

## ESTIMATION OF GENETIC PARAMETERS FOR MILK YIELD AND MILK COMPOSITION OF SOUTH AFRICAN SAANEN GOATS

C.J.C. Muller<sup>1</sup>, S.W.P. Cloet<sup>1</sup> and S.J. Schoeman<sup>2</sup>

<sup>1</sup> Animal Production, Private Bag X1, Elsenburg 7607, South Africa

<sup>2</sup> Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa

### INTRODUCTION

The dairy goat industry in South Africa is small in comparison to the dairy cow industry. Breeding and selection of dairy goats by producers have been based on various factors such as pedigrees, conformational traits and phenotypic performances. Milk recording has been done since 1980 and lactation performances of ewes are available from 1981 (Hallowell *et al.*, 2000). Linear regressions of production parameters for all dairy goat breeds on production year show no change in milk yield, protein percentage and protein yield from 1981 to 2000. Fat content and fat yield, however, were reduced ( $P < 0.05$ ) over the same period, *i.e.* from 3.44 to 2.76% and 31.3 to 26.8 kg/doe (Muller, 2001). Although these parameters are influenced by environmental factors, the lack of a scientific breeding strategy for the national herd probably also contributed to this situation. Genetic improvement of farm animals requires reliable methods of determining the genetic merit of candidates for selection (Wiggans *et al.*, 1984). The routine recording and genetic evaluation of dairy breeds have become commonplace in South Africa. No information is, however, available on genetic parameters for yield and component traits for the South African dairy goat herd.

Permission has been obtained from the South African Dairy Goat Association to merge pedigrees with production parameters to calculate genetic parameters for the national herd and to establish a breeding programme to improve milk yield and composition traits.

### MATERIALS AND METHODS

All lactations longer than 60 days were included in the analysis. A total of 1 915 lactation records from 992 does in 25 herds was available. ASREML (Gilmour *et al.*, 1999) was used to estimate variance components in single-trait analysis initially. Direct additive genetic effects, permanent environmental goat effects, as well as a random farm effect were fitted to the data. All possible combinations of traits were subsequently fitted in a series of two-trait analyses. Genetic correlations, goat permanent environmental correlations, environmental correlations and phenotypic correlations between traits were estimated.

### RESULTS AND DISCUSSION

Known significant sources of variation in the case of yield traits included the length of lactation (fitted as a linear covariable), year and month of production, and whether the doe was maintained on the same property where it was bred. Lactation number also influenced yield traits. Percentage traits were not affected by length of lactation and lactation number, but by year, month and production region. The random effect of the property on which does were

maintained was significant, variance ratios ranging between  $0.11 \pm 0.05$  in the case of protein percentage and  $0.33 \pm 0.08$  in the case of butterfat yield when expressed to the total phenotypic variation. Heritability ( $h^2$ ) values obtained for the South African Saanen goat herd ranged from 0.20 for protein yield to 0.44 for protein percentage (Table 1).

**Table 1. Genetic and phenotypic parameters and correlations between production parameters in the Saanen goat herd. Heritability (upper) and permanent environmental (lower) ratios are printed in bold type on the diagonal. Genetic (upper) and permanent environmental (lower) correlations are printed above the diagonal, and phenotypic (upper) and environmental (below) correlations below the diagonal**

Trait	Trait					R
	MY	BFY	PY	BFP	PP	
MY						
$h^2$	<b>0.23±0.05</b>	0.80±0.06	0.89±0.03	-0.12±0.17	-0.24±0.14	$r_g$
$pe^2$	<b>0.18±0.05</b>	0.72±0.08	0.91±0.03	-0.28±0.15	-0.18±0.17	$r_{pe}$
BFY						
$r_p$	0.80±0.01	<b>0.22±0.05</b>	0.79±0.07	0.48±0.13	0.02±0.15	$r_g$
$r_e$	0.82±0.01	<b>0.16±0.04</b>	0.83±0.06	0.42±0.13	0.17±0.19	$r_{pe}$
PY						
$r_p$	0.93±0.01	0.81±0.01	<b>0.20±0.05</b>	0.02±0.19	0.23±0.14	$r_g$
$r_e$	0.96±0.01	0.81±0.01	<b>0.19±0.04</b>	-0.03±0.15	0.22±0.17	$r_{pe}$
BFP						
$r_p$	-0.12±0.03	0.45±0.02	-0.01±0.03	<b>0.21±0.06</b>	0.34±0.15	$r_g$
$r_e$	-0.05±0.03	0.45±0.02	-0.02±0.03	<b>0.27±0.05</b>	0.47±0.14	$r_{pe}$
PP						
$r_p$	-0.16±0.03	0.02±0.03	0.17±0.03	0.25±0.03	<b>0.44±0.06</b>	$h^2$
$r_e$	-0.11±0.03	-0.04±0.03	0.11±0.03	0.10±0.03	<b>0.19±0.05</b>	$pe^2$
MY:	Milk yield		$h^2$ :	heritability		
BFY:	Butterfat yield		$pe$ :	permanent environment		
PY:	Protein yield					
BFP:	Butterfat percentage					
PP:	Protein percentage					

