EVALUATION OF SKIN CHARACTERISTICS AS EARLY SELECTION CRITERIA IN MERINO SHEEP

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INTRODUCTION

The design and development of genetic improvement programs for the Merino requires accurate estimates of phenotypic and genetic parameters for the characters used as selection criteria and genetic correlations between the selection criteria and the traits in the breeding objective.

In a review of genetic parameters for Australian Merinos, Mortimer (1987) concluded that if variability of published estimates reflects true differences between strains and environments, then different correlations and heritabilities may need to be utilised for each strain in developing Merino improvement programs such as WOOLPLAN.

BACKGROUND TO EXPERIMENT

Current industry practice in South Australian ram breeding flocks is to initially performance record rams at 10-12 months of age with 6-7 months of wool growth. Most of the genetic parameter estimates available for Australian Merino sheep have been obtained from flocks in which estimates were made at 15-16 months of age with 12 months wool growth (Mortimer, 1987). Recently Atkins and Mortimer (1987) reported that the genetic correlations between hogget and adult fleece weights were less than unity and the heritability of adult fleece weight was higher than that at the hogget age. Mortimer (1987) argues that at even earlier ages (9 to 10 months of age, 6 months wool growth) the heritability and genetic correlations may be even lower.

The rate of genetic improvement in commercial flocks is determined by the selection and breeding policies adopted by studs (McGuirk, 1976). Thus it is essential that breeding programs implemented in studs, aimed at genetically improving the commercial South Australian Merino, are based on accurate genetic parameters obtained at ages which reflect stud industry practice. Specifically the correlations between ram performance at 10 months and 16 months with 6 months wool growth and lifetime performance of their daughters are required for sheep representative of leading South Australian Merino studs.

TURRETFIELD MERINO RESOURCE FLOCK

A base flock of 2000 South Australian Merino ewes representative of the Collinsville and Bungaree family groups has been established at Turretfield Research Centre. For each family group, the base flock ewes were purchased from two studs, chosen on the basis of their impact as ram sellers in the industry.

The Bungaree family group is represented by 'East Bungaree' and 'Anama' with 'Collinsville' and 'Southrose' covering the Collinsville family.

Each year, twelve sires selected from each of the four studs will be single sire mated, on a within-stud basis, to approximately 40 randomly allocated base ewes.

The sire selection procedures used will depend on information available in the individual studs. A random selection of rams will be obtained from those performance tested at 10 to 12 months of age or from rams in various price grades established by the stud master.

The management program for the flock will reflect as far as practicable current South Australian stud Merino industry practices. Mating will commence in early November and following a weaner shearing the performance of experimental ram progeny will be recorded at 10 months and 16 months of age respectively. Experimental ewe progeny will be performance recorded at approximately 16 months of age with 12 months wool growth.

The experimental rams will be sold after assessment at 16 months of age while all the experimental ewes will be retained until their fourth adult shearing.

PRODUCTION RECORDS

Pedigree information will be recorded on all experimental progeny. At 10 and 16 months of age liveweight, greasy fleece weight, yield, clean fleece weight, fibre diameter, testicular size and a series of visual fleece characteristics will be recorded in the experimental rams.

The same production records, testes size excepted, will be recorded in experimental ewes initially at 16 months and then for a further three adult shearings. Pregnancy status, foetal number, number of lambs born, birth weight, number of lambs weaned and weaning weight constitute the components of reproductive performance which will be observed on experimental ewes each year.

The experimental sheep will also be used to assess the potential of skin characteristics as indirect selection criteria. The sampling procedures and observations are detailed in the next section.

