AN ANALYSIS OF CREEPING BELLY IN THE CARNARVON AFRINO SHEEP FLOCK

M.A. Snyman[#] & W.J. Olivier

Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg (EC), 5900

[#]E-mail: GrethaSn@daff.gov.za

INTRODUCTION

In many dual purpose and wool sheep breeds there is a tendency for belly type wool to creep up the sides of the animal into the fleece wool, therefore the name creeping belly. Some breeders discriminate strongly against creeping belly, even to the extent of culling animals that were superior in terms of the economically important traits. Negative genetic correlations of –0.33 ± 0.23 and –0.25 ± 0.20 were estimated between creeping belly assessed at two-tooth age and lifetime total weight of lamb weaned and number of lambs weaned respectively in the Carnarvon Afrino flock (Snyman & Olivier, 2002). However, at that stage, no creeping belly data were available on reproducing ewes.

Olivier et al. (2009), Olivier (2013) and Naidoo et al. (2014) discussed aspects of creeping belly in the Grootfontein Dohne Merino stud, the Cradock fine wool Merino stud and the Dohne Merino stud maintained at the Mariendahl experimental farm of the University of Stellenbosch respectively.

MATERIALS AND METHODS

Creeping belly data collected on 5130 14-month old Afrino ram and ewe lambs from 1990 to 2011, as well as on 1078 reproducing Afrino ewes from 2004 to 2011 in the Carnarvon Afrino flock, were analysed. Creeping belly was assessed on a linear scale from 1, indicating a severe creeping belly, where belly type wool was found more than halfway up the side, to 50, for sheep with no creeping belly.

The effect of year of birth, sex, birth status, age of dam and age of animal at recording on creeping belly score of the 14-month old ram and ewe lambs was determined with the GLM procedure of SAS (SAS, 2009). The same statistical procedures were used to determine the effect of year, ewe age, number of lambs born and weaned, as well as total weight of lamb weaned on creeping belly score of the Afrino ewes. The phenotypic relationships between creeping belly score and greasy fleece weight and fibre diameter of the Afrino ewes were also determined with the GLM procedure of SAS (SAS, 2009). Heritability of and genetic correlations between creeping belly score and 14-month fleece weight, fibre diameter, staple strength and wool quality in terms of crimp definition, were estimated with multiple-trait animal models. The ASREML program of Gilmour et al. (2009) was used to fit

models including direct additive genetic effects for all traits.

Estimated breeding values were obtained as back solutions with the ASREML program. Genetic trends were obtained by regressing estimated breeding values for individual animals averaged within birth years, on the birth year.

RESULTS AND DISCUSSION

Creeping belly score of lambs at 14 months of age, as influenced by year of birth, sex and birth status, is presented in Table 1. At 14 months of age, rams had more creeping belly than ewes. Birth status significantly influenced the occurrence of creeping belly, more so in rams than in ewes (Figure 1).

Table 1. Effect of year of birth, sex and birth status on creeping belly score (± s.e.) of lambs

Effect	Creeping belly score
Year*	
1990	40.0 ± 0.4
1991	45.7 ± 0.4
1992	43.8 ± 0.5
1993	41.8 ± 0.4
1994	44.8 ± 0.4
1995	41.5 ± 0.5
1996	35.9 ± 0.4
1997	35.2 ± 0.5
1998	36.9 ± 0.4
1999	34.7 ± 0.6
2000	35.2 ± 0.4
2001	34.0 ± 0.4
2002	33.3 ± 0.5
2003	35.5 ± 0.4
2004	36.1 ± 0.4
2005	32.5 ± 0.5
2006	35.7 ± 0.4
2007	35.2 ± 0.4
2008	33.2 ± 0.4
2009	32.0 ± 0.4
2010	32.2 ± 0.4
2011	30.6 ± 0.5

Effect	Creeping belly score
Sex	
Ram	35.6[a] ± 0.2
Ewe	37.7[b] ± 0.2
Birth status	
Single	37.2[a] ± 0.2
Twin	36.4[b] ± 0.2
Triplet	36.4 ± 0.4

* Significant differences were observed among most of the years

[a, b] Values with different superscripts differ significantly (P<0.01) within effects

