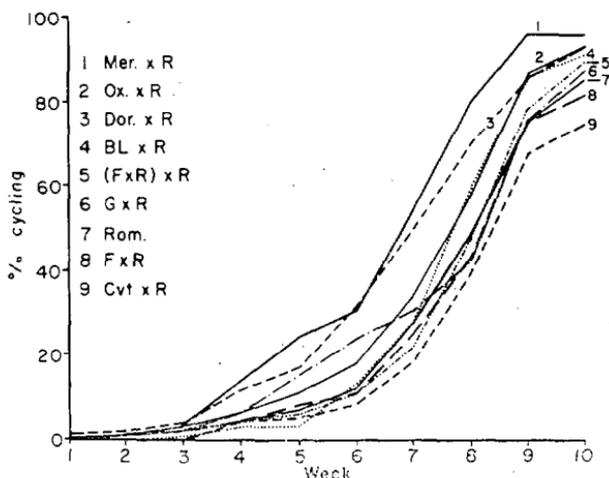


FIG. 1: Cumulative proportions of ewes marked by teasers according to ewe breed.

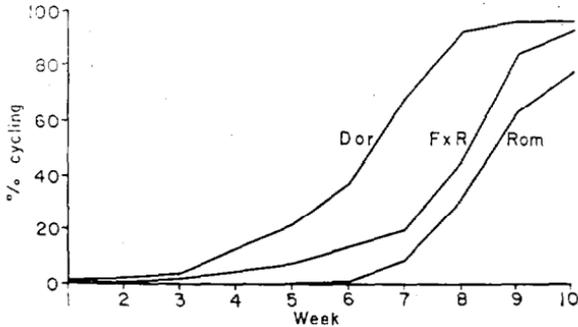


FIG. 2: Cumulative proportions of ewes in oestrus according to breed of teasers.

intermediate but more similar to Romneys than to Dorsets. During the early stages of the trial more than twice as many ewes in the Dorset teaser group had been mated than in either of the other two teaser groups. By the end of the trial (and the start of mating), over 90% of ewes in the Dorset and Finn \times Romney teaser groups had been mated, compared with 76% in the Romney group. There was no interaction between ewe and teaser breeds for proportion of ewes tupped at any point in time.

OVULATION RATE

Whereas teaser breed had major effects on the proportion of ewes cycling pre-mating, there was no effect on the OR of ewes observed at their first oestrus following the start of mating. Mean OR is shown by ewe breed and age in Table 1. With the exception of the oldest group of Border Leicester cross ewes (which had displayed low OR the previous year at 2½ years of age as well), ovulation rate increased across ages in all breed groups. Finn cross ewes displayed their characteristic high and uniform OR over ages as noted in the previous year of this trial and observed by other workers. The one age class of Booroola cross females available (1½-year-old) had a mean OR very comparable to the Finn cross ewes of the same age. However, the distribution of ovulation rates differed markedly. Finn cross ewes had 15, 70 and 15% single, twin and triple ovulations, respectively, while the Booroola cross ewes had 32, 37 and 31% of ovulating ewes in the same respective classes. Straightbred Romney ewes had the lowest mean OR over all three ages apart from the apparently abnormally low OR for the oldest class of Border Leicester crosses.

TABLE 1: MEAN OVULATION RATE AT FIRST MATING (AND OBSERVATIONS) BY BREED AND AGE

Sire Breed ¹	Age (years)		
	1½	2½	3½
Oxford	1.39 (61)	1.62 (40)	— —
Finn	2.03 (63)	2.05 (45)	2.18 (38)
German	1.17 (59)	1.27 (33)	1.56 (36)
Romney	1.06 (65)	1.19 (46)	1.37 (37)
Border Leicester	1.38 (73)	1.58 (34)	1.35 (20)
Cheviot	1.29 (73)	1.34 (35)	1.68 (19)
Dorset	1.44 (94)	— (—)	1.54 (27)
Booroola	2.06 (89)	— (—)	— (—)
Finn × Romney	1.30 (70)	1.92 (26)	— (—)

¹ Crossbred ewes all born to Romney dams and sired by nine sire breeds.

Just as teaser breed had no influence on ewe OR, neither did the number of teaser matings recorded pre-mating. The ovulation rates for ewes which were not marked by teasers prior to the start of fertile mating were no lower than for ewes which had oestrous cycles previously.

