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Techniques to establish flocks from fecund ewes by superovulation with and without ova transfer

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ABSTRACT

Superovulation with ova transfer (1979, 1980) and superovulation (without ova transfer) plus artificial rearing (1981, 1982) were used to establish flocks of Romney, Perendale and Coopworth sheep from fecund animals donated by farmers. In their first and second years respectively in the ova transfer programme, 39% and 32% of donor ewes failed to have any progeny by ova transfer, and 38% and 44% failed to lamb themselves while the mean number of lambs tailed per donor at joining was 2.68 and 2.21. In their first and second years respectively in the artificial rearing programme only 7% and 3% of ewes failed to produce a lamb with a mean number of lambs born per donor joined of 2.15 and 2.36. High lamb mortality rates (27% and 32% of lambs born) resulted in 1.58 and 1.64 lambs tailed/ewe/annum. About 40% of ewes failed to reach the objective of at least 2 live lambs/ewe/annum in both programmes.

Keywords Sheep; reproduction; superovulation; ova transfer; artificial rearing; lamb production

INTRODUCTION

Ova transfer techniques have been exploited in domestic animals to rapidly increase the number of progeny from female stock. Extensive use of ova transfer has been made in New Zealand for multiplying 'exotic' cattle (Struthers and Marshall, 1976). In the sheep industry in New Zealand there has been limited use of such techniques although a programme was undertaken in 1975 with poor results using 'exotic' sheep (Tervit *et al.*, 1976). This paper reports the results of a project in which superovulation with ova transfer was compared with superovulation and artificial rearing to establish a special flock selected for high fecundity. The objective of these 2 techniques was to produce at least 2 live progeny/ewe/annum.

MATERIALS AND METHODS

In 1979 ewes with a history of high lambing performances in industry flocks were loaned or donated to MAF to allow the establishment of highly fecund Romney, Perendale and Coopworth flocks. The criterion by which ewes qualified for entry was 'best in the flock' although multiple sets of triplets or equivalent lamb production index (Rae, 1963) was also used.

Ewes received had a mean age of 6½ years and a lambing history of 2.67 (s.e.m. ± 0.05) lambs born per lambing. These sheep were retained for 1 or more years, depending upon individual agreements with their owners. All joinings were in single-sire groups using rams screened on their dams lambing performance.

Two programmes were used to establish high fecundity flocks from these elite ewes, both with superovulation but using either ova transfer (1979, 1980) or artificial rearing (1981, 1982).

Superovulation with Ova Transfer

There were 49 ewes and 10 rams in 1979 and 71 ewes (30 new entrants and 41 from the previous year) and 12 rams in 1980. The superovulation — ova transfer programme was similar to that outlined by Allison (1973). Oestrus synchronisation was achieved using intra-vaginal sponges containing 60 mg medroxyprogesterone acetate (MPA; Upjohn Pty Ltd), with 6 donors receiving sponges each day for 14 days from 21 March. All ewes were laparoscoped in the subsequent oestrous cycle to determine their natural ovulation rate (number of corpora lutea [CL] per ewe ovulating). Pregnant mares serum gonadotrophin (PMSG; Folligon, Intervet Ltd) was injected on day 13 of the oestrous cycle following progestagen treatment, the dose being 1200 i.u. (ewes with > 3 CL, 1979 only), or 1500 i.u. Recipient ewes, drawn from a large flock of Romney ewes (> 5½ years old), received 1 fertilised ova each.

Between day 4 and 7 after ova transfer (day 7 to 10 of the oestrous cycle) all donor ewes in which number

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TABLE 1 Mean performance per ewe for superovulation with ova transfer or artificial rearing.

