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Reproductive performance of progeny of prolific Romney, Coopworth and Perendale sheep

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ABSTRACT

Highly prolific flocks of Romney, Coopworth and Perendale sheep have been established from the progeny of ewes screened from industry. Ovulation rates of 1.5-year-old Romney, Coopworth and Perendale ewes were 1.82, 2.08 and 1.87 respectively. Corresponding ovulation rates for older ewes were 2.13, 2.27 and 2.07. Mean litter size of 1.5-year-old Romney, Coopworth and Perendale ewes was 1.63, 1.87 and 1.61 respectively and for older ewes the respective litter size was 1.88, 1.94 and 1.78. The proportion of ewes twinning ranged from 0.57 to 0.69. Within the flocks there are some family lines which are showing outstanding prolificacy and are the subject of a progeny testing programme.

Keywords Sheep; reproduction; prolificacy; animal breeding.

INTRODUCTION

Highly prolific flocks of Romney, Coopworth and Perendale sheep have been established at Woodlands Research Station in Southland. The foundation flock of 212 ewes consisted of 63 Romneys, 95 Coopworths and 54 Perendales with histories of high prolificacy and was established between 1979 and 1984 from sheep loaned or donated from registered and non-registered flocks throughout New Zealand. Prior to entering the flock the foundation ewes had a mean litter size (lambs born per ewe lambing) of 2.66. Their ovulation rate (number of corpora lutea per ewe ovulating) measured after entry averaged 2.33. The ovulation rate was measured early in the breeding season (March) prior to stimulation with pregnant mares serum gonadotrophin and is likely to be lower than their natural ovulation rate in mid-April. Seasonal changes in ovulation rate have been shown to increase by 0.12 between successive oestrous cycles in this environment (Thompson *et al.*, 1985). These foundation ewes were joined with rams whose dams had been highly prolific (mean litter size = 2.58). The techniques of superovulation and embryo transfer were used to increase the number of progeny and the results of this work have been published (Kelly *et al.*, 1983.) This paper reports the ovulation rate and litter size data for the progeny of the foundation ewes born between 1979 and 1984.

METHODS

All female progeny born between 1979 and 1984 were retained and run together as 1 flock except during mating. Each year 5 rams per breed were joined in single sire groups for 34 d from early April. Most rams were aged 1.5 years at joining and each was used for only 1 season. Initially rams from outside flocks were used but rams bred from within the flocks have been used since 1985.

Within 2 d prior to joining, ewes were weighed after an overnight fast and laparoscoped to measure ovulation rate. All ewes were laparoscoped again 19 to 23 d later. All sheep were fully recorded at lambing. Most ewes which gave birth to 3 or more lambs were left to rear 2. Surplus lambs were fostered onto other ewes or artifically reared.

RESULTS AND DISCUSSION

Data from 1.5-year-old progeny and progeny aged 2.5 years and older have been presented separately in Table 1 because the younger ewes had significantly lower ovulation rates than older ewes ($P < 0.01$). The ovulation rates shown in Table 1 were measured 18 to 21 d after joining whereas litter size was calculated from the total 5 weeks' lambing period.

The coefficient of variation for ovulation rate is typically 0.34 (Hanrahan and Owen, 1985) but for the 3 breeds the coefficient of variation ranged from 0.26 to 0.30 which does not indicate the high phenotypic variance typical of a flock with a major gene having a large effect on ovulation rate.

Clarke (1982) summarised several New Zealand trials involving Romneys and Coopworths and concluded that much of the variation between trials was associated with differences in joining weight. Litter size increased by 0.02 lambs/ewe/kg body weight and at 60 kg body weight Romneys had a litter size of 1.46 and Coopworths a litter size of 1.53. The present highly prolific Romney flock averaged 60.2 kg at joining and the resultant litter size was 1.77. The Coopworths weighed 61.8 kg and had a mean litter size of 1.91. These litter sizes are markedly higher than those reported by Clarke (1982) and show that the high prolificacy of these flocks is not simply a body weight effect.

Although 1.5-year-old Coopworths were significantly heavier than contemporary Romneys and Perendales at joining ($P < 0.01$) the difference was small (3.0 and 1.8 kg respectively). There were no significant differences in joining weight between the breeds for ewes aged 2.5 years and older. Coopworths had significantly higher ovulation rates than Romneys and Perendales at both ages ($P < 0.01$, see Table 1). Within each breed ewes with 2 ovulations were heavier than ewes with 1 ovulation at 1.5 years of age (3.6 ± 0.4 kg) and at older ages (5.1 ± 0.8). The 1.5-year-old ewes with 3 ovulations were not signifcantly heavier than ewes of the same age with 2 ovulations (0.6 ± 0.7 kg). Older Romney and Perendale ewes with 3 ovulations were heavier (3.3 ± 0.5 kg) than ewes with 2 ovulations but in older Coopworths the difference was not significant (0.6 ± 0.7 kg).