CONCEPTION RATES

Teaser breed had no effect on proportions of ewes conceiving to first or subsequent matings, and hence no effect on proportion of barren ewes. Similarly, the number of oestrous cycles observed pre-mating was not related to success of conception to first mating.

Ewe breeds showed large differences in conception rates at first mating and in proportion of barren ewes (Table 2). Finn cross ewes had the highest overall conception to first mating (82%) and the lowest proportion barren (3%), while the Romney had the lowest conception (62%) and the most barren (15%). Booroola crosses, represented by only 2-tooths, had 18% of the ewes barren, compared with 13% as the average for all breeds. The only breed with a higher rate of barren 2-tooth ewes was the ¼ Finn — ¾ Romney at 20%. However, the rate of barren ewes amongst the next older (4-tooth) class was only 4% for this breed.

Conception rate at first mating increased with increasing ewe age while the proportion of dry ewes decreased. For the five breeds represented by all three age classes the mean proportions of dry ewes were 11, 9 and 4% for 1½-, 2½-, and 3½-year-old ewes, respectively.

TABLE 2: CONCEPTION TO FIRST MATING AND PROPORTION OF BARREN EWES BY AGE

<i>Sire Breed</i>	<i>Conception (%)</i>			<i>Barren (%)</i>		
	<i>1½ years</i>	<i>2½ years</i>	<i>3½ years</i>	<i>1½ years</i>	<i>2½ years</i>	<i>3½ years</i>
Oxford	69	73	—	8	10	—
Finn	83	84	78	6	2	2
German	78	70	89	10	6	0
Romney	60	57	69	16	21	9
Border Leicester	73	72	62	11	11	5
Cheviot	62	75	81	11	3	5
Dorset	68	—	65	14	—	13
Booroola	63	—	—	18	—	—
Finn × Romney	57	81	—	20	4	—

Averaged across breeds and taking into account the fact that not all ages were represented in all breeds, conception rate at first mating was 69% for single-ovulating versus 74% for twin-ovulating ewes. As shown in Table 3, conception rate was higher for twin than single ovulators in six of the nine ewe breeds. Only the Oxford and Booroola crosses had lower conception to first mating among twin than among single ovulators.

EFFICIENCY OF MULTIPLE OVULATION

Ewe breeds varied considerably in the number of foetuses produced when conception followed twin ovulation (Table 3). Romney ewes conceiving to twin ovulations averaged lowest at

TABLE 3: CONCEPTION RATE (CR) OF SINGLE- VS TWIN-OVULATING EWES AND FOETUSES/TWIN-OVULATING EWES CONCEIVING AT FIRST MATING

<i>Sire Breed</i>	<i>1 Ova CR(%)</i>	<i>Two-ova Ewes Conceiving</i>		
		<i>2 Ova CR(%)</i>	<i>Foetuses/Ewe</i>	<i>No. Ewes</i>
Oxford	75	69	1.81	43
Finn	77	85	1.93	114
German	82	82	1.83	41
Romney	62	76	1.71	33
Border Leicester	66	73	1.88	69
Cheviot	70	75	1.74	54
Dorset	68	71	1.75	53
Booroola	72	63	1.83	30
Finn × Romney	52	75	1.88	40
Mean	69	74		

1.71 foetuses per ewe, while at the other extreme Finn cross ewes averaged 1.93 foetuses. Across breeds there was no effect from the age of the ewe on efficiency from producing lambs from twin ovulations. For the five breeds represented in all three age classes, the means were 1.80, 1.88 and 1.84 foetuses/ewe for twin-ovulating, 1½-, 2½- and 3½-year-old ewes, respectively. In the comparison of 1½-year-old Finn and Booroola cross ewes only, the mean numbers of foetuses were 1.93 and 1.83, respectively, for the 1½-year-old ewes conceiving following twin ovulations, and 2.47 and 2.57, respectively, for ewes conceiving following triple ovulations.

Among twin-ovulating ewes, the production of one ovum from each ovary versus production of both ova from the same ovary resulted in no difference either in conception rate or in the number of foetuses produced. Similarly, there was neither an age nor a breed effect for this comparison, but numbers within each subclass were often small. In total, 209 of 407 (51.4%) twin-ovulating ewes produced one ovum from each ovary.