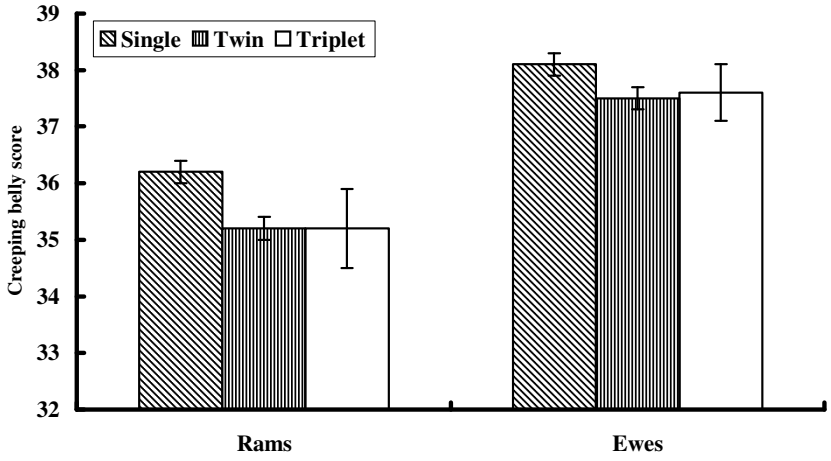

Figure 1. Effect of sex and birth status on creeping belly

Differences in creeping belly score of reproducing ewes were observed among years, and to a lesser extent among age groups (Table 2). No differences in creeping belly score were evident in number of lambs born or weaned (Table 3). The relationships between creeping belly score and total weight of lamb weaned, greasy fleece weight and fibre diameter of ewes are summarised in Table 4. A low negative relationship between weight of lamb weaned and creeping belly was found in this flock, implying that ewes with more creeping belly weaned somewhat higher total weight of lamb. A positive relationship was found between greasy fleece weight and creeping belly score, as well as between fibre diameter and creeping belly score of Afrino ewes.

Table 2. Effect of year and ewe age on creeping belly score

Effect	Creeping belly score (± s.e.)
Year	
2004	35.0^{ade} ± 0.6
2006	34.6^{de} ± 0.6
2007	33.6 ± 0.6
2008	32.7^{bc} ± 0.6
2009	34.9^{e} ± 0.6
2010	32.0^{c} ± 0.6
2011	32.2^{c} ± 0.6
Ewe age	
2	34.9^{a} ± 1.0
3	33.5^{a} ± 0.4
4	34.0^{a} ± 0.4
5	32.4^{b} ± 0.4
6	32.7 ± 0.5
7	32.6 ± 0.7
8	35.0 ± 2.0

^{a,b,c,d,e} Values with different superscripts differ significantly (P<0.05) within effects

Table 3. Effect of number of lambs born and weaned on creeping belly score

Effect	Creeping belly score (± s.e.)
Number of lambs born	
0	33.9 ± 1.0
1	33.4 ± 0.9
2	33.2 ± 0.9
3	32.2 ± 1.2
Number of lambs weaned	
0	33.9 ± 0.9
1	33.4 ± 0.9
2	33.1 ± 0.9
3	32.0 ± 1.4

Table 4. Relationship between creeping belly score and production of ewes

Trait	Relationship	P-value
Total weight of lamb weaned	y = 32.39 – 0.017x	0.020
Greasy fleece weight	y = 27.33 + 2.482x	0.001
Fibre diameter	y = 32.34 + 0.226x	0.001

Heritabilities of and genetic and phenotypic correlations among creeping belly score, fleece weight, fibre diameter, staple strength and crimp quality estimated at 14 months of age are summarised in Table 5.