Coopworths' litter size at 1.5 years of age was significantly larger ($P < 0.01$) than Romneys (+0.24) and Perendales (+0.26). Differences in litter size between breeds in older ewes were less and the only significant difference was the larger litter size of Coopworths compared with Perendales (+0.16, $P < 0.01$).

Although mean litter sizes were high for all breeds there are commercial flocks in Southland with comparable prolificacy. Roloff and Hinch (1984) identified 6 Coopworth flocks with mean litter sizes ranging from 1.80 to 2.07. These Coopworth flocks have about 25% of females selected for replacements which would exaggerate the difference between them and the experimental flocks because the experimental flocks have not been culled. Many of the foundation ewes were from highly selected flocks and the breed differences should not be extrapolated to the general population. In the future it is intended to use sires from some commercial flocks and sires bred from the selection flocks to compare the genetic merit of different flocks. Also, a control flock was established within the Coopworth flock in 1985 so that the genetic progress from future selection for ovulation rate can be estimated.

From 1986 the total flock will be maintained at 1000 stock units and there will be no further introduction of ewes or rams from outside flocks. Selection is carried out on 2-year-old ewes using the criterion of ovulation rate. A selection index based on the lifetime ovulation rate records of an individual and all relatives bred within the flock is calculated using the best linear unbiased prediction (BLUP) technique. The index is calculated within each breed and corrected for fixed effects of year, age and date of laparoscopy. There are 5 sire lines per breed and the top index sire in each line is used for 1 year.

The distribution of birth ranks for each breed (Table 2) was in the range reported by Davis *et al.* (1983) for New Zealand breeds.

The proportion of ewes twinning ranged from 0.57 to 0.69. None of the flocks showed the higher

TABLE 1 Reproductive performance of ewes born between 1979 and 1984 (values are mean ± standard error).

Age (years)	Breed	No. records	Joining weight (kg)	Ovulation rate	Litter size
1.5	Romney	262	57.2 ± 0.4	1.82 ± 0.03	1.63 ± 0.03
	Coopworth	391	60.2 ± 0.3	2.08 ± 0.02	1.87 ± 0.03
	Perendale	228	58.4 ± 0.5	1.87 ± 0.03	1.61 ± 0.04
2.5 and older	Romney	313	62.8 ± 0.5	2.13 ± 0.03	1.88 ± 0.04
	Coopworth	471	63.1 ± 0.4	2.27 ± 0.03	1.94 ± 0.03
	Perendale	284	62.4 ± 0.5	2.07 ± 0.03	1.78 ± 0.04

TABLE 2 Birth rank distribution.

Age (years)	Breed	Litter size	Birth rank 1	2	3	4
1.5	Romney	1.63	0.40	0.57	0.03	—
	Coopworth	1.87	0.22	0.69	0.08	0.01
	Perendale	1.61	0.41	0.58	0.01	—
2.5 and older	Romney	1.88	0.26	0.61	0.12	0.01
	Coopworth	1.94	0.22	0.62	0.15	0.01
	Perendale	1.78	0.32	0.59	0.09	—

incidence of triplets and quadruplets associated with the Booroola F gene. Because the foundation ewes for the 3 breeds were highly screened and came from numerous sources it is possible that some major genes for prolificacy are present in the flocks. Within the flocks there are some family lines showing continuing high ovulation rates. The most outstanding is a Romney ewe screened into the flock after having 33 lambs in 11 lambings. Her 3 daughters, 7 granddaughters and 6 great grandaughters have mean ovulation rates of 2.56 ± 0.13, 2.44 ± 0.18, and 2.70 ± 0.18 respectively. Individual ovulation rate records range from 1 to 5, and 13 of the 16 descendants have at least 1 ovulation rate record ⩾3. Some progeny testing of rams from this and other outstanding family lines is being undertaken to identify genetically superior strains.

The High Fertility breed in Ireland (established 1963) and the Cambridge in Britain (established 1964) are examples of prolific flocks formed from screening prolific ewes from industry flocks. Both of these flocks consist of a mixture of breeds which include the prolific Finn at 6% (High Fertility) and 25% (Cambridge). The litter size of 1.5-year-old High Fertility ewes is quoted at 1.79 (Hanrahan, 1984) and the Cambridge at 2.6 (Hanrahan and Owen, 1985) showing that selection of exceptional individuals from a very large population is an effective means of establishing prolific flocks. The continuation of the Romneys, Coopworths and Perendales as separate purebreds should ensure ready acceptance of these animals by industry.

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