LITTER SIZE

The cumulative results of the reproductive process, number of lambs per ewe present and proportion of barren ewes and litter size of ewes conceiving are shown in Table 4. The combination of high ovulation rate and good conception resulted in Finn cross ewes producing 1.92 lambs per ewe present. Except for the Booroola cross (2-tooths only) at 1.53 and the Romney at 0.97 the remaining six breeds averaged between 1.20 and 1.37 lambs per ewe present.

TABLE 4: LAMBS PRESENT AT AUTOPSY OF EWES

<i>Sire Breed</i>	<i>Barren Ewes (%)</i>	<i>Litter Size</i>	<i>Lambs per Ewe Present</i>
Oxford ¹	9	1.45	1.50
Finn	3	1.99	1.92
German	5	1.30	1.24
Romney	16	1.15	0.97
Border Leicester	9	1.50	1.37
Cheviot	6	1.35	1.27
Dorset ²	14	1.40	1.20
Booroola ³	18	1.87	1.53
Finn × Romney ¹	12	1.53	1.35

¹ Four-tooth and two-tooth ewes only.

² Six-tooth and two-tooth ewes only.

³ Two-tooth ewes only.

DISCUSSION

In this trial, Dorset teasers initiated seasonal oestrus about 16 days earlier than Romney teasers. Whether the large effect noted in the present trial relative to that found by Tervit *et al.* (1977) was due to the range of ewe breeds, mob exposure to several teasers (at 2%) or other factors is not known. Although the onset of first behavioural oestrus was not closely synchronized, 50 to 60% of the ewes were mated a fortnight earlier with Dorset teasers than with teasers of either of the other breeds.

Apart from the effect on initiation of seasonal oestrus, teaser breeds produced no differences in reproductive performance thereafter. This may have been due to the fact that all groups were cycling at high rates at the start of mating and that conception overall was quite high. With lower mean performance, factors such as number of pre-mating oestrous cycles may influence ovulation and/or conception rates and hence breed of teaser effects. Unfortunately, there was no control group run for comparison without pre-mating exposure to rams. Tervit *et al.* (1977) reported a mean delay in first oestrus of about 20 days when teasers were not present.

The effect of ewe breed on onset of oestrus was quite small compared with interbred variation for other reproductive traits, and indicates little advantage in the use of any particular breed if earlier lambing is desired. The overall high reproductive performance of the Finn cross is apparent in virtually every trait measured: ovulation rate, conception to first mating, and ability to produce two lambs when conceiving to a twin ovulation. In contrast, the Romney showed uniformly low performance for these traits. Because of the termination of the trial just as interbred Finn cross ewes were being produced, the contribution of heterosis to the performance of Finn (and other) crosses relative to that of straightbred Romneys cannot be assessed.

It would appear that the Finn cross has the ability to achieve high reproductive performance and realize most of its potential at an early age relative to the increases with age noted in other breeds. This would agree with the exceptionally high levels of hogget oestrus observed for Finn cross females previously (Meyer and French, 1979). The dramatic differences in ovulation and conception rates between year classes for the $\frac{1}{4}$ Finn ewes do nothing to help suggest the nature of the genetic basis for high fertility in Finns. The variation between years in this and other breeds clearly demonstrates the role of sampling variance when

each year class is based on only a small sample of rams, and gives warning of the dangers of interpreting results based on a single year's data.

Nevertheless, it is interesting to compare performance of the two high-fertility genotypes — the Finn and Booroola crosses. Apart from its very high ovulation rate, the 1½-year-old Booroola cross is only average at best in its ability to conceive at the first or successive matings. When conception does occur following a twin ovulation, the success rate for producing twin lambs is average compared with other breeds. As a consequence, if lambing rate is compared with the ovulation rate at first mating, the Booroola cross has the poorest "reproductive efficiency" as measured in this way — well below that of most other breeds. It is only the high ovulation rate of the Booroola cross which leads to its superior lambing rates.

Apart from the Finn, Booroola and Romney, the remaining six breed crosses show variation in ovulation and conception rates over ages, but end up ranging from 1.20 to 1.37 for lambs per ewe present.

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