

Genetic trends for fleece traits and body weights in South African Angora goats

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Abstract

South Africa is considered the most reliable producer of a good quality clip of mohair worldwide, and produces approximately half of the world product annually. Mohair traits include production and quality traits with fibre diameter being the most important economically. Genetic parameters estimated for the South African Angora goat population indicated that both fiber diameter and fleece weight is moderate heritable. Unfavourable correlations between fibre diameter and fleece weight and body weights pose challenges in attaining optimum levels for these individual traits. A selection index has been developed for SA Angora breeders including these three traits, but due to low participation in animal recording application was limited. South African producers are facing challenges to remain productive and competitive and breeders have to adapt to decreasing profit margins, a challenging production environment and changed land-use patterns. Therefore, the continuous evaluation and improvement of selection criteria and breeding goals are of the utmost importance to maintain the quality clip and efficient production of South African mohair. The aim of this study was evaluate the genetic trends for fleece traits and body weights in the Angora flocks taking part in animal recording in South Africa.

Keywords: Angora goat, fleece traits, fiber diameter, fleece weight

Introduction

The Angora goat industry is a relatively small industry compared to the other livestock sectors in South Africa (SA). The South African industry currently consists of 44 stud breeders and 800 commercial farmers. It has historically been a stable industry, but over the past decade both stud breeders and commercial farmers had been subjected to severe droughts in large parts of the primary production region as well as additional challenges regarding financial instability in world markets.

The mohair produced by Angora goats is a luxury and high quality fibre produced for a specialized market. The total mohair production in SA has decreased from 3.7 million kg in 2004 to 2.32 million kg per in 2013. Average production per year per goat is 3.6 kg with an average fibre diameter of 26.5µm for kid mohair. South Africa has earned its place as a reliable producer

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of good quality clip on the world market and contributes up to 50% of the world product (DAFF, 2011).

Selection emphasis has changed considerably over the past three decades. During the mid-1980s, mohair commanded exceptionally high prices in South Africa. At this time the mohair clip was becoming coarser, probably due to selection for increased fleece weight without consideration for fibre diameter. In the 1980s, the price of coarse hair was 25% of that paid for fine hair (Snyman, 2002). As far as mohair production was concerned, only 47% of the clip consisted of mohair below 36 μ m (kids, young goats and fine adults), while 18% of the national herd was made up of older animals or castrates. Thus, younger goats also produced coarser hair. Selection up to 1990 was only aimed at increasing mohair production *per se*, and very little attention was given to fibre diameter. In fact, some young rams at selection age at the end of the 1980s even produced over-strong adult mohair (38+ μ m). The goats had heavy fleeces with face and legs covered with hair. They were also relatively small, as there was no selection directed towards increasing body weight. During the 1990s, selection emphasis moved to decreased fibre diameter. Since then, fibre diameter became finer and animals larger, with decreased mohair production per goat. Currently, emphasis is shifting again from excessive attention to fibre diameter to fleece weight.

It is important for the industry to continuously evaluate the breeding goals and selection criteria to ensure genetic improvement and maintaining high quality and feasible mohair production. In this study the aim was to evaluate the genetic trends for fleece traits in the Angora flocks taking part in animal recording in South Africa.

Material and Methods

The data set used for the estimation of breeding values included all available records collected in various projects on Angora goat kids born in 10 different studs from 2000 until 2011. Traits included in the analysis were fleece weight, fibre diameter, staple length and coefficient of variation of fibre diameter recorded on the second shearing of the kids. Body weights at weaning, 12 and 16 months of age were also included in the analyses due to the emphases placed on body weight in the selection programs. The number of records and means are summarized in Table 1.

