Journal of Animal and Veterinary Advances 10 (14): 1801-1803, 2011
ISSN: 1680-5593

Genetic Trends Estimation for Some of the Growth Traits in Arman Sheep

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Abstract: In this study, 6574 growth trait records of Arman sheep bred and reared in Abbas-Abad sheep breeding station, Mashhad, Iran during 1997-2007 were used to estimate the genetic trends for some of the growth traits using Animal model for lambs, rams and ewes. Genetic trends were estimated for Birth Weight (BW), Weaning Weight (WW) and 6 Months Weight (6 MW) traits. Appropriate models from single and three-trait analysis were applied for research of traits. Predicted breeding values averaged by year of birth from both the single and three-trait analysis for growth traits increased over time. Genetic trends of studied traits were estimated by regressing mean of breeding values on birth year. Direct genetic trends were positive and highly significant ($p<0.01$) for BW, WW and 6 MW and were 2, 7 and 8 g year^{-1}, respectively. Also, maternal trends for BW and WW were positive and highly significant ($p<0.01$) and were 22 and 7 g year^{-1}.

Key words: Single and three-trait analysis, body weight, direct genetic trend, growth traits, maternal genetic trend, Arman sheep, Iran

INTRODUCTION

Birth weight of an animal and its early growth rate in particular till weaning are determined not only by its own genetic potential but also by the maternal effects. Hence for achieving optimum progress, especially in growth traits both direct and maternal components must be considered.

The Arman sheep was obtained by crossbreeding among four breeds of Chios, Suffolk, Ghezel and Baluchi which is a fat tailed and dual purpose (mutton and wool) breed developed for arid regions and well adapted to a wide range of harsh environmental conditions in north eastern region of Iran.

Success of a breeding program can be assessed by actual change in breeding value expressed as a proportion of expected theoretical change of the breeding value mean for the trait under selection (Jurado *et al*., 1994).

Estimation of genetic trend is important to test the efficiency of applied breeding schemes and to provide breeders with information to develop more efficient selection programs in the future. Genetic trend estimates for growth traits of Arman sheep is unavailable. So, the purpose of this study was to estimate and document genetic trends for some of the growth traits in Arman sheep.

MATERIALS AND METHODS

In order to study the genetic trends for growth traits of Arman sheep used information that was collected in Abbas-Abad sheep breeding station, Mashhad, Iran during 1997-2007. The studied traits were Birth Weight (BW), Weaning Weight (WW) and 6 Months Weight (6 MW). Description of data structure of the studied traits is shown in Table 1.

The details about characteristics and management of Arman sheep in Abbas-Abad sheep breeding station have been explained in the previous study (Farokhad *et al*., 2010). For estimation of variance components simplex procedure was applied also, DFREML 3.1 (Meyer, 2000) to fit three-trait analysis for the studied traits. Genetic analysis of mentioned traits illustrated the importance of maternal genetic effects for BW and WW but only direct genetic effects on 6 MW. Thus, the most appropriate models obtained were used

Table 1: Description of data set with some pedigree informations about the under studied traits in Arman sheep

	Numbers				
Weight at	Records	Sires	Dams	Mean±SD (kg)	CV (%)
Birth	2394	69	708	4.02±0.85	17.93
Weaning	2132	61	686	21.65±5.53	20.77
6 months	2048	61	682	32.54±6.78	22.90

SD: Standard Deviation; CV: Coefficient of Variation

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in the current three-trait analysis. The most appropriate models for these traits were as follows:

Model I: $Y = Xb + Z_1a + e$
Model III: $y = Xb + Z_1a + Z_2m + e$ Cov (a, m) = 0

Where:
y = A vector of records on the different traits
b = Vectors of fixed effects
a = Vectors of direct additive genetic effects
m = Vectors of maternal genetic effects
e = Vectors of residual effects

While, X, Z_1 and Z_2 are corresponding design matrices associating the fixed effects, direct additive genetic effects and maternal permanent environmental effects to vector of y. The most appropriate model for BW and WW included direct additive genetic effects as well as maternal genetic effects (model III) but the best model for 6 MW had only the direct additive genetic effects (model I) in this study.

The model accounting for fixed effects included type of birth (single, twin and triplet), age of dam at lambing (2-7 years), sex of lamb (male and female), year of birth (1997-2007) and age of lamb at 3 and 9 months of age (days) as a covariate for WW and 6 MW, respectively.

Breeding values of individual animals were predicted with Best Linear Unbiased Prediction methodology. In order to estimate the genetic trends, means of predicted breeding values for lambs in year of birth were calculated. Genetic trends were obtained by regression means of predicted breeding values on year of birth for each trait. Genetic trends analyses were performed with the REG procedure of the SAS 9.1 software package (SAS, 2003).

RESULTS AND DISCUSSION

The estimates of genetic trends (g year^{-1}) for mentioned traits are showed in Table 2. The magnitude of genetic trends estimated illustrate that there has been a highly significant and positive genetic improvement in traits studied and reveals that overall, breeding programs in this station has been relatively effective.