SKIN ANALYSIS AS AN AID TO SELECTION OF WOOL-PRODUCING SHEEP

The breeding flocks described above represent an ideal resource for the evaluation of skin characters as early-selection criteria for wool-producing sheep. There are two main reasons for using skin characters as indirect selection criteria; first, skin analysis may identify superior genotypes more accurately than fleece measurement at a very early age; and second, combining skin analysis with fleece measurement at later ages (eg. 12-24 months), may be superior to fleece measurement alone. A previous investigation of skin characters such as follicle depth, curvature, density and S/P ratio indicated these characters were moderately heritable (0.40), and reasonably repeatable (0.5-0.7) with age (Jackson et al. 1975). Together these four characters accounted for 83% of the genetic variance in clean wool weight (CWW) in Peppin Merinos. However, single-character selection lines based on these follicle characters failed to increase CWW, suggesting there were compensating, antagonistic changes in other follicle characters (Davis and McGuirk 1987). It is clear from these results that single character selection is unlikely to be successful. This is hardly surprising considering the complexity of the follicle system but which combination of skin characters does relate to the quantity and quality of wool produced?

The amount of fibre produced by an individual follicle is largely a function of the size of the germinative region of the follicle bulb (r=0.87, Hynd unpubl.), so it is likely that the volume of fibre produced per unit area of skin is a function of the total volume of bulb material in that area. This, in turn, is a function of mean bulb volume and follicle density, but these are negatively related, so the amount of wool produced per area of skin tends to be relatively constant (ie. independent of bulb size and density), in line with the follicle competition theory (Fraser 1951). However the relationships are imprecise so there are some sheep which have relatively larger bulbs than their counterparts with similar follicle densities. It is these individuals which we believe will produce more wool per area of skin, and hence have higher CWW (Williams 1987). The "quality" or "style" of a fleece would then be determined by the way that extra follicle tissue is distributed in the skin (ie. in a few very large bulbs, or in many small bulbs, or in bulbs varying widely in size, etc.). Because the two criteria (bulb size and density) are antagonistic, the rate of genetic change achieved by selection of sheep with the highest total bulb volume per unit area of skin, will be slow, but probably no more so than is the case when high fleece weight and low fibre diameter are the breeding objectives. In fact it could well be that selection for high CWW and low diameter (D) is actually selecting for high bulb volume per area of skin (low D is consistent with high follicle density and selection for high CWW would then tend to maximise bulb volume at that density). If this hypothesis proves to be correct, it may be possible to select sheep of this type at a very young age using skin analysis.

The hypothesis will be tested by skin sampling all the progeny in the resource flock at weaning, 10 months and 16 months of age (ewes will also be sampled as adults). In addition to follicle density and average bulb size, other skin characters including thickness (measured as the weight of the skin biopsy sample), production ratio (Butler and Wilkinson, 1979) and the relative proportions of ortho- and para-cortex in the fibre will be measured and the genetic parameters estimated. The shape of the follicle bulb and the dermal papilla will also be measured because there are indications that fibre shape (length/diameter) is closely related to bulb shape (Hynd, unpublished).

In conclusion, we believe skin analysis of stud rams, particularly at a young age, may be a useful aid to selection, in conjunction with visual assessment and objective fleece measurement. The concept of total bulb volume and its pattern of distribution in the skin, as the major determinants of fibre quantity and quality, is a novel way of approaching wool biology and sheep selection.

FUTURE WORK

Mortimer (1987) stated that the need for genetic parameter estimates for wool quality traits becomes more acute as developments in the type and availability of measurement information for the marketing of greasy wool occur.

Funds are being sought to enable genetic parameter estimates for staple length and strength, scoured colour, resistance to compression and variability of fibre diameter and length to be made. In addition to these characters which are important in processing performance of wool it is intended to include dust penetration, tip structure and wax and suint which are associated with fleece protection.

As noted earlier the sub-division of the Australian Merino into bloodlines within strains may prevent the wide-spread use of a standard set of genetic parameters for designing breeding programs. The genetic parameters estimated for the South Australian Merino for production, wool quality and skin characters in this project should ensure that accurate breeding values are estimated in performance recording schemes such as WOOLPLAN for this strain.

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