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Wool production and other characteristics of progeny from high performance Coopworths x Romney rams

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ABSTRACT

'rom a population of 1270 Coopworth ewe hoggets 70 were selected for high greasy fleece weight (CHFW) at hogget shearing and 50 controls 'ere selected at random (CC).

The CHFW ewes were joined in 1987 and 1988 to sires from a Romney high fleece weight (RHFW) flock, also mated ontemporaneously within that flock. The CC were mated with commercial Coopworth rams. The CHFW and CC flocks were grazed with 'ie RHFW flock and its control (RC). Results for progeny showed that relative to the RC (100) the greasy fleece weight of the RHFW, CC nd RHFW x CHFW were 118, 112 and 125 respectively. Corresponding values for lamb fleece weight were 112, 106 and 121; and for October 12 month) live weight were 106, 109 and 114 respectively. RHFW rams crossed with CHFW ewes generated progeny markedly superior to 'omney and Coopworth controls for greasy fleece weight, showing that appropriate breeding programmes can rapidly improve this trait.

Keywords Coopworth, Romney, fleece weight, live weight, selection, fleece characteristics.

INTRODUCTION

\ high fleece weight breeding and selection flock was stablished at Woodlands Research Station in 1985 rom a population of about 30,000 commercial Romney we hoggets (Hawker and Littlejohn, 1986). Romney igh fleece weight (RHFW) progeny born in 1985 and 986 had hogget greasy fleece weight (GFW) responses of 12 to 28% which were equivalent to an advantage of ! to 3 generations of genetic progress (Hawker, *et al.*, 988). Previous trials (Baker, *et al.*, 1987; Clarke, *et al.*, 1982) have suggested that further additive gains in leece weight are possible by utilizing different breeds. n this experiment Coopworth mixed age ewes were screened on their hogget GFW and then crossbred with RHFW sires with the aim to produce progeny superior for fleece weight and other characteristics.

MATERIALS AND METHODS

Design and Animals

A flock of 70 Coopworth high fleece weight (CHFW) dams were selected from a population of 1270 animals using breeding values (BV) for hogget GFW estimated by best linear unbiased prediction (BLUP) statistical procedures. From the same population a flock of 50 Coopworth control (CC) dams were selected at random after 70 Coopworth ewes with low BV were eliminated.

The CHFW and CC dams were single sire mated to RHFW rams (2 sires per year) and commercial Coopworth rams (5 sires per year; mean BV = + 0.08 kg for fleece weight) respectively, in 1987 and 1988. The sires used for the CHFW dams were mated contemporaneously in the RHFW flock. The resulting Romney x Coopworth progeny (RxCHFW) and control Coopworth progeny (CC) were managed together with the RHFW flock and its associated Romney control (RC) flock for the duration of the trial. After weaning CC ram hoggets were culled while other ram hoggets were transferred to another property.

Measurements

Birth details and pedigree were recorded. Lambs were weaned in December at approximately 70 days of age. Fleece weights were recorded at shearing, for lambs (LFW) in January and for hoggets in October, at 12 months-of-age. Live weights were recorded at weaning (WW), in May and October (SLW). Back fat thickness

TABLE 1 Effect (±SE) and significance of birth/rearing rank on wool production and live weight.

Variable	Birth/rearing rank Single/ single	Twin/ single[1]	Twin/ twin[1]
Number of animals	180	97	587
Lamb fleece weight (kg)	1.27	-0.16 ± 0.03 ***	-0.30 ± 0.02 ***
Hogget fleece weight (kg)	3.23	-0.11 ± 0.05 *	-0.17 ± 0.04 ***
Weaning weight (kg)	23.6	-2.7 ± 0.4 ***	-4.8 ± 0.2 ***
Spring live weight (kg)	43.4	-1.8 ± 0.6 **	-3.1 ± 0.4 ***

[1] Difference from single born and reared.

was measured in May by ultrasonic scanning (Gooden, *et al.*, 1980). All hogget fleece midside samples were measured for washing yield and clean fleece weight calculated (CFW) while those of the RxCHFW and CC lines were also measured for staple length (SL); mean fibre diameter (FD) by sonic fineness tester (Andrews, *et al.*, 1987); staple strength and position of break, by Agritest Staple Breaker (Agsearch/Agritest P/L, Australia); brightness (Y) and yellowness (Y-Z) (Andrews, *et al.*, 1988), and loose wool bulk (Bigham, *et al.*, 1984).

