# Genetic Relationships Among Fibre Diameter Measures At Different Ages In A Fine Wool Merino Stud

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## Introduction

Fibre diameter is one the most important factors influencing wool price (Erasmus and Delport, 1987). This fact and the subsequent price premium for fibre diameter have lead to the emphasis being shifted to selection for decreased fibre diameter in the wool industry of South Africa. In some flocks, it is the only selection objective regardless of the impact on the other traits. Selection for a reduced fibre diameter is exercised at performance testing age and in most flocks no or little attention is given to the fibre diameter of the adult ewe flock. This selection procedure is practiced despite the fact that a large portion of the total wool clip marketed by wool producers is produced by the adult ewes. Therefore, the aim of this study was to quantify the genetic relationship among fibre diameter measures at different ages in a fine wool Merino stud in South Africa.

## Material and methods

Data description. The Cradock Fine Wool Merino Stud was established in 1988 as described by Olivier *et al*. (2006). Ewes (fine wool line) were bought from Merino farmers with the finest clips throughout South Africa and four fine wool rams were imported from Australia. A second group of ewes (strong x fine wool line) originating from the strong wool Merino flock at Cradock was run together with the fine wool line and were also mated to the same sires (Olivier, 2009). Data collected on 1176 adult ewes from the Cradock Fine wool Merino stud from 1988 to 2003 were used for this analysis.

Statistical analyses. The means and standard deviations for the fibre diameters were obtained with the PROC MEANS-procedure of SAS, and significance levels for the fixed effects were obtained with the PDIFF-option under the PROC GLM-procedure of SAS (SAS, 2006). Fibre diameter was measured on 6 (FD6), 15 (FD15), 22 (FD22), 34 (FD34), 46 (FD46), 58 (FD58), 70 (FD70), 82 (FD82) and 94 (FD94) months of age, and only data from ewes which have records of the first four measurements were included in the analysis.

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Several fixed effects (year of birth, line (fine or strong x fine), rearing status, age of the dam in years and age at measurement in months as a linear regression) were tested and only effects which had a significant effect (P<0.01) were included in the final operational model.

The estimation of the genetic parameters with repeatability and random regression models were done with ASREML (Gilmour *et al.*, 2009). Log likelihood ratio tests were done to determine the most suitable model for the estimation of (co)variance components and the most suitable model included only the direct additive genetic variance. The polynomial for age of measurement at level 1 was included in the random regression model.

## Results and discussion

The number of records, mean, coefficients of variation, standard errors, minima and maxima of the different fibre diameter measures are presented in Table 1. It is evident from Table 1 that the mean fibre diameter range from 17.8µm (FD6) to 20.3 µm (FD70). The high maximum fibre diameter measurements were recorded on the early progeny of the fine x strong line.

**Table 1: The number of records (n), mean, coefficient of variation (CV), standard error (SE), minimum and maximum of the different fibre diameter measures**

| Traits | n | Mean (µm) | CV (%) | SE (µm) | Minimum (µm) | Maximum (µm) |
|---|---|---|---|---|---|---|
| **FD6** | 1176 | 17.77 | 6.71 | 0.03 | 14.50 | 22.30 |
| **FD15** | 1176 | 18.98 | 7.15 | 0.04 | 14.50 | 24.70 |
| **FD22** | 1177 | 19.48 | 7.01 | 0.04 | 14.60 | 25.10 |
| **FD34** | 1177 | 19.58 | 7.42 | 0.04 | 15.90 | 28.90 |
| **FD46** | 957 | 19.91 | 7.22 | 0.05 | 15.60 | 28.70 |
| **FD58** | 646 | 19.98 | 7.16 | 0.06 | 16.20 | 27.70 |
| **FD70** | 425 | 20.28 | 7.08 | 0.07 | 16.00 | 25.70 |
| **FD82** | 252 | 20.03 | 6.94 | 0.09 | 16.20 | 24.50 |
| **FD94** | 50 | 19.57 | 6.56 | 0.18 | 16.50 | 22.60 |

Estimates of the heritabilities of fibre diameter at the different ages are illustrated in Figure 1 and the genetic correlations among the age-specific fibre diameter measurements are presented in Table 2. The heritability estimates ranged from 0.37 at 6-months of age to 0.86 at 94-months of age and the heritability of fibre diameter in a repeatability model (fitting only the intercept) amounted to 0.50.