Year of entry	Ova transfer 1st	2nd	Artificial rearing 1st	2nd
Number of ewes	74	39	97	64
Ovulation rate				
natural	2.49	2.14	2.39	2.33
following PMSG	7.11	6.32	3.08	3.14
Percentage of ova				
recovered per CL†	79	72	—	—
fertilised per ova recovered	69	72	—	—
Lambs born to fertilised ova (%)	58	59	—	—
Lambs born to donor ewes	1.08	0.85	2.15	2.36
Percentage of ewes with progeny				
from ova transfer attempts	61	68		
from natural lambing	62	56	93	97
Lamb deaths % of lambs born	16	19	27	32
Lambs tailed per ewe at joining	2.68	2.21	1.58	1.64

† Excludes ewes in which no recovery was attempted.

of ova recovered was less than the number of CL observed were injected with 125 μg prostaglandin (Estrumate; ICI Ltd) and then joined for the second oestrus after prostaglandin treatment. Ewes in which all ova were recovered were joined for the first oestrus after ova transfer.

Superovulation and Artificial Rearing

There were 113 ewes (75 new entrants and 38 from the previous years) and 22 rams in 1981, and 111 ewes (23 new entrants and 88 from the previous years) and 17 rams in 1982. Prejoining treatment of ewes was similar to that described in the previous section except for starting date (6 April) and dose of PMSG (750 i.u.). Ewes were single-sire joined for the oestrus following PMSG treatment, and to cover 1 (1981) or 2 (1982) subsequent returns to service. Ovulation rate to PMSG was recorded by laparoscopy. At lambing the lightest lambs from litters in excess of 2 were removed so that no ewe had to rear more than 2 lambs. The removed lambs were fed cow's colostrum for 24 h and then reared for 7 to 8 weeks on a calf rearing machine (Legrain 2000). This machine supplied warm milk *ad libitum* to the lambs (milk powder — Reeves Ltd: 24% fat, 27.5% protein; 200 g/litre water).

Statistical Analyses

Differences in proportions were tested by t-test of binomial proportions.

RESULTS

Data from ewes which were pregnant on receipt or which died from natural causes (mainly advanced age) during pregnancy, have been omitted. Animals with higher natural ovulation rates on their first year of entry had higher ($P < 0.001$) previous mean lambing performances.

Superovulation with Ova Transfer

The data for the first year of entry of ewes over the 2 years have been combined (Table 1). Four of the 79 ewes failed to be mated to PMSG treatment and 1 ewe had gross abdominal adhesions; all 5 failed to produce progeny and were excluded. Twenty-five (32%) ewes were barren and 5 (6%) died as a result of surgery. The mean weight of the lambs at 50 days of age was 17.0 (s.e.m. ± 0.2) kg.

There was only 1 year's data for ewes in their second year of entry (Table 1). Performances were similar to those of the ewes in their first year of entry, with no significant difference in fertilisation rates or lambing rates to fertilised ova transferred. The percentage of ova recovered was lower in the second than first year of entry (72 *v* 79, $P < 0.05$). Hanrahan and Quirke (1982) also recorded lower recovery rates in repeat donor ewes. The mean weight of the lambs at 50 days of age was 19.1 (s.e.m. ± 0.2) kg.

Superovulation and Artificial Rearing

The data for the first year of entry of 97 ewes over the 2 years have been combined (Table 1). Three ewes did not receive PMSG treatment as they had very high natural ovulation rates (viz 5, 5, 7). The mean number of lambs born to the treated ewes present at joining was 2.15, with 7 (7%) of ewes being barren. The growth rate of lambs on the artificial rearing machine was not significantly different from their counterparts reared on the ewe (Table 2).

The performances of the animals in their second year were similar to those in the first year of entry (Table 1).

TABLE 2 Mean growth rate (g/d) of lambs reared on the ewe and the artificial rearing machine (number of lambs in brackets).

Birth rank	Rearing method	Year of rearing 1981	1982
2	Machine	235 (9)	282 (8)
	Ewe (1)[1]	284 (7)	235 (7)
		SED = 33	SED = 35
≥ 3	Machine	278 (19)	245 (27)
	Ewe (2)[1]	274 (21)	231 (32)
		SED = 23	SED = 12

[1] Rearing rank on ewe.

