# SKIN AND FOLLICLE CHARACTERS I. HERITABILITIES AND CORRELATIONS AMONG THEM

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## SUMMARY

Heritabilities, phenotypic correlations and genetic correlations were estimated in South Australian Merinos for the following skin and follicle characters: skin biopsy weight, follicle density, mean bulb area, total bulb area, standard deviation of mean bulb area, coefficient of variation of mean bulb area, paracortex percentage, fibre area, standard deviation of fibre area, and skin quality. Generally heritabilities were low to moderate, the greatest values being for fibre area (0.45), skin quality (0.36) and paracortex percentage (0.33). The strongest genetic associations were between skin biopsy weight and follicle density (-0.74), follicle density and total bulb area (0.72), follicle density and the standard deviation of fibre area (-0.53), the standard deviation of mean bulb area and the standard deviation of fibre area (0.53) and skin biopsy weight and the standard deviation of fibre area (0.51). The implications of these findings are discussed.

**Keywords:** Skin, follicles, heritability, correlations.

## INTRODUCTION

The potential for using skin and follicle characters as indirect selection criteria for Merino sheep has long been recognised by sheep breeders and researchers. The emphasis is well placed as it is the skin that nourishes and supports the massive population of follicles, and it is the follicle that provides all the cells forming the fibre. Evaluating the potential of introducing skin characters into a genetic improvement program for the South Australian Merino requires accurate estimates of phenotypic and genetic parameters for the characters used as selection criteria and for the traits in the breeding objective. In this paper we present heritabilities for, and correlations among, a number of skin and follicle characters. In Part II we present correlations with objectively measured and subjectively assessed wool characters.

## MATERIALS AND METHODS

**Location and sheep.** A resource flock of 2000 South Australian Merino strain ewes representative of the Bungaree and Collinsville family groups was established at the Turretfield Research Centre (South Australian Research and Development Institute) in 1988 (Gifford *et al.* 1993, Ponzoni *et al.* 1995). The results presented in this paper are from 1800 young rams born over 3 years (1990,1991 and 1992), offspring of 140 sires.

**Management and records.** Mating took place over an eight week period in Nov-Dec, on a single-sire, within stud basis. Lambs were born in April-May and weaned at an average age of 13 weeks in early August. For each experimental lamb born, the identity and age of dam, the date of birth,

the type of birth and of rearing, as well as all management details were recorded. Skin quality (SQ) was subjectively assessed by a professional sheep classer prior to shearing at 10 months of age (Gifford *et al.* 1993).

**Skin measurements.** After shearing at 10 months of age, the experimental rams were skin sampled. Four skin biopsies were taken from the midside of each experimental ram using the trephine method. The skin samples were then placed in 10 ml of 10 per cent buffered formalin in labelled plastic vials. The skin and follicle characters studied are listed in Table 1. Details on the sample collection, preparation and analysis are given by Hynd *et al.* (1996).

**Analyses.** Phenotypic and genetic parameters were estimated by fitting a sire model to the data. The mathematical model included the fixed effects of year of birth, stud, age of dam and type of birth and rearing class. Day of birth of the individual was fitted as a linear covariate. Sires were treated as a random effect nested within year of birth and stud. Variance and covariance components were calculated by restricted maximum likelihood using PROC Mixed in SAS (1992). Preliminary analyses included two way interactions among the above mentioned fixed effects. However most were deleted from the model as they were non-significant.

## RESULTS AND DISCUSSION

Table 1 shows the means, ranges and standard deviations for each of the skin and follicle characters. There was considerable variation for all characters. Table 1 also shows that the heritabilities of most of the skin and follicle characters were low or moderate. The exceptions were paracortex percentage, fibre area and skin quality which may be classified as having a moderate to high heritability. The heritability value calculated for follicle density was similar to that reported by Skerritt (1995), but lower than that reported by Purvis and Swan (1997).

Table 2 shows that generally, the phenotypic correlations were very low to low, but there were some exceptions. Follicle density was highly correlated with total bulb area, and mean, total and standard deviation of bulb area were moderately to highly correlated with each other. The average and standard deviation of fibre area were moderately correlated.

The genetic correlations were estimated with moderate accuracy, the standard errors ranging form 0.036 to 0.272. Skin biopsy weight had a high negative correlation with follicle density, and it was moderately correlated with total bulb area and standard deviation of fibre area. The very low correlation between skin biopsy weight and classer assessed skin quality suggests that they are totally different traits. Follicle density had a high correlation with total bulb area, and a moderate one with paracortex percentage, fibre area and fibre area standard deviation. Mean bulb area had a high correlation with total bulb area and a very high correlation with bulb standard deviation, whereas total bulb area had a moderate correlation with the standard deviation and with the coefficient of variation of bulb area. The standard deviation of fibre area had a moderate correlation with average fibre area and with the standard deviation of bulb area. All other genetic correlations were either low or very low.