Table 5. Heritabilities (on diagonal) of and genetic (above diagonal) and phenotypic (below diagonal) correlations among creeping belly score and other wool traits

	Creeping belly	Fibre diameter	Fleece weight	Crimp quality	Staple strength
Creeping belly	**0.35 ± 0.03**	0.42 ± 0.05	0.60 ± 0.05	-0.59 ± 0.05	0.45 ± 0.10
Fibre diameter	0.25 ± 0.02	**0.73 ± 0.03**	0.32 ± 0.04	-0.37 ± 0.05	0.08 ± 0.08
Fleece weight	0.30 ± 0.02	0.23 ± 0.02	**0.59 ± 0.03**	-0.09 ± 0.05	0.27 ± 0.09
Crimp quality	-0.28 ± 0.02	-0.26 ± 0.02	-0.03 ± 0.02	**0.51 ± 0.03**	0.25 ± 0.11
Staple strength	0.13 ± 0.02	0.05 ± 0.03	0.23 ± 0.02	0.09 ± 0.02	**0.35 ±0.04**

High heritability estimates were obtained for all the wool traits included in this study. The genetic correlations of creeping belly score with the other traits imply that animals with creeping belly have less, finer wool with good crimp definition and poorer staple strength. Naidoo et al. (2014) reported a heritability for creeping belly score, defined as a binary trait, of 0.16 ± 0.04. A similar genetic correlation between wool quality and creeping belly score of -0.55 ± 0.27 was reported by Naidoo et al. (2014), indicating that sheep with acceptable wool quality scores have more creeping belly. However, the latter authors reported a negative genetic correlation between creeping belly score and fleece weight (-0.29 ± 0.16), which is in contrast with the correlation estimated in this study (0.60 ± 0.05). Olivier (2013) also reported an unfavourable genetic correlation between belly and points, a score, which includes creeping belly, and fibre diameter.

Heritabilities of and genetic and phenotypic correlations between creeping belly score and body weight at 14 months of age, as well as between creeping belly score and total weight of lamb weaned, are summarised in Table 6.

Table 6. Heritabilities (on diagonal) of and genetic (above diagonal) and phenotypic (below diagonal) correlations between creeping belly score and body weight and total weight of lamb weaned

	Creeping belly	**Body weight**	**Total weight of lamb weaned**
Creeping belly	**0.35 ± 0.03**	-0.27 ± 00.07	-0.63 ± 0.53
Body weight	-0.04 ± 0.02	**0.51 ± 0.03**	-
Total weight of lamb weaned	-0.05 ± 0.03	-	-

The genetic correlation between creeping belly score and body weight implies that the heavier animals have less creeping belly. Although the standard error of the genetic correlation between creeping belly and total weight of lamb weaned is high, due to few data records, the high negative value of the correlation is a cause for concern. This implies that ewes with creeping belly weaned more kilogram of lamb than ewes with less creeping belly. A similar result was obtained by Olivier (2013) for Merino sheep. Discriminating against animals with creeping belly could therefore adversely affect the reproductive efficiency of the ewe flock.

Repeatability of creeping belly scores from 14 months until 8 years of age was estimated as 0.23 ± 0.06. When including only data from the ewes, the repeatability of creeping belly was estimated as 0.45 ± 0.03.

Selection in the Carnarvon Afrino flock was aimed at increasing reproductive performance, increasing body weight, maintaining wool weight, decreasing fibre diameter and improving wool quality traits. Putting a lot of emphasis on crimp quality, together with the emphasis on fibre diameter, led to a correlated increase in the appearance of creeping belly in the Carnarvon Afrino flock. The high heritabilities and nature of the genetic correlations among these three traits ensured a rapid genetic response in the traits. Since 2001, less emphasis was put on fibre diameter and crimp quality, especially with the selection of young ewes, and more emphasis on wool weight. The resultant genetic trend in creeping belly (Figure 2) from 1990 until 2001 was $y = -0.2218x – 0.5297$, compared to the genetic trend from 2001 until 2011 of $y = 0.226x - 5.1615$.

The genetic trends in fibre diameter, crimp quality, clean fleece weight and staple strength for the same periods are depicted in Figures 3 to 6. Staple strength has only been recorded since 2000. It is obvious from these figures that since 2001 when selection pressure on fibre diameter and crimp quality was relaxed, the occurrence of creeping belly decreased, clean fleece weight increased, and fibre diameter and crimp quality seem to have stabilised.

