Is it possible to decrease fibre diameter without compromising other economically important traits?

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Introduction

During the 1950's and 1960's much emphasis was placed on the selection for the amount of wool produced. This resulted in a decrease in the proportion of fine wool (20 μm and finer) in the national clip from 69% in 1951/55 to only 4 % in 1976/80 (Marx, 1981). There was a shift in the demand for finer wool during the 1980's and early 1990's. This increase in the demand of finer wool resulted in a huge price premium paid for finer wool types during this period. These facts lead a shift in the emphasis in wool production towards the production of fine wool, rather than simply the amount of wool. The proportion of fine wool in the national clip had since then increased to 24 % in 2005/06 (Cape Wools SA, Personal communication, 2007).

Consequently, the number of flocks in South Africa where selection for decreased fibre diameter was practiced increased markedly. In other words, selection for decreased fibre diameter was an important selection objective for many producers. In some instances it was even the only objective, regardless of the effect on the other production traits. The price premium that was paid for the finer wool types was in some cases the end goal of producers, as it would lead to increased profitability.

It is, however, important to maintain a balance between the economically important traits. This is particularly true in South Africa, where meat production contributes more than 75% of the farm income of Merino farmers. The purpose of this study was therefore to evaluate the effect of selection for decreased fibre diameter on production and subjective traits.

Materials and methods

- **Data**
  Data collected on 5820 ram and ewe hoggets of the Grootfontein Merino stud (GM) from 1985 to 2003 and 6127 ram and ewe hoggets of the Cradock fine wool Merino stud (CM) from 1988 to 2004 was used in this study. Detailed descriptions of the management and selection procedures followed in these flocks have been reported for the Grootfontein Merino stud (Olivier, 1989) and for the Cradock fine wool Merino stud (Olivier et al., 2006). The hogget production traits analyzed included 15-month age body weight (BW), clean fleece weight (CFW), mean fibre diameter (MFD) and staple length (STPL). The subjective traits assessed on a linear scale from 1 to 50 were wool quality (QUAL), variation over the fleece (VAR), staple formation (STAP), conformation of the front quarters (FQRT) and overall body conformation (CONF) (Olivier et al., 1987).

- **Statistical analyses**
  The significance levels for the fixed effects were obtained with the PDIFF-option under the PROC GLM-procedure of SAS (Littell et al., 2002). Several fixed effects (year of birth, sex, rearing status and age of dam in years, as well as the hogget age as a linear regression) were tested. Only effects and interactions which had a significant effect ($P < 0.01$) on a specific trait were included in the final model.

The estimation of the genetic parameters and breeding values were done with ASREML (Gilmour et al., 2002). Log likelihood ratio tests were done to determine the most suitable model for the estimation of (co) variance components for each trait. The most suitable model for BW and CFW included both the direct additive genetic variance and the maternal additive genetic variance. For MFD, the direct additive genetic variance and the maternal permanent environmental variance were included in the model. Only the direct additive genetic variance was included in the models for STPL, QUAL, VAR, STAP, FQRT and CONF. The genetic trends for the respective traits were obtained from univariate analyses.

Results and discussion

The genetic trends of the traits analysed are depicted in Figures 1, 2 and 3 for the Cradock fine wool Merino stud and Figures 4, 5 and 6 for the Grootfontein Merino stud. The genetic trends and R^2 values are summarized in Table 1 for both studs.

Table 1. The genetic trends and R^2 values of both studs

	Cradock fine wool Merino stud		Grootfontein Merino stud	
	Trend	R^2	Trend	R^2
MFD	-0.09	0.80	-0.08	0.92
CFW	0.08	0.80	0.02	0.22
STPL	0.11	0.85	0.01	0.11
QUAL	0.13	0.96	0.09	0.87
VAR	0.08	0.59	0.05	0.66
STAP	-0.00	0.00	-0.02	0.26
BW	0.13	0.94	0.09	0.86
FQRT	0.12	0.94	0.09	0.84
CONF	0.14	0.94	0.10	0.84

It is evident from Table 1 and Figure 1 that the genetic trend for MFD was negative in CM. Furthermore, it is evident from Figure 1 that there was only a slight decrease in MFD from 1988 until 1996. This was due to the fact that the animals were small with poor conformation; therefore, more emphasis was placed on BW than on MFD during the first few years. Since 1997, more selection emphasis was placed on MFD, as the BW and conformation of the animals had improved.