Table 1. Number of records and means (\pm s.e.) for traits included in the study

Trait	Number of records	Mean
Weaning weight (kg)	25342	17.15 \pm 0.32
12-month body weight (kg)	6956	22.16 \pm 0.51
16-month body weight (kg)	6725	26.19 \pm 0.59
Fleece weight (kg)	6854	1.29 \pm 0.01
Fibre diameter (μ m)	7089	26.59 \pm 0.04
Staple length (mm)	2074	142.43 \pm 0.43
Coefficient of variation of fibre diameter (%)	3830	28.19 \pm 0.07

Greasy fleece weight (measured to the nearest 0.1 kg) was determined just after shearing. Individual midrib samples were taken from each kid for determination of fibre diameter. From 2000 to 2003, fibre diameter of mohair samples was determined with the OFDA100 at the Wool

Testing Bureau. Since 2004, fibre diameter measurements were done using an OFDA2000 instrument. Staple length was determined on 10 locks per sample and the average length recorded.

The data were initially analysed by least-squares methods to identify the non-genetic effects which contributed significantly to variation, using the General Linear Model (GLM) procedure of the SAS computer package (SAS, 2009). The fixed effects finally included in the models for all traits were herd-year of birth (HY), sex (male or female), birth status of the kid (single or twin-born), age of dam at kidding (2 to 12 years of age), as well as a linear covariate for age of the kid at shearing (in days).

Variance components were estimated using the ASREML program (Gilmour *et al.*, 2009).

The following single trait animal model, including only a direct additive genetic effect, was fitted for all mohair traits and for 16-month body weight:

$$\mathbf{y} = \mathbf{X}\mathbf{b} + \mathbf{Z}\mathbf{a} + \mathbf{e}$$

The following model was fitted for weaning weight and 12-month body weight:

$$\mathbf{y} = \mathbf{X}\mathbf{b} + \mathbf{Z}_1\mathbf{a} + \mathbf{Z}_2\mathbf{m} + \mathbf{Z}_3\mathbf{c} + \mathbf{e}; \text{ with } \text{cov}(\mathbf{a},\mathbf{m}) = 0$$

where \mathbf{y} is a vector of observed traits of animals; \mathbf{b} , \mathbf{a} , \mathbf{m} and \mathbf{c} are vectors of fixed effects, direct additive genetic effects, maternal additive genetic effects and maternal permanent environmental effects, respectively; \mathbf{X} , \mathbf{Z}_1 , \mathbf{Z}_2 and \mathbf{Z}_3 are incidence matrices, respectively relating fixed effects, direct additive genetic effects, maternal additive genetic effects and maternal permanent environmental effects to \mathbf{y} ; \mathbf{e} is the vector of residuals; \mathbf{A} is a numerator relationship matrix, and σ_{am} is the covariance between direct additive genetic and maternal additive genetic effects. It was assumed that $V(\mathbf{a}) = \mathbf{A}\sigma_a^2$; $V(\mathbf{m}) = \mathbf{A}\sigma_m^2$; $V(\mathbf{c}) = \mathbf{I}\sigma_c^2$; $V(\mathbf{e}) = \mathbf{I}\sigma_e^2$, where \mathbf{I} is an identity matrix, and σ_a^2 , σ_m^2 , σ_c^2 and σ_e^2 are the direct additive genetic variance, maternal additive genetic variance, maternal permanent environmental variance and environmental variance, respectively. All components, with the phenotypic variance (σ_p^2) being the sum of σ_a^2 , σ_m^2 , σ_c^2 , and σ_e^2 , were derived at convergence. Estimated breeding values were obtained as back solutions with the ASREML program. Genetic trends were obtained by regressing breeding values on year of birth.

Results

The genetic trend for fibre diameter shown in Figure 1 for the 12-year time period indicate a slight increase, while fleece weight shown in Figure 2 has no discernible trend.