It is evident from Figure 1 that the heritability of fibre diameter increased with age. A likely explanation is that lambs and hoggets are possibly still concentrating on growing (body size) not wool yield. Later in life, given adequate nutrtion, their genetic potential for fibre diameter may be expressed better. It can also be ascribed to some extent to the increase in the available genetic information on an individual with age. Therefore, the influence of the genetic makeup on the phenotype of an animal increases with age. The heritability estimates (point estimates) reported in the literature for adult fibre diameter range from 0.62 to 0.76

(Coelli *et al.,* 1998; Lee *et a.,* 2002; Cloete *et al.,* 2003). These estimates for 22 to 70-months of age falls within the reported range, while the heritability at 82 and 94 months of age are higher than the reported values.

It is evident from Table 2 that the genetic correlations among the fibre diameters at different ages range from 0.73 (between FD6 and FD94) and unity (between FD82 and FD94). The genetic correlations among fibre diameters at different ages reported in the literature ranged from 0.82 to 0.96 (Hickson *et al.,* 1994; Coelli *et al.,* 1998). The values estimated in this study correspond with the reported values. Furthermore, it is evident from Table 2 that the genetic correlations between fibre diameters were inversely proportional to the time lapse between measurements.

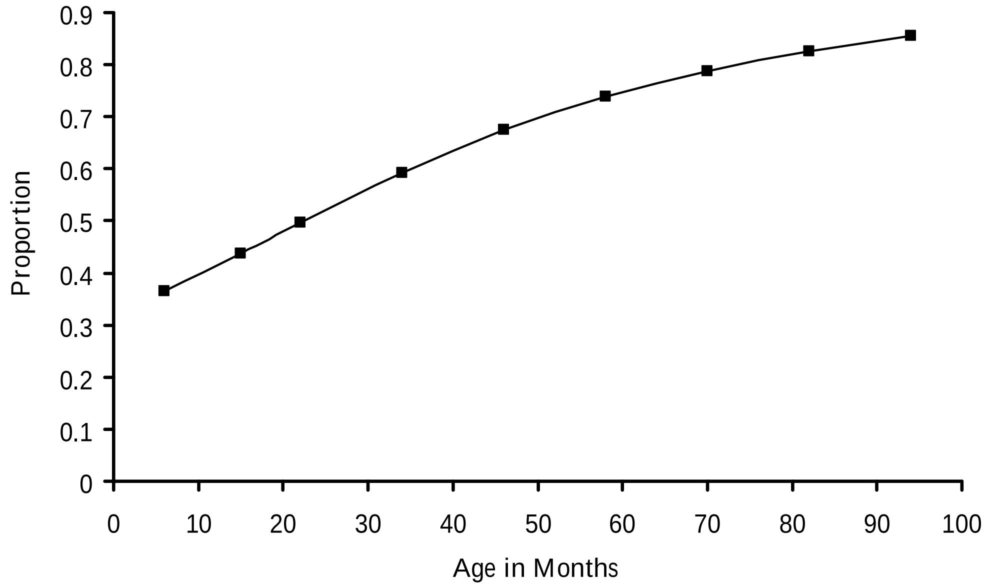


Figure 1: Heritability estimates for fibre diameter of Merino ewes at the different ages

**Table 2: Estimated genetic correlations among the fibre diameter measures**

| Traits | FD15 | FD22 | FD34 | FD46 | FD58 | FD70 | FD82 | FD94 |
|---|---|---|---|---|---|---|---|---|
| **FD6** | 0.9809 | 0.9518 | 0.8974 | 0.8489 | 0.8088 | 0.7763 | 0.7497 | 0.7278 |
| **FD15** | | 0.9933 | 0.9661 | 0.9354 | 0.9077 | 0.8840 | 0.8641 | 0.8472 |
| **FD22** | | | 0.9895 | 0.9701 | 0.9502 | 0.9322 | 0.9165 | 0.9030 |
| **FD34** | | | | 0.9950 | 0.9853 | 0.9748 | 0.9648 | 0.9557 |
| **FD46** | | | | | 0.9974 | 0.9922 | 0.9862 | 0.9803 |
| **FD58** | | | | | | 0.9986 | 0.9955 | 0.9919 |
| **FD70** | | | | | | | 0.9992 | 0.9973 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **FD82** | | | | | | | | 0.9995 |

## Conclusions

It can be concluded from this study that the heritability of fibre diameter increased with age, while the genetic relationships decreases in strength among fibre diameter measures with increasing age. The high genetic correlations among fibre diameter at 15 months of age, which is performance testing age for Merino sheep in South Africa, and adult fibre diameter measures, indicate that selection for decreased fibre diameter at 15 months will have a favorable effect on the fibre diameter of adult ewes.

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