SELECTION FOR AND AGAINST WEANING WEIGHT IN MERINO SHEEP

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I. INTRODUCTION

Breeding plans, based on heritability estimates, have been developed for various characteristics in Australian Merino sheep; but there has been no published report of selection for body weight at weaning which is a characteristic that may be important in meat production.

Taneja (1953) calculated theoretical estimates of heritability for weaning weight from correlations between the weaning weight of relatives. The values were low (0.0, 0.15), but the errors were high because of small numbers. Reliable estimates of the heritability of weaning weight are available for the American Rambouillet and allied breeds (e.g. Hazel and Terrill 1945). These estimates range from 0.12 to 0.45 with an average of 0.30.

This paper presents theoretical estimates of heritability for weaning weight in the Australian Merino, obtained from a randomly bred flock. Results from a selection experiment have also been used to estimate realised heritability.

II. MATERIALS AND METHODS

In 195 1 several single-character selection flocks were established at Trangie Agricultural Research Station from a base flock of 1,000 ewes and 150 rams. This base flock was of medium-wool Peppin Merino origin. Each selection flock consists of 100 ewes and five rams. One of these flocks has been selected for high weaning weight and one for low weaning weight. A third flock ("random") of 100 ewes mated to 10 rams, for which replacements are selected at random, has been used as a control.

Data from both the base flock and the random flock were used to calculate the theoretical heritability of weaning weight by dam-offspring and paternal half-sib correlations. The numbers available for each method are given in Table 1.

The "high weaning weight", "low weaning weight" and "random" flocks were mated in March each year. All lambs were grown together and weaned on the same day, but the average age at weaning varied each year from 85 to 168 days according to seasonal conditions. Data covering four generations were analysed up to and including that for the 1961 "drop"†

Sexes were examined separately. All weaning weights were individually adjusted to the average weaning age of the drop, using the weight per day of age. For each year, correction factors for age of dam and type of birth (single or twin)

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†All lambs born in a particular year are referred to as the "drop" of that year.

TABLE 1

Realised and estimated heritabilities of weaning weight

METHOD	EWES			RAMS		
	Heritability	Fiducial Limits (P = 0.05)		Heritability	Fiducial Limits (P = 0.05)	
Realised (Divergence)	0.31	0.20	0.41	0.19	0.01	0.27
Dam-offspring correlation	0.28	0.09	0.48	0.32	0.11	0.53
Half-sib correlation	0.16	0.02	0.30	0.15	—0.07	0.52
Numbers:						
Dam-offspring	436 pairs			377 pairs		
Half-sib	80 sires, 1,052 lambs			35 sires, 329 lambs		

were calculated using data from the random flock. The former proved to be unimportant and were not applied.

In each year cumulated responses to selection were measured as the differences between the mean weaning weight of the selection flocks and the mean weaning weight of the random flock. To overcome the effects of season and of variations in the average age at weaning, these responses and the selection differentials described below, were expressed as a percentage of the mean weaning weight of the random flock in the same year.

The calculation of cumulated selection differentials was complicated by overlapping generations and variations in fertility. To overcome these difficulties an "individual cumulated selection differential" was calculated for every animal producing off spring. Firstly an individual selection differential was calculated for each animal in a drop; this was the difference between the weaning weight of the animal concerned and the mean weaning weight of its "drop" in the same selection flock. This figure was expressed as a percentage of the mean weaning weight of the random flock born in the same year. The individual selection differential for each animal was then added to the average of the individual cumulated selection differentials of its parents.

The cumulated selection differential corresponding to the cumulated response of any "drop" in a selection flock was then calculated as the average of the individual cumulated selection differentials of all parents contributing offspring to that drop.

Cumulated responses for the divergence between the two flocks were obtained in each year by adding the cumulated response for the high weaning weight flock to that for the low weaning weight flock. A similar procedure was used to obtain the cumulated selection differential for divergence.

Realised heritabilities were then calculated as the regression of cumulated response on cumulated selection differential for the four generations of selection (Falconer 1960). These estimates were calculated for the high and low weaning weight flocks and for the divergence between the two flocks. The latter was calculated as a pooled heritability for comparison with theoretical estimates which apply to variation both above and below the population mean.

III. RESULTS AND DISCUSSION

Table 1 presents the heritability estimated by two methods from the base and random flocks, and the realised heritability estimated from the divergence between the two selected flocks. As indicated by the fiducial limits there are no significant differences among the six estimates shown.

Figure 1 shows the realised heritabilities for high and low weaning weight for ewes and rams. The realised heritability for high weaning weight with ewes was significantly $(P<0.05)$ greater than with rams.

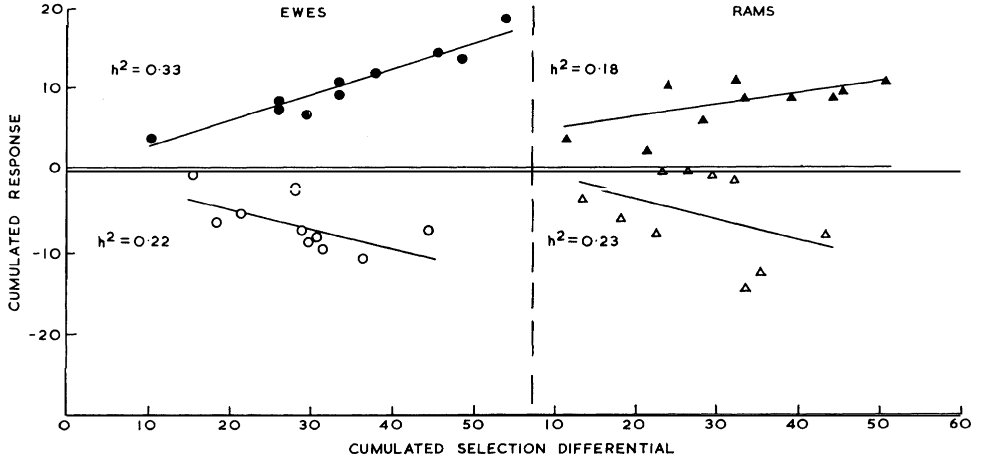

Fig. 1.—Responses to selection, and realised heritabilities for high and low weaning weight in both ewes and rams. Each point represents the mean of one drop.

As judged by the realised heritabilities, responses to selection for weaning weight would have been within the range of predictions based on the theoretical heritability estimates. The best estimate of the heritability for use in formulating breeding plans would be the average, 0.23, of estimates calculated by the two methods. This value indicates that moderate response would occur following simple mass selection for weaning weight. However with half-sib families of 20 to 30 lambs, which occur with sheep, the formulae given by Falconer (1960, p. 235) shows that a 15 to 20% improvement in response, above that possible from mass selection, would occur if selection were based on an index combining both individual and half-sib family records.

The significantly lower response to selection for high weaning weight in rams is difficult to explain from the limited data, as there were no sex differences in the heritabilities calculated by variance analyses. Furthermore no information is available on this point as in the published estimates of heritability of weaning weight, data for males and females have been corrected to a common level or only females have been considered.

IV. ACKNOWLEDGMENTS

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