Statistical Analyses

The data were analysed by residual maximum likelihood (REML) procedures. Initial models fitted included year born, sex, birth date, birth/rearing rank, rearing group, sire, age of dam, selection line, and interactions for two factors. Back fat analyses also included live weight in May, ultrasonic scanner operator and their interactions. Non-significant interactions for each variable were eliminated from the final model. Sire and rearing group were fitted as random factors. Selection line comparisons for the variables not measured on the RHFW and RC lines are based on ewe hogget performance only.

RESULTS AND DISCUSSION

Environmental Effects

Birth date and birth/rearing rank (Table 1) significantly affected all live weight and fleece weight measurements, similar to other work (Hawker, *et al.*, 1988). The actual estimated differences in fleece weight and live weight between hoggets born and reared as singles or twins were similar to the results of larger studies with Romneys and Coopworths (Baker, *et al.*, 1974; Elliott *et al.*, 1978) and Border Leicester x Romneys (Hight and Jury, 1971). The effect of birth date on fleece production was also similar to these previous studies. Age of dam effects were significant for the live weights and for LFW, with progeny of 2-tooth dams having 0.12 ± 0.02(SE) kg lighter LFW (at the mean birth date) than those of mixed-age ewes. Birth date regressions for WW and LFW showed that dam age effects were greater for younger lambs. Birth/rearing rank had little effect on fleece characteristics.

Selection Line and Breed Comparisons for Productive Traits

There were major productivity differences between the RxCHFW, CC, RHFW and RC lines (Table 2). Progeny of Coopworth dams had significantly higher ($P<0.001$) live weights and fleece weights than those of Romney dams. Lines selected for high fleece weight also had significantly higher ($P<0.001$) live weights and fleece weights than the control lines, which demonstrates the positive correlated or direct responses in live weights and fleece weights that result from selection for GFW (Johnson and Dobbie, 1987). There was no significant difference between the lines for washing yield and as a result relative differences in GFW were reflected in CFW. The differences between selection lines due to maternal effects are likely to be minor

TABLE 2 Coopworth control (CC), Romney control (RC), Romney x Coopworth high fleece weight (RxCHFW) and Romney high fleece weight (RHFW) selection line means for live weight, back fat thickness, fleece weight and washing yield. The data were obtained from models containing year born, sex, birth date, birth/rearing rank, rearing group, sire, age of dam, selection line, and sex by year of birth interaction.

	Selection Line				
	CC	RC	RxCHFW	RHFW	Average SED
Number of animals	63	187	161	486	
Weaning weight (kg)[2,3]	21.0	20.0	22.4	21.2	0.4
Spring live weight (kg)[3]	42.5	39.0	44.3	41.2	0.8
Adj. back fat thickness (mm)[1]	4.16	4.23	4.40	3.93	0.24
Lamb fleece weight (kg)[2]	1.08	1.02	1.23	1.14	0.03
Hogget GFW (kg)	3.08	2.76	3.45	3.25	0.07
Hogget CFW (kg)	2.15	1.94	2.40	2.27	0.05
Yield (%)	69.7	70.3	69.6	69.8	0.6

[1]Also adjusted for live weight; Males: 0.122 ± 0.012 (SE)mm/kg, Females: 0.198 ± 0.012 mm/kg.
[2]Also adjusted for birth date by age of dam interaction.
[3]Also adjusted for age of dam by breed of dam interaction (averaged over age of dam classes).

because reciprocal crosses between Romneys and Border Leicesters have been shown to be similar (Clarke, 1982).

Back fat thickness was 12% more (P<0.001) in the RxCHFW line than in the RHFW line (when adjusted to the same live weight), but there were no other significant differences between lines for this trait. The reason for this effect is not obvious, and will require further studies involving fleece weight selection with different breeds.

The RxCHFW line had 6% higher (P<0.001) GFW, were 8% heavier (P<0.001) for SLW and 6% heavier (P<0.05) for WW than the RHFW line. The difference between these two lines for LFW was not significant. The ratio of GFW:SLW was similar for these two lines.

The CC line had 12% higher (P<0.001) GFW, 6% higher (P<0.01) LFW, were 9% heavier (P<0.001) for SLW and 5% heavier (P<0.01) for WW than the RC line. As in the high fleece weight lines, the ratio of GFW:SLW was similar for the two control lines. These fleece weight results are at variance with the diallele crossing trial of Clarke, *et al.* (1982) and also with the trial of Hight *et al.* (1976) which suggest that Coopworths would have advantages over Romneys for live weight but not for fleece weight. However more recent experiments (Baker *et al.*, 1987) where strains of Romneys and Coopworths were compared indicate that Coopworths now have an advantage for fleece production as well as live weight, presumably in response to a higher selection pressure on fleece weight by Coopworth breeders in the last 10 years.