In 1985 the selection objectives in the GM were changed to selection based on breeding values of economically important traits. It is evident from Table 1 and Figure 4 that fibre diameter steadily decreased over the 18 year period. This was achieved by placing more emphasis on fibre diameter from the start rather than body weight and conformation which was at a satisfactory level, compared to CM.

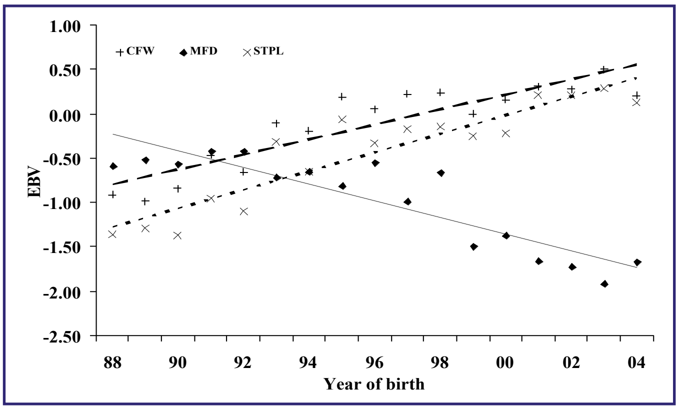

Figure 1. *Genetic trends of MFD, CFW and STPL of the Cradock fine wool Merino stud*

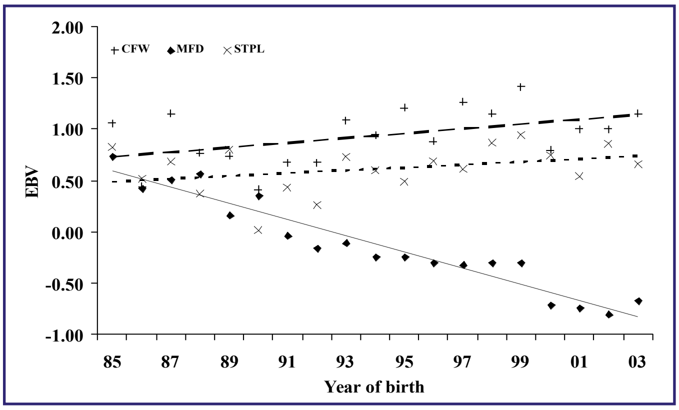

Figure 4. *Genetic trends of MFD, CFW and STPL of the Grootfontein Merino stud*

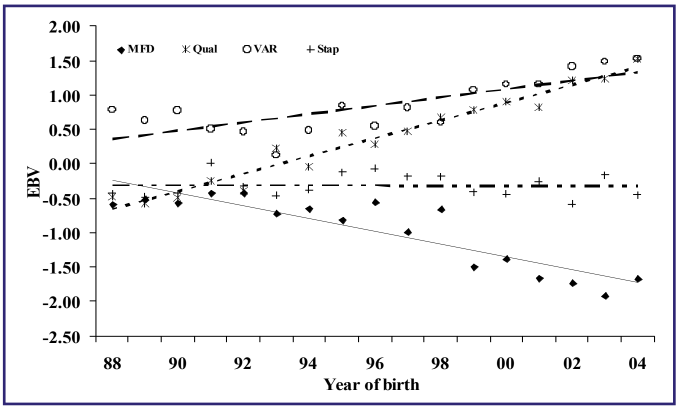

Figure 2. *Genetic trends of MFD, QUAL, VAR and STAP of the Cradock fine wool Merino stud*