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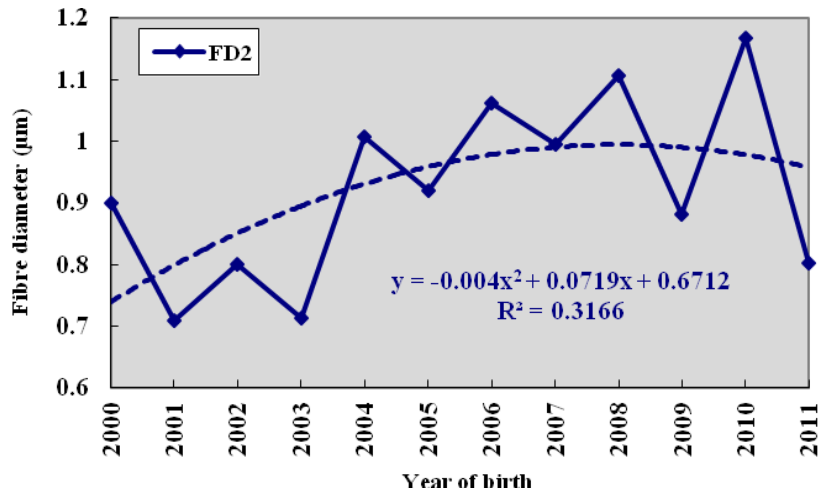


Figure 1 Genetic trend for fibre diameter from 2000 to 2011

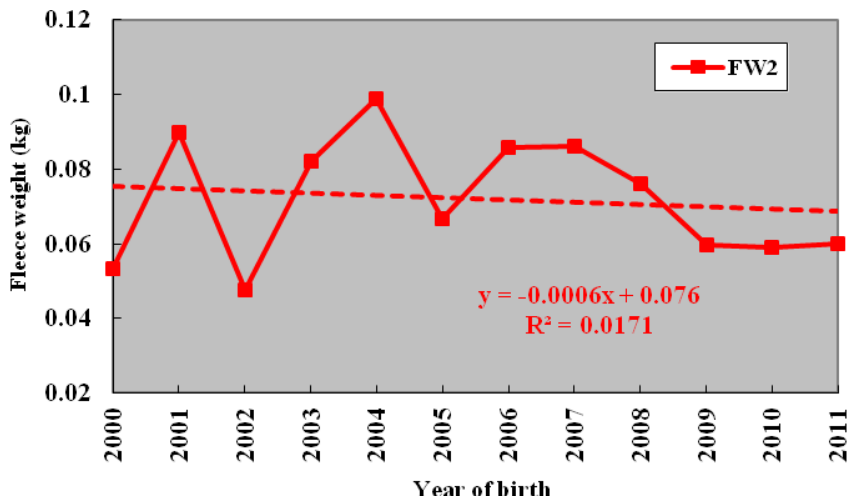


Figure 2 Genetic trend for fleece weight from 2000 to 2011

The genetic trends for the OFDA-measured quality traits show no clear trend and indicate the lack of selection focus on these traits as can be seen from the lack of a distinct trend for CV of fibre diameter shown in Figure 3.

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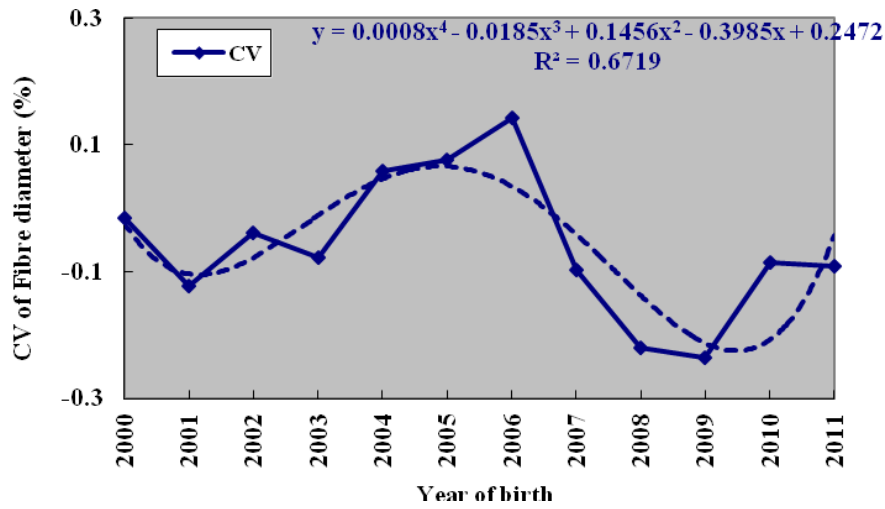