These values were higher than those obtained by Analla *et al.* (1996) in Spain who found values of 0.18, 0.16 and 0.25 for milk yield, fat content and protein content. The heritability of milk yield for Saanen goats in Italy was 0.16 (Moioli *et al.*, 1995). Singireddy *et al.* (1997) found in an across-breed genetic evaluation of New Zealand dairy goats (6 517 lactation records of 3 856 does in 20 herds) a heritability of 0.25 for milk yield. The heritability of daily milk yield in indigenous goats in Greece was 0.35 while it was 0.38 and 0.51 for fat and protein percentages respectively (Zygoyiannis, 1994). Higher  $h^2$  values (0.32 to 0.40 for yield and 0.50 to 0.60 for contents) were obtained from the French national milk recording database on first lactation French Alpine and Saanen goats (Bellichon, *et al.*, 1999). Iloeje *et al.*, (1981) found heritability values of milk and fat yield and fat percentage of Saanen does of 0.53, 0.48 and 0.62 respectively. Kennedy *et al.* (1982) also found heritability values for milk and fat

yields of Alpine, Saanen and Toggenburg does of 0.61 to 0.69. The heritability of fat percentage was slightly lower (0.52 to 0.54).

Permanent environmental variance ratios ( $c^2$ ) ranged from 0.19 for protein percentage to 0.27 for butterfat percentage. All correlations between yield traits were high and positive (Table 1). Genetic and goat permanent environmental correlations of MY with the percentage traits were negative, but failed to exceed twice their respective standard errors. Corresponding phenotypic and environmental correlations were lowly negative. Genetic correlations of BFP with BFY were high and positive. The corresponding correlations between PP and PY did not exceed twice their standard errors. The genetic and permanent environmental correlations between percentage traits were moderate to high.

Phenotypic correlations between milk yield and fat and protein yields were positive and negative between milk yield and fat and protein percentages (Table 1). This accords with other studies (Analla *et al.*, 1996 and Zygoyiannis, 1994) although the magnitude was smaller specifically for fat and protein content. Iloeje *et al.* (1981) found phenotypic and genetic correlations of 0.94, -0.04 and 0.86 and -0.24 between milk and fat yield and milk and fat percentage respectively. Estimates of heritability of traits can vary considerably between studies because of breed, population sampled, environmental conditions and random and systematic errors in the estimation process (Wiggans, 1989).

## CONCLUSION

Heritability values and genetic correlation estimates in this study were in the range of those found in the literature. This might reflect the large variation in production systems used in this country. The dairy goat industry in South Africa should address some of the problems encountered in the analysis of data. This include factors such as many short lactations, incomplete pedigrees, little information on production performance of does that have completed two and more lactations and no clear breeding and selection programme. The relative importance of factors such as length of lactation, year and month of production and lactation number should be taken into account in the evaluation of sires. A national breeding programme would be influenced by the milk payment scheme. A combination of fat and protein yield is normally used in the dairy industry as a selection tool to improve the production of milk products. These factors would be applicable for commercial dairy goat farmers. As a large percentage of goats in South Africa is used in less developed rural areas, the selection of goats for these farmers would be based on volume of milk produced as that is the way milk is traded. Ways to determine fat and protein content are not available in these areas.

## REFERENCES

- Analla, M., Jimenez-Gamero, I., Munoz-Serrano, A., Serradilla, J.M. and Falagan, A. (1996) *J. Dairy Sci.* **79** : 1895-1898.
- Bellichon, S., Manfredi, E. and Piacere, A. (1999) *Genet. Sel. Evol.* **31** : 5-6.
- Gilmour, A.R., Cullis, B.R., Welham, S.J. and Thompson, A. (1999) NSW Agriculture Biometric Bulletin no 3. Orange Agricultural Institute, Orange 2800 NSW, Australia.

- Hallowell, G.J., Moore, S.J. and Mostert, B.E. (2000) Annual report. South African National Dairy Animal Improvement Scheme Vol **20** : 17-18.
- Iloeje, M.U., Van Vleck, L.D. and Wiggans, G.R. (1981) *J. Dairy Sci.* **64** : 2290-2293.
- Kennedy, B.W., Finley, C.M. and Bradford, G.E. (1982) *J. Dairy Sci.* **65** : 2373-2383.
- Moioli, B.M., Pilla, A.M., Rosati, A., Catillo, G. and Fresi, P. (1995) *Zoot. Nutr. Anim.* **21** : 231-236.
- Muller, C.J.C. (2001) Unpublished data.
- Singireddy, S.R., Lopez-Villalobos, N., Garrick, D.J. and Villalobos, N.L. (1997) *Proc. of the NZ Soc. Anim. Prod.* **57** : 43-45.
- Wiggans, G.R. (1989) *J. Dairy Sci.* **72** : 2411-2416.
- Wiggans, G.R., Dickinson, F.N., King, G.J. and Weller, J.I. (1984) *J. Dairy Sci.* **67** : 201-207.
- Zygyiannis, D. (1994) *World. Rev. Anim. Prod.* **29** : 2, 3, 6, 9, 19-28.