Birth weight: Means of predicted breeding values of BW in each year of birth calculated from the three-trait analysis are showed in Fig. 1. As perceived since, the beginning of study period, ascendant direct and maternal genetic trends but these trends were irregular. The decrease of predicted breeding values mean in the year 2006 was apparently due to selection of sires with low breeding value. It seems that this low selection response

Table 2: Estimates of genetic trends (g year^{-1}) for some of the growth traits in Arman sheep

Weight	DT±S.E	R^2 (%)	MT±SE	R^2 (%)
Birth	2±0.39**	0.78	22±1.7	0.95
Weaning	7±1.31**	0.79	7±0.61	0.94
6 months	8±0.46**	0.97	-	-

DT: Direct Trend, MT: Maternal Trend, SE: Standard Error, R^2: Regression fit for genetic trend. **p<0.01

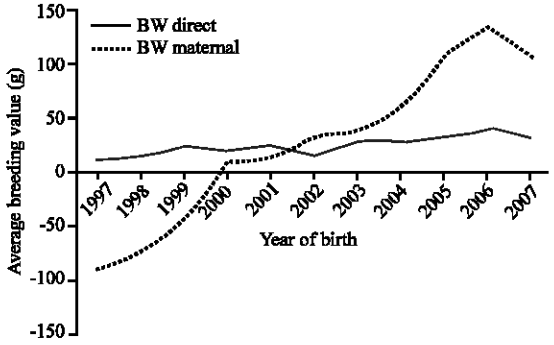

Fig. 1: Means of predicted breeding value of BW in each year of birth

implying that introduction of outside sires was based on phenotypic characteristics. The direct genetic trend value estimated for BW in the current study (2 g year^{-1}) was low and in accordance with findings of Mansour *et al.* (1977) in Barki sheep and Mokhtari and Rashidi (2010) in Kermani sheep. Furthermore, Klerk and Heydenrych (1990) researched on Dohne Merino in South Africa and reported that annual genetic gain during 1948-1985 was 5 g year^{-1} for birth weight.

However, estimates reported by Gizaw *et al.* (2007) in Menz sheep was higher than the estimate. Maternal trend estimate for BW was 22 g year^{-1} and very higher than the direct one. This may be because maternal effects in Arman sheep have more pronounced effect on BW. The poor accuracy with which breeding values have been predicted may explain the low direct trend for BW.

Weaning weight: Figure 2 showed direct and maternal genetic trends during a period of 10 years for WW of Arman sheep. The direct genetic trend estimate of WW (7 g year^{-1}) was very lower than those of 20 and 92 g year^{-1} obtained by Shaat *et al.* (2004) in Ossimi and Rahmani breeds, respectively. Mokhtari and Rashidi (2010) reported that mean of predicted of breeding values for WW increased about 125 g in Kermani. Also, Lax *et al.* (1979) reported mean increase for breeding value in WW was 620 g year^{-1}. The results of these researchers were higher than estimate obtained in this study. Maternal trend estimate for WW was also low and equal with direct one (7 g year^{-1}).

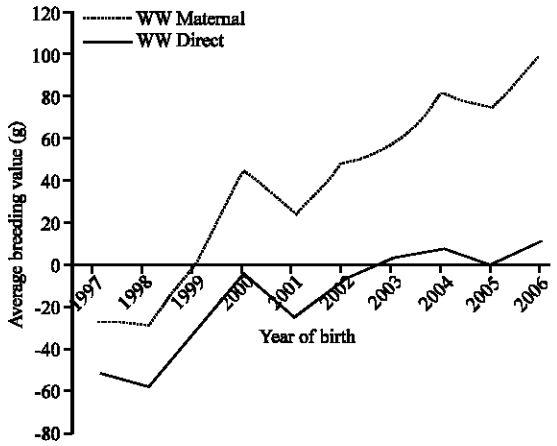

Fig. 2: Means of predicted breeding value of WW in each year of birth

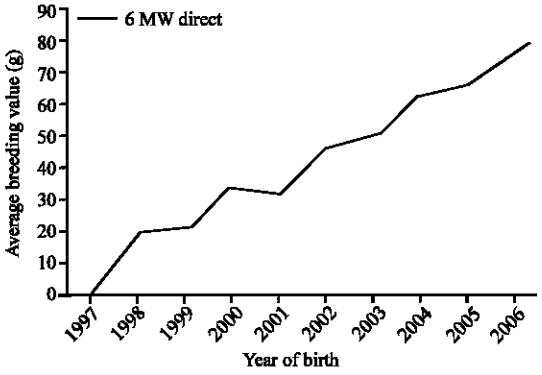

Fig. 3: Means of predicted breeding value of 6 MW in each year of birth

Six months weight: In Fig. 3, means of predicted breeding values of 6 MW in each year of birth calculated from the three-trait analysis are depicted. The current direct genetic trend estimate for 6 MW (8 g year^{-1}) was closer to the value obtained for WW.

Mohammadi *et al.* (2011) researched on Zandi sheep and reported that genetic trend during 1993-2008 was 21 g year^{-1} for 6 MW which the finding of these researchers was higher than amount obtained in this study. Higher estimate was observed by Shaat *et al.* (2004) in Egypt for Rahmani sheep (135 g year^{-1}).

CONCLUSION

Results from this study were positive and agree with those of the values estimated by Mohammadi *et al.* (2011) that the main reason for low genetic progress estimated could be the absence of clear and focused selection criteria during this period.

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