Figure 3 Genetic trend for CV of fibre diameter from 2000 to 2011

Over the past 25 years breeders tended to place more emphases on body weight as indicated by the positive trends for weaning weight (not shown), 12- and 16-month weights (Figures 4 and 5).

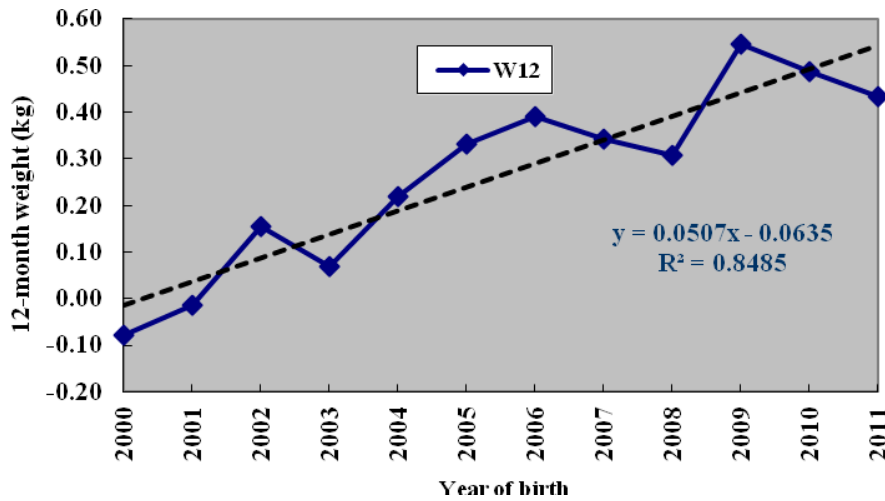


Figure 4 Genetic trend for 12-month weight from 2000 to 2011

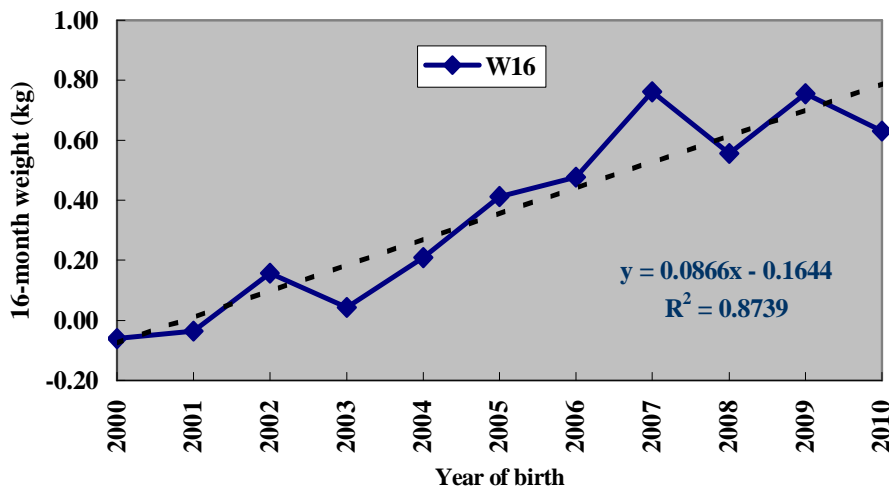


Figure 5 Genetic trend for 16-month weight from 2000 to 2011

Discussion

The genetic trends presented here is an indication of the selection focus of the breeders over the past 12 years. Genetic trends are positive for weights at all three ages and fine fibre diameter is maintained. Fibre diameter remains the price determining fleece trait and therefore receives due attention in selection. Unfortunately, the OFDA measured quality traits are not included in selection programs by most of the breeders due to additional costs for these measurements. It should be kept in mind that the trends presented are based on only a small segment of the industry, with only a few stud breeders actively taking part in performance recording.