The RHFW line had 18% higher (P<0.001) GFW and were 6% heavier (P<0.001) for SLW than the RC line, indicating the higher efficiency of fleece production in the RHFW line. These differences are similar to the results for the previous two years (Hawker *et al.*, 1988) and demonstrate the effectiveness of screening as a method to create a high fleece weight line.

Selection Line Comparisons of Coopworth Fleece Characteristics

Best linear unbiased estimates and differences for the fleece characteristics of Coopworth ewe hoggets are shown in Table 3. Fleece characteristics that showed a significant difference between selection lines were FD (P<0.05) and Y-Z (P<0.05), with the fleeces from the RxCHFW line being 3% coarser and 22% more discoloured. There were no significant differences between lines for staple strength, position of break or loose wool

TABLE 3 Comparison of fleece characteristics of control Coopworth with high fleece weight Romney x Coopworth ewe hoggets. The data were obtained from models containing year born, sex, birth date, birth/rearing rank, rearing group, sire, age of dam, selection line, and sex by year of birth interaction.

Variable	Control	Difference (high-control)	SE	Significance
Staple length (mm)	124	3 (2)[a]	3	NS
Staple strength (N/ktex)	23.6	-0.2 (-1)	2.4	NS
Position of break (%)[b]	65.0	-1.9 (-3)	2.4	NS
Loose wool bulk (cm3/g)	21.8	0.3 (1)	0.4	NS
Fibre diameter (±m)	34.8	1.0 (3)	0.5	*
Brightness (Y)[c]	61.0	-0.2 (0)	0.3	NS
Yellowness (Y-Z)	2.57	0.57 (22)	0.24	*

[a]% difference, relative to controls.

[b]From staple tip.

[c]Also adjusted for selection line x year of birth interaction (averaged over year of birth classes).

bulk.

Johnson and Dobbie (1987) found increases in SL as well as FD for lines selected for high fleece weight. The difference in FD between selection lines was similar to other results (Baker *et al.*, 1987; Hawker *et al.*, 1988). A difference in fibre volume accounted for about 60% of the selection line differences in fleece weight, thus fibre density and wool follicle bearing skin (body size) must have also contributed to the differences.

The higher Y-Z values of the RxCHFW line is consistent with other reports of its genetic and phenotypic relationships with fleece weight (Bigham *et al.*, 1983). There was a significant year of birth x selection line interaction (P<0.001) for Y, with the 1987 and 1988 born RxCHFW line being -1.16 ± 0.58 (SE) units (2%) duller, and 0.75 ± 0.58 units (1%) brighter respectively than the CC line. This is possibly due to a genotype x environment interaction.

Selection Differentials

The results of the RxCHFW line were consistent with the fleece weight genetic differences in its parental lines being additive, apart from any heterosis due to breed differences. The CHFW dams had a BV 0.30kg higher than those of the CC dams. The RHFW flock averaged 0.49kg GFW more than the RC flock over the past four years. The RHFW sires of the RxCHFW progeny had an average breeding value of 0.27kg above the average of the RHFW line. If these effects are additive, this would suggest that the RxCHFW line should produce 0.53kg more fleece than a line of commercial Coopworth x Romneys.

The performance of a hypothetical RC x CC line, taking heterosis into account, can be calculated in two different ways. The first method uses results of Baker *et al.* (1987) whereby Coopworth x Romney hoggets outperformed Romney hoggets by 11% for GFW. Alternatively, crossbreeding trials have shown that the heterosis in Border Leicester x Romney cross is about +8% (Clarke and Meyer, 1982). About half of this effect would be expected to be retained within the Coopworth breed, with half of that retained in a Coopworth x Romney. Thus the Coopworth x Romney would be expected to produce 2% below the mean of the two parental lines. Predicted performance of the hypothetical RC X CC line would be (depending on the method) either 3.06kg or 2.86kg, which would make the RxCHFW line about 3.6kg or 3.4kg, both of which are close to the actual performance of this line.

CONCLUSIONS

Intensive selection for GFW in two different strains may, as the results suggest, be available for exploitation when those strains are crossed, making possible the development of exceptional strains for this trait.

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