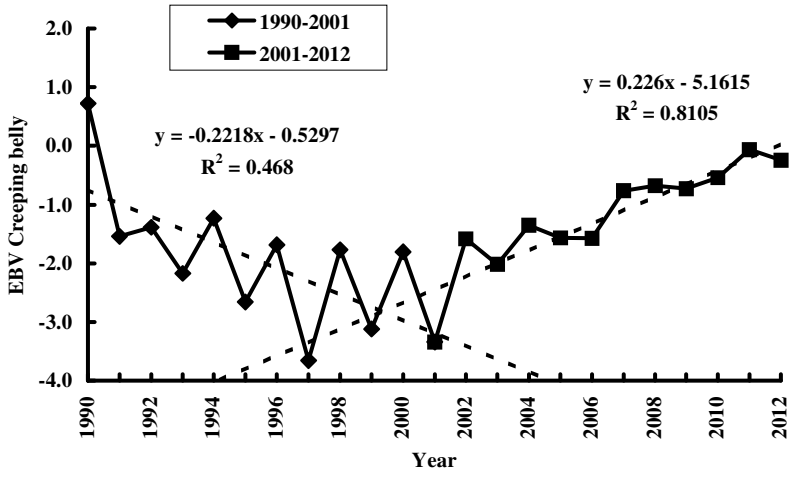

Figure 2. Genetic trends in creeping belly from 1990 until 2001 and from 2001 until 2012

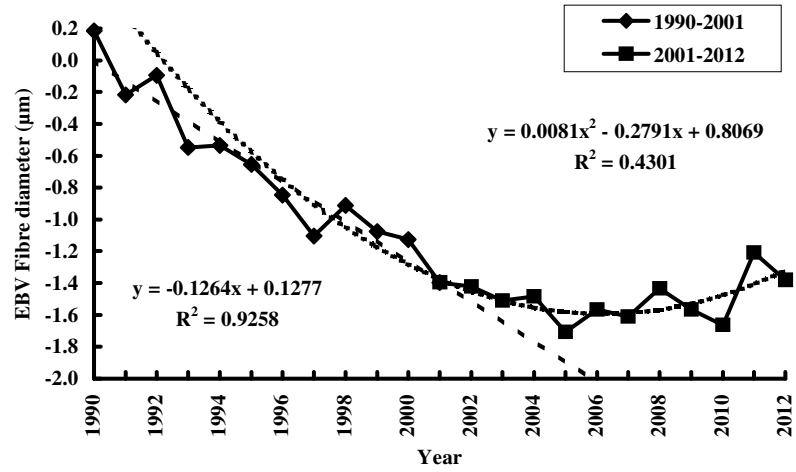

Figure 3. Genetic trends in fibre diameter from 1990 until 2001 and from 2001 until 2012

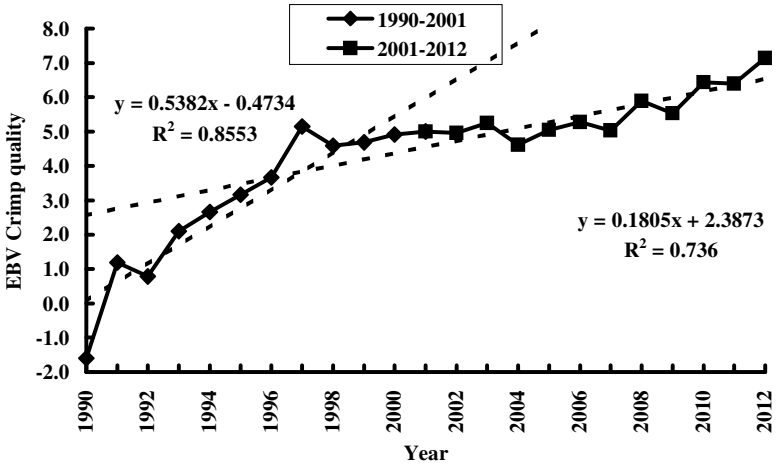

Figure 4. Genetic trends in crimp quality from 1990 until 2001 and from 2001 until 2012