The registration system for all seed stock animals in South Africa dates back to 1904 (Schoeman *et al.*, 2010), making provision for storage of pedigree information and official performance recording. However, the National Small Stock Information Scheme (NSIS) of South Africa only became operational in 1999 (Olivier, 2002). Participation of Angora goat breeders in the NSIS has not been compulsory and poor participation in the NSIS resulted in a lack of comprehensive and complete data for South African Angora breeders. The poor participation limits the application of Estimated Breeding Values in the Angora goat industry in South Africa.

Research over more than three decades has shown that fibre diameter, fleece weight and body weight are the most important traits for mohair producers. The trends indicate that genetic progress was made in body weight, while maintaining fine fibres. Body weight has received emphasised due to the adverse effects of small body sizes on hardiness and fitness traits (Snyman *et al.*, Visser *et al.*, 2013).

In the two indices used by most of the breeders participating in the performance scheme, emphasis is placed on either maintaining fiber diameter and fleece weight with an increase in

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body weight or a decrease in fiber diameter and increase in body weight (Snyman *et al.*, 1996; Snyman & Olivier, 1996). The trends indicate that the second selection index is more used by breeders with no selection pressure being put on fleece weight. Fleece weight was therefore neglected and in the current economic climate breeders cannot afford to decrease total mohair production. There is still too much emphasis on the individual traits and there is a lack of buy-in by the breeders to use the selection indices for overall genetic improvement.

Conclusion

Poor participation in the national recording and improvement scheme limits genetic progress in the SA Angora industry. With no clear collective breeding objective, breeders will find it difficult to achieve a satisfactory rate of genetic progress in the traits of economic importance.

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Introduction

- South African mohair industry
 - Niche market
 - Only 44 Stud breeders
 - 800 commercial farmers
 - 2.32 million kg per year to world market
 - 3.6 kg average per goat per year
 - High quality clip
 - FD for kids average 26.5 μm



Research focus...

Trait	Heritability range	References
Fleece weight	0.22 ± 0.04 in exp. herds 0.24 ± 0.03 in stud & commercial herds	Snyman & Olivier (1996; 1999) Visser et al. (2009)
Fibre diameter	0.29 - 0.30 ± 0.05 in exp. herds 0.45 ± 0.03 in stud & commercial herds	Snyman & Olivier (1999) Visser et al. (2009)
Coefficient of variation of fibre diameter	0.37 ± 0.10 in stud & commercial herds	Visser et al.(2009)

Aim of this study

To evaluate genetic trends for fleece traits and body weight in South African Angora goats



Material & Methods

- **Data:**

- based on 10 stud herds
- Herds taking part in animal recording projects
- Period 2000 – 2011
- Fleece traits based on second shearing

