LIFETIME REPRODUCTIVE PERFORMANCE OF BOOROOLA MERINO X ROMNEY EWES OF DIFFERING GENOTYPE FOR THE BOOROOLA FECUNDITY GENE AND ROMNEY EWES

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SUMMARY

First cross Booroola Merino x Romney (B x R) ewes born in 1975, 1976, 1978 and 1979 were classified as being heterozygous (F+) or non carriers (++) for the Booroola fecundity gene. Their performance as hoggets (< 1 year of age), and to six years of age (1975 and 1976 bornonly) was compared with contemporary Romney (R) ewes. As hoggets, the F+ ewes had ovulation rates about 0.5 higher than ++ B x R and R ewes. As adults B x R ewes were 5-7 kg lighter at joining than R ewes. Mean ovulation rates were 0.06-0.16 and 1.28-1.55 higher for ++ and F+ B x R ewes respectively than R ewes which together with differences in barrenness and lamb survival gave 0.05-0.32 and 0.35-0.85 more lambs tailed per ewe joined.

INTRODUCTION

Kelly et al. (1980) reported the productive changes in longwool breeds in New Zealand following cross breeding with Booroola-type (B) rams, in which the performances of the Booroola cross progeny were considered on a flock basis. Recent evidence (Piper and Bindon 1982; Davis et al. 1982) has indicated that the exceptional reproductive performance of the Booroola Merino appears to be largely influenced by a single gene (denoted the F gene) with an additive' effect on ovulation rate (OR). It is important therefore to distinguish between homozygous (FF), heterozygous (F+) and non carrier (++) ewes when evaluating the changes in performance that result from crossbreeding or interbreeding with Booroolatype rams. Consequently, the reproductive performances that occurred in the first cross Booroola Merino x Romney (B x R) ewes, reported by Kelly et al. (1980) have been re-examined with the ewes classified as either F+ or ++. Additionally, the performance as hoggets (< 1 year of age) of another flock of similarly generated first cross B x R ewes born in 1978 and 1979 has been included. In both cases the performance of these animals is compared with that of contemporary Romney (R) ewes.

MATERIALS AND METHODS

Within years of birth, the B x R and R animals were run as one flock from weaning at three months of age. At about 1.3 years of age the 1976 born ewes were combined with the 1975 born ewes and run as one flock to 1982 (inclusive) - Expt 1. The 1978 and 1979 born animals were run separately until the 1979 born animals were 1.3 years of age - Expt 2.

Experiment 1

Generation of these ewes is outlined by Kelly et al. (1980). Nine B rams were flock joined with R ewes over two years (1975, 1976) to produce the B x R ewes. Ewes with at least one record of an OR $\geq$ 3 up to 3.5 years of age were

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classified as F+, and no ewe was considered to be a ++ genotype unless it had at least three annual OR observations. For the total of two years of birth (1975, 1976) there were 175 R, 69 ++ B x R and 113 F+ B x R ewes present at joining at 1.5 years of age.

Experiment 2

Four B Merino rams were single sire joined with R ewes in 1978 and a further six B rams were single sire joined with R ewes in 1979 to generate first cross B x R progeny. Contemporary R ewes were generated from the R ewes used in Expt 1. Harnessed vasectomised rams were run with the hoggets throughout the breeding season in both years. Hoggets detected in oestrus were laparoscoped within 10 days of each oestrus. In addition, all of the 1978 born and about half of the 1979 born hoggets were laparoscoped on three occasions : about May 1, May 28 and June 28. Subsequently, ewes with at least three OR records from 1.5-3.5 years of age were assigned a Booroola genotype as in Expt. 1. The total number of animals present at eight months of age were 229 R, 98 ++ B x R and 54 F+ B x R ewes.

Data and statistical analyses

Liveweights, hogget oestrous activity, OR, mating and lambing performances, were recorded for all ewes. For each age of ewe, the mean value for each genotype (R, ++ B x R, F+ B x R) within birthrank (single, twin) of ewe was used in the analysis. Weighted regression analyses were used to adjust for year of record and number of animals per mean value. For proportional data analogous logit analyses were used.

RESULTS

Liveweights

The liveweights of ewes within each experiment were not significantly different between genotypes (++, F+, R) to 12 months of age. Thereafter in Expt 1 the R ewes at joining were significantly (1.3 years of age $P < 0.05$, older ages $P < 0.01$) heavier than both genotypes of B x R ewes, the differences being greatest (5-7 kg) at 3.5-5.5 years of age. The ++ B x R ewes were 2-3 kg heavier than the F+ B x R ewes at 3.5-5.5 years of age but the difference was only significant ($P < 0.05$) at 4.5 years of age. Ewes born as twins were 2-3 kg lighter ($P < 0.05$) than single birthrank ewes from 5-10 months of age; in older ewes the effect of birthrank was not significant.

Hogget Performance

The proportion of hoggets displaying oestrus was greater in the F+ than R hoggets ($P < 0.05$) and in single than twin birthrank animals ($P < 0.01$) in Expt 1 (Table 1), with no significant difference between F+ and ++ animals. Similar but non significant differences were evident in Expt 2 (Table 1). Number of oestruses, and date of first oestrus werenot significantly different between genotypes or birthrank of hogget in either Experiment.