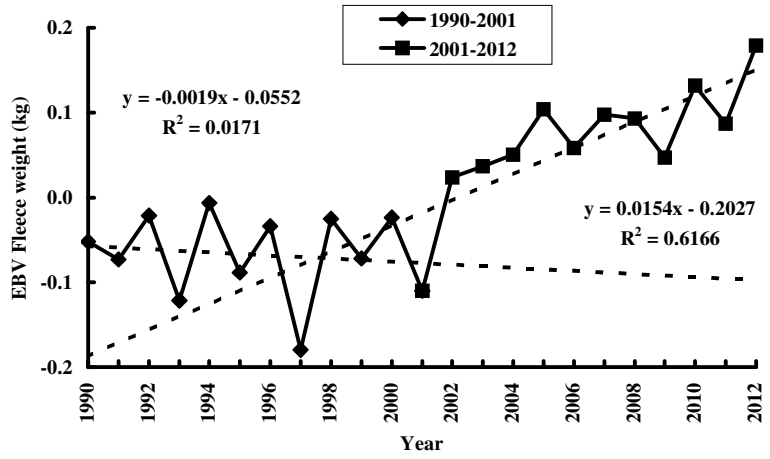

Figure 5. Genetic trends in fleece weight from 1990 until 2001 and from 2001 until 2012

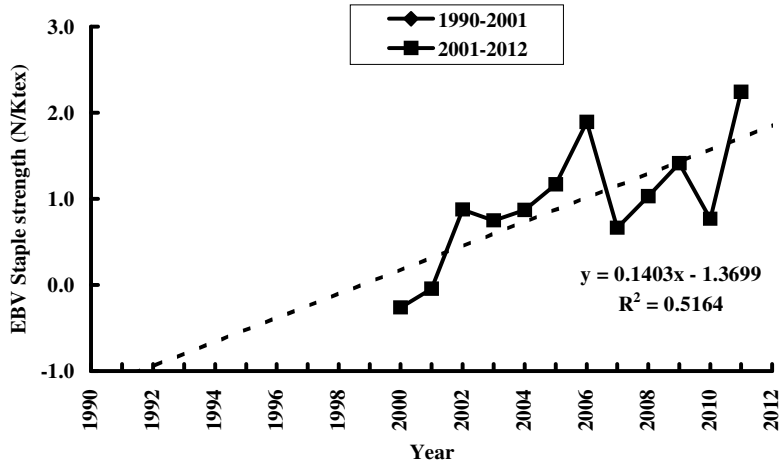

Figure 6. Genetic trend in staple strength from 2000 until 2012

Olivier et al. (2009) also reported a high incidence of creeping belly in the Grootfontein Dohne Merino stud and concluded that selection for decreased fibre diameter in dual purpose sheep should be done in such a way that staple strength and creeping belly score are maintained or improved. Naidoo et al. (2014) supported this and concluded that the incidence of creeping belly should be monitored in a selection program of dual purpose sheep aimed at increasing fine wool production.

CONCLUSIONS

Preliminary results indicate that ewes with creeping belly weaned more kilogram of lamb than ewes with less creeping belly. Discriminating against animals with creeping belly could therefore adversely affect the reproductive efficiency of the ewe flock. However, more data are needed to quantify the

economic implications if less selection pressure is placed against creeping belly, especially with regard to reproduction and income realised from wool production. In the meantime, it is proposed that only animals with extreme creeping belly be culled.

REFERENCES

Gilmour, A.R., Gogel, B.J., Cullis, B.R. & Thompson, R., 2009. ASReml User Guide Release 3.0 VSN International Ltd, Hemel Hempstead, HPI 1ES, UK.

Naidoo, P., Olivier, J.J., Morris, J. & Cloete, S.W.P., 2014. Does selecting for finer wool result in higher incidence of creeping bellies in Dohne Merino sheep? Proc. 47th SASAS Congress, Pretoria, 6-8 July, 89.

Olivier, W.J., 2013. The evaluation of a South African fine wool genetic resource flock. PhD thesis, Stellenbosch University

Olivier, W.J., Herselman, M.J. & Van Heerden, M., 2009. Effect of selection for decreased fibre diameter on staple strength and creeping belly score in a dual purpose sheep flock. Proc. 44th SASAS Congress, Stellenbosch, 11-14 July, 78.

SAS Institute Inc., 2009. SAS OnlineDoc® 9.2. Cary, NC, SAS Institute Inc.

Snyman, M.A. & Olivier, W.J., 2002. Correlations of subjectively assessed fleece and conformation traits with production and reproduction in Afrino sheep. S. Afr. J. Anim. Sci. 32(2), 88-96.