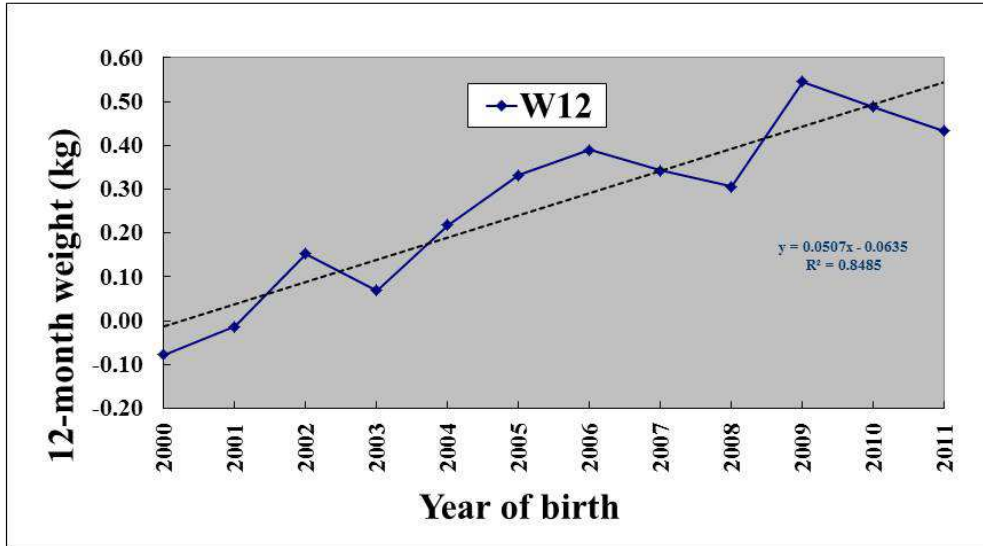
- **Analyses:**

- Single trait model -fitting direct additive effects
- ASREML (Gilmour, 2009) for estimation of EBV's
- Genetic trends - regressing EBV's on year of birth.

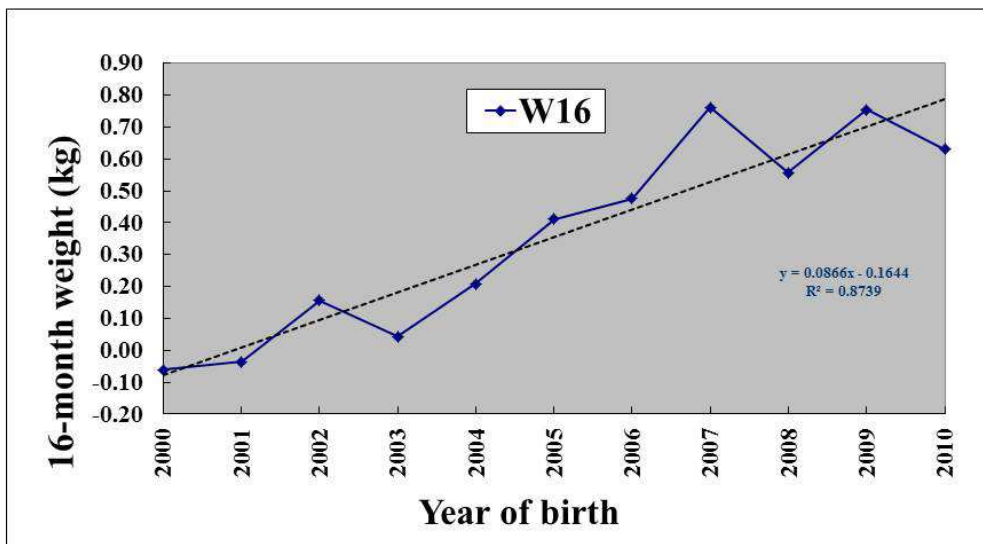
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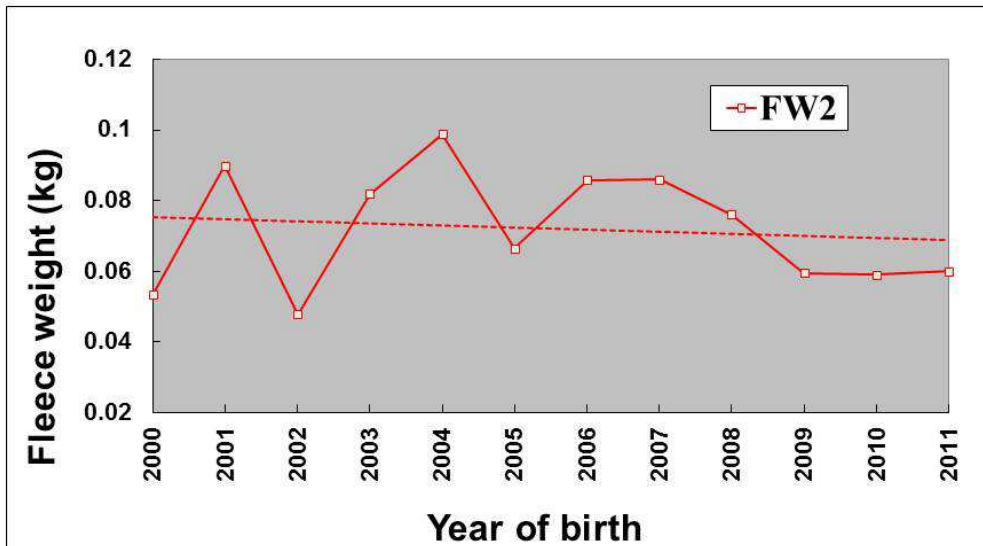
Genetic trend for 12 month weight