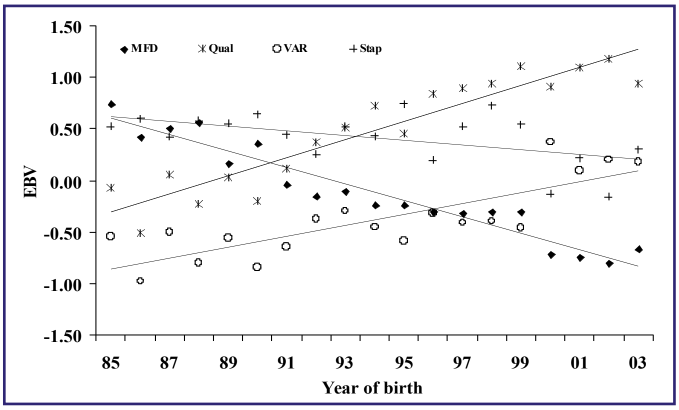

Figure 5. Genetic trends of MFD, QUAL, VAR and STAP of the Grootfontein Merino stud

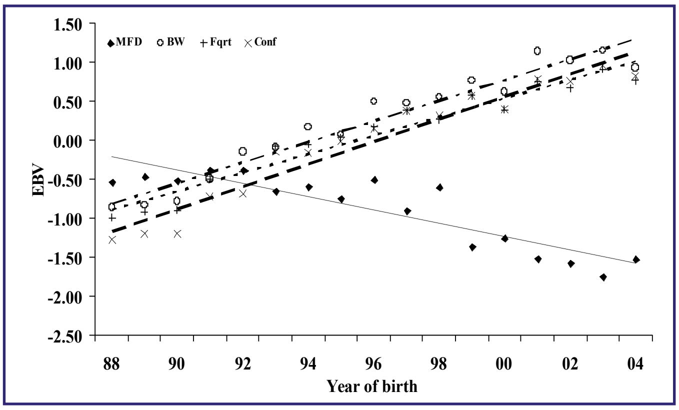

Figure 3. *Genetic trends of MFD, BW and the conformation traits of the Cradock fine wool Merino stud*

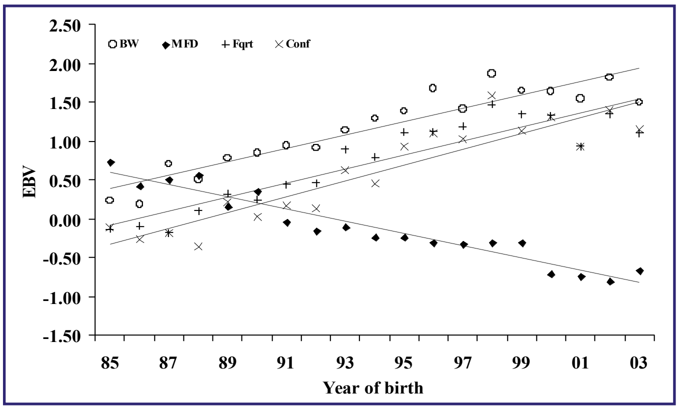

Figure 6. *Genetic trends of MFD, BW and the conformation traits of the Grootfontein Merino stud*

It is however important to realise that unfavourable genetic correlations (r_G) exist between fibre diameter and the other economically important traits (Olivier et al., 2006). Of particular importance are the unfavourable r_G between fibre diameter and body weight, clean fleece weight and staple length reported by several authors (Safari et al., 2005; Swan et al., 1995; Purvis & Swan, 1997) Nonetheless, genetic change in BW, FQRT, CONF, CFW, STPL and QUAL were in the desired direction in both studs. Staple formation in CM remains constant, while there was a slight decrease in the staple formation in the GM.

It is evident from the results of this study that the breeding objectives of these studs, namely, to increase BW and STPL, to maintain CFW and to decrease MFD, were largely achieved. This was done despite the existence of unfavourable genetic correlations between MFD and the other traits and was achieved through the use of estimated breeding values. The use of estimated breeding values made it possible to select the bigger and finer animals as replacement animals and consequently increasing body weight and decreasing fibre diameter of the next generation.

Conclusions

It can therefore be concluded that it is possible to decrease fibre diameter without compromising other economically important traits. However, it is important to note that the other traits must be included in the breeding objectives, or monitored to detect possible unwanted correlated changes early.