Progeny Produced by each Programme

The results for both programmes have been combined to summarise the number of lambs born (Fig. 1a) and tailed (Fig. 1b) per treated ewe per annum. For the ova transfer programme, of 118 ewe observations over both years 19% and 12% had 0 and 1 lamb born, respectively, and 22% and 18% had 0 and 1 lamb tailed, respectively. In comparison, the artificial rearing programme resulted in 161 ewe observations over both years of which 6% and 16% had 0 or 1 lamb born, and 15% and 27% had 0 and 1 lamb tailed, respectively. The differences between programmes in the proportions of ewes with 0 or 1 lamb tailed were not significant.

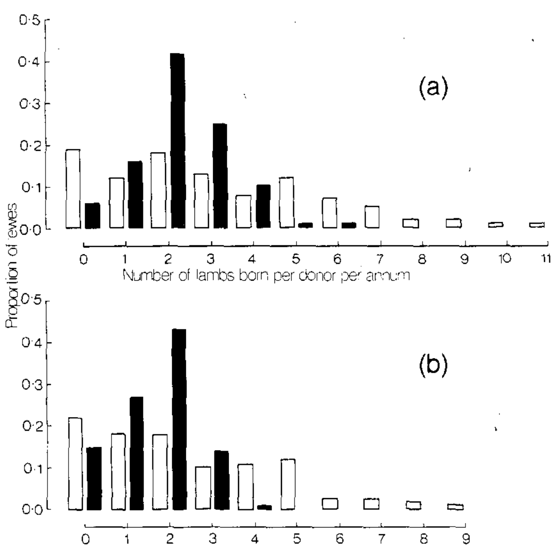

FIG. 1 *Frequency distributions of number of lambs born* (a) and tailed (b) per donor ewe per annum.

☐ Superovulation with ova transfer.
■ Superovulation and artificial rearing.

DISCUSSION

Ova recovery rates, fertilisation rates and lambs born to fertilised ova transferred are similar to those obtained by Moore and Shelton (1962), Tervit *et al.* (1976) and Hanrahan and Quirke (1982). The mean number of lambs born and tailed was greater than expected from the natural ovulation rate (allowing for normal losses) and therefore in these terms the ova transfer programme was successful. However, such comparisons take no account of the extreme variability in number of offspring produced per donor ewe, ranging from 0 to 11 lambs born. A large percentage of donor ewes present at joining failed to produce progeny by ova transfer (39%, 32%) or by natural lambing (38%, 44%). Similarly Hanrahan and Quirke (1982) reported that 35% of ewes in which ova recovery was attempted had no progeny by ova transfer, and that even with joining for a period covering 2 cycles after transfer only 67% of donor ewes themselves lambed. Our failure to produce lambs from the ova transfer programme resulted largely from total failure of fertilisation, due largely to differences in fertility between rams. The extreme case was 1 ram, joined with 9 ewes from which 36 ova were recovered, of which only 1 (3%) was fertilised. If this ram is excluded the mean fertilisation rate per ova recovered for the other rams was 0.69 (s.e.m. ± 0.08). A similar problem was encountered in the artificial rearing programme in 1982, when all of the 7 treated ewes joined to 1 ram returned to service. Such variability in these programmes is not surprising since differences between rams in conception rates of ewes to which they are mated in single-sire situations are well known (Quinlivan and Martin, 1972). This variation has a profound effect on the success of any programme where single-sire joining is necessary.

The artificial rearing programme, while minimising the number of ewes which fail to produce progeny in any one year (7%, 3%), had high mortality rates in the lambs due to the higher number of multiple births (in the ova transfer work most lambs were single born). By tailing there was no significant difference between programmes in the proportion of ewes that had 0 or 1 lamb alive.

It is concluded that both programmes had limitations in meeting the objective of producing 2 live lambs/donor/annum — about 40% of ewes failed to achieve this level of performance. No doubt better performances could be expected in an ova transfer programme by repeated ova recoveries within a breeding season (Rowson and Adams, 1957) and the use of uterine flushes compared with our oviduct flushing (Tervit and Havik, 1976). Similarly, lambing and rearing lambs indoors could be expected to increase survival rates of the multiple born lambs in both programmes.

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