**Table 1.Means, ranges, phenotypic standard deviations ($\sigma_p$) and heritabilities ($h^2$ (se)) for skin characters measured at 10 months**

| SKIN CHARACTERS | MEAN | RANGE | | $\sigma_p$ | $h^2$ (se) |
|---|---|---|---|---|---|
| | | min | max | | |
| Skin Weight (SW), g/4 biopsies | 0.61 | 0.24 | 1.13 | 0.11 | 0.17 (0.058) |
| Follicle Density (DE), follicles/10.6mm$^2$ | 70.0 | 23.0 | 172.0 | 17.0 | 0.18 (0.060) |
| Mean Bulb Area (MBA), $\mu m^2 * 10^{-2}$/follicles | 35.7 | 9.7 | 73.4 | 6.9 | 0.25 (0.065) |
| Total Bulb Area (TBA), $\mu m^2 * 10^{-4}$/10.6mm$^2$ | 25.0 | 4.1 | 67.1 | 7.7 | 0.26 (0.065) |
| Standard Deviation of MBA (BSD),$\mu m^2 * 10^{-2}$ | 16.6 | 6.0 | 40.2 | 3.6 | 0.22 (0.061) |
| Coefficient of variation MBA (BCV), % | 47.7 | 25.0 | 98.0 | 7.7 | 0.09 (0.048) |
| Paracortex Percentage (PC), % | 25.0 | 5.9 | 49.6 | 5.0 | 0.33 (0.072) |
| Fibre Area (FA), $\mu m^2$ | 370.0 | 162.0 | 771.0 | 64.6 | 0.45 (0.082) |
| Standard Deviation of FA (FASD), $\mu m^2$ | 103.0 | 43.0 | 312.0 | 28.9 | 0.25 (0.065) |
| Skin Quality (SQ), subj.score 1-5 | 2.83 | 1 | 5 | 0.76 | 0.36 (0.073) |

**Table 2 Phenotypic (above diagonal) and genetic (below diagonal) correlations between skin and follicle characters, measured at 10 months**

| | SW | DE | MBA | TBA | BSD | BCV | PC | FA | FASD | SQ |
|---|---|---|---|---|---|---|---|---|---|---|
| SW | | -0.04 | 0.07 | 0.01 | 0.05 | -0.02 | 0.13 | 0.18 | 0.12 | 0.05 |
| DE | -0.74 | | 0.03 | 0.77 | 0.12 | 0.12 | -0.10 | -0.17 | -0.10 | 0.07 |
| MBA | 0.02 | 0.03 | | 0.61 | 0.76 | -0.25 | 0.03 | 0.22 | 0.14 | -0.03 |
| TBA | -0.44 | 0.72 | 0.71 | | 0.53 | -0.07 | -0.06 | -0.01 | -0.01 | 0.04 |
| BSD | 0.11 | -0.23 | 0.90 | 0.40 | | 0.39 | -0.00 | 0.15 | 0.17 | -0.06 |
| BCV | 0.01 | -0.32 | -0.25 | -0.46 | 0.19 | | -0.04 | -0.06 | 0.05 | -0.03 |
| PC | 0.05 | -0.40 | 0.02 | -0.31 | 0.02 | 0.07 | | 0.08 | 0.09 | 0.01 |
| FA | 0.37 | -0.43 | 0.25 | -0.14 | 0.23 | -0.16 | 0.09 | | 0.47 | 0.01 |
| FASD | 0.51 | -0.53 | 0.35 | -0.16 | 0.53 | 0.21 | 0.41 | 0.56 | | 0.05 |
| SQ | -0.07 | 0.34 | -0.13 | 0.22 | -0.32 | -0.38 | -0.27 | 0.07 | 0.12 | |

## CONCLUDING REMARKS

Paracortex percentage, fibre area and classer assessed skin quality had the highest heritability values among the skin characters studied. Of the correlations studied, those involving follicle density appear to be of greatest significance. If confirmed, they would indicate that follicle density is moderately to highly correlated genetically with skin biopsy weight, total bulb area, paracortex percentage, fibre area and standard deviation of fibre area (note that the latter two variables are strongly related to fibre diameter). While the observed associations among the skin characters studied are of biological interest, from a practical point of view, the association between skin characters and economically important wool traits is what matters most. This aspect is dealt with in Part II of this paper (these Proceedings).

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