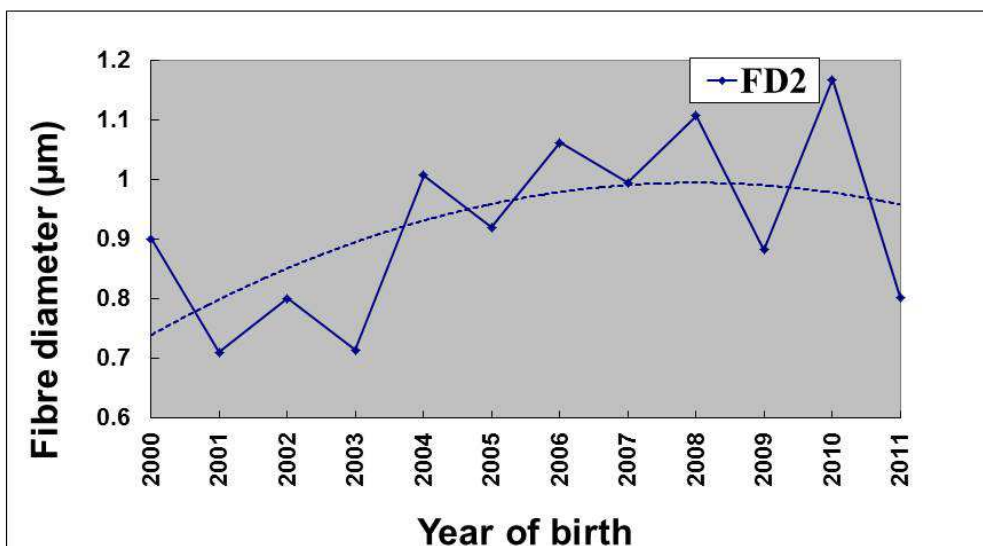
Genetic trend for 16 month weight



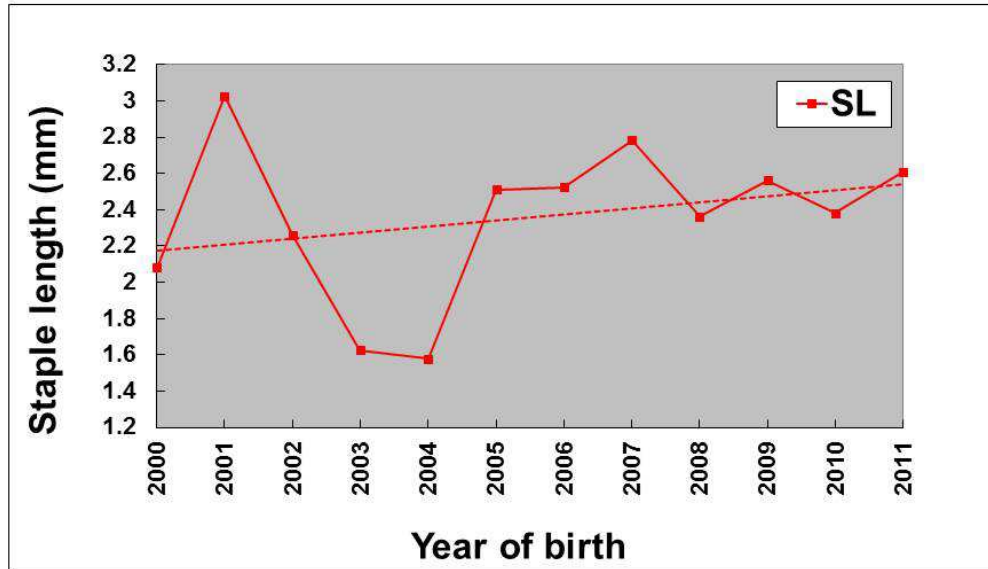
Genetic trend fleece weight



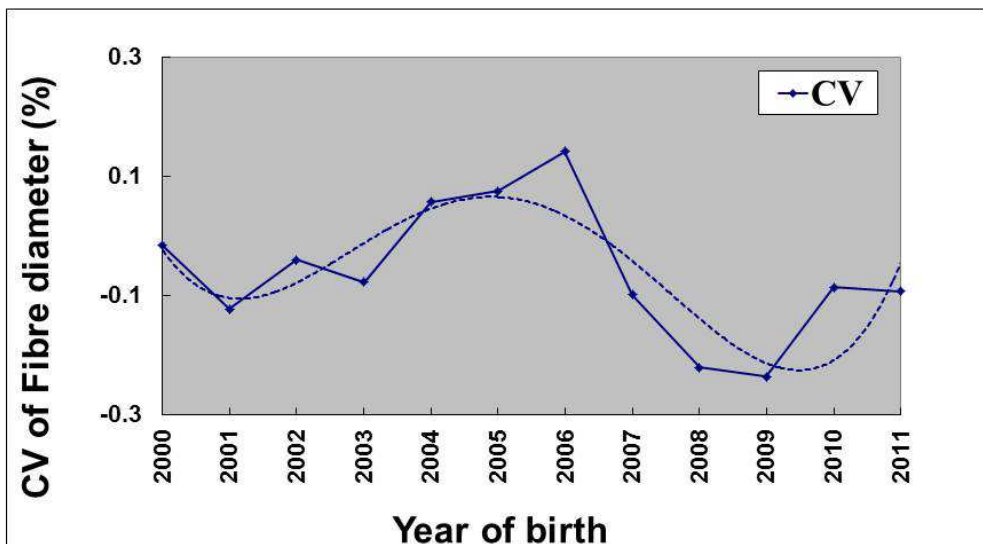
Genetic trend fiber diameter



Genetic trend fiber length



Genetic trend CV of fiber diameter



Discussion

- Trends indicate **selection emphases** was on:
 - Body weight & Fibre diameter
 - Fleece weight no improvement
 - CV of fibre diameter not selected for
 - Staple length low repeatability, not reliable
- **Body weight** due to:
 - Adverse effects of too small
- **Fibre diameter** due to:
 - Price

Current two indices available

- **SI = 13xBW + 4xFW – 23xFD**

Increase Body weight

Maintain Fleece weight

Decrease Fibre Diameter



- **SI = 3xBW + 15xFW – 1xFD**

Maintain body weight

Increase fleece weight and maintain fibre Diameter

Conclusion

- **Challenges for SA Angora**

- Increase participation official recording
- Need more data on **all** traits
- Improved pedigree integrity
- Breeders more aware of the **value of EBV's**
- Need more focus improvement of **fleece weight**
- Breeders encouraged to **record** data & **apply EBV's**
- Integrated approach