Mean OR per hoggetovulating at first oestrus was greater ($P < 0.01$) in the F+ than ++ and R hoggets in both experiments. Additionally, in Expt 2 there was an interaction ($P < 0.05$) for mean OR between genotype and birthrank for the B x R ewes, there being a larger effect of birthrank on the OR of the F+ (1.78 v. 1.38, single and twin birthrank respectively) than ++ (1.11 v. 1.07) ewes. On average 45% (s.d. = 1.7%) of the F+ hoggets in both

experiments had an ovulation rate of one at first oestrus. In Expt 2, for the hoggets laparoscoped on three occasions the percentage that were recorded as ovulating on at least one occasion did not differ between ++ and F+ B x R animals (69%). The percentage of total observations in which an ovulation rate of one was recorded was 51% for the F+ B x R hoggets, compared with 93% for the ++ B x R and 95% for the R hoggets. In only 9% of observations on the F+ hoggets were ovulation rates of three or more recorded.

TABLE 1 Mean reproductive performance of hoggets in Expt's 1 and 2

Characteristic	Genotype				Birthrank		
	R	B x R					
		++	F+	SED*	1	2	SED
Proportion displaying oestrus							
Expt 1	0.47	0.60	0.70	0.05	0.70	0.48	0.04
Expt 2	0.52	0.60	0.65	0.11	0.73	0.52	0.10
OR at first oestrus							
Expt 1	1.04	1.00	1.56	0.03	1.21	1.19	0.03
Expt 2	1.11	1.09	1.58	0.07	1.44	1.22	0.06

* SED for max.- min. number of animals per mean

Adult performance

In comparison with the R ewes, the ++ B x R ewes (Table 2) had slightly (but not significantly) improved reproductive performance in OR, lambs born per ewe lambing (LB/EL), barrenness and lamb survival. This lead to 0.05-0.32 more lambs tailed per ewe joined (LT/EJ). Differences in LT/EJ generally increased with increasing age of ewe. The F+ B x R ewes in comparison with the R ewes (Table 2) had higher ovulation rates ($P < 0.001$), fewer barren ewes (6% v. 12%, n.s.) more lambs born ($P < 0.001$) and tailed ($P < 0.01$). Survival rate of all lambs born averaged 69% over the 5 F+ ewe age groups. The percentage of ewes having 1 lamb was lower ($P < 0.001$) in all F+ B x R age groups (12 - 22%) in comparison with the other genotypes (46-90%), but there was no significant difference in the percentage of ewes having twins between genotypes except at 2 years of age (10 v. 20 v. 50%; R, ++, F+ respectively; $P < 0.001$).

TABLE 2 Mean OR, LB/EL and LT/EJ of R ewes, and relative increases in performance of ++ and F+ B x R ewes compared with R ewes, at 1.5 - 5.5 years of age

Age at joining (years)	Romney			Relative performance of B x R ewes					
				++			F+		
	OR_1	LB/EL_1	LT/EJ_1	A	B	C	A	B	C
1.5	1.14	1.10	0.72	0.11	0.10	0.05	1.28	0.98	0.35
2.5	1.38	1.30	1.00	0.11	0.01	0.08	1.45	1.04	0.63
3.5	1.49	1.35	0.99	0.06	0.14	0.32	1.55	1.13	0.85
4.5	1.55	1.40	0.94	0.10	0.20	0.30	1.41	1.01	0.56
5.5	1.60	1.43	*	0.16	0.15	*	1.55	0.93	*

A = $OR - OR_1$; B = $LB/EL - LB/EL_1$; C = $LT/EJ - LT/EJ_1$
* incomplete data as animals withdrawn for other experiments

DISCUSSION

The reproductive superiority of the F+ B x R over R ewes in LB/EL from 1.5 - 5.5 years of age remained relatively constant at about1 LB/EL, despite their being up to 7 kg lighter than the R ewes. These increases in LB/EL are about 0.2 greater than those recorded in the progeny of Merino ewes mated with Booroola type rams (Davis et al. 1982), but within the 0.7 - 1.0 range of increases in performance that have been recorded on commercial properties (Davis and Meyer 1983).

Higher mean ovulation rates (1.3 - 1.6) of F+ B x R over R ewes were only partially reflected in lambs tailed (0.4 - 0.9). Weaning weight of lambs from F+ ewes was 3.3 kg (s.e. = 0.5 kg) less than for lambs from R ewes, largely due to the higher incidence of multiple born/reared lambs. For efficient commercial utilisation of high fecundity genotypes, penalties in lamb survival and growth need to be minimised. In the present study all genotypes were run as one flock and there was no preferential management to maximise lamb survival and growth. As a consequence the lighter but more prolific F+ B x R ewes had to compete with heavier and less productive R ewes, a situation which may have influenced the differences recorded in lamb production between genotypes. Nutritional management around lambing and through to weaning, as well as preferential treatment of replacement stock will undoubtedly be important components in the utilisation of the F gene in commercial flocks. This is particularly so since the data reported by Davis et al. (1983) suggests that F+ ewes will have more triplet born lambs than recorded in other breeds of similar mean litter sizes.

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REFERENCES

DAVIS, G.H., KELLY, R.W., HANRAHAN, J.P. and ROHLOFF, R.M. (1983). Proc. N.Z. Soc. Anim. Prod. 43 : 25.

DAVIS, G.H. and MEYER, H.H. (1983). Proc. Ruakura Fmrs Conf. 35 : (in press).

DAVIS, G.H., MONTGOMERY, G.W., ALLISON, A.J., KELLY, R.W. and BRAY, A.R. (1982) . N.Z. Jl agric. Res. 25 : 525.

KELLY, R.W., DAVIS, G.H. and ALLISON, A.J. (1980). Proc. Aust. Soc. Anim. Prod. 13 : 413.

PIPER, L.R. and BINDON, B.M. (1982). In "Proceedings of the World Congress on Sheep and Beef Cattle Breeding" Vol. 1, p.395, editors R.A. Barton and W.C. Smith. (The Dunmore Press Ltd, Palmerston North, N.Z.)