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Genetic evaluation of growth performance in Awassi sheep

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SUMMARY - A total of 1090 male and female Awassi lamb records were analyzed for pre-weaning growth performance and genetic parameters. Results indicated that progeny of Israeli rams were significantly heavier than pure Turkish Awassi at birth and weaning (70 days). Slightly higher pre-weaning daily gain observed for the offspring of the Israeli rams were not found to be significant. Hertabilities estimated from paternal half sib analyses were found to be 0.16, 0.22 and 0.20 for birth weight, weaning weight and preweaning daily gain. Birth weight was seen to have a moderate genetic correlation with weaning weight (61.6%) and preweaning daily gain (49.5%). The genetic correlation between weaning weight and the preweaning daily gain was 99%. Postweaning growth performance and genetic parameters were estimated using the feedlot data of 309 male lambs fattened along with the 11 000 male lambs of the State Farm. Sire lines were not found to be significant but the male lambs of the Israeli rams were 1.27 kg heavier than the pure Ceylanpinar lambs. Heritability of the final feedlot weight was found to be 0.35 and post-weaning daily gain 0.10, the latter being surprisingly low. Both genetic and phenotypic correlations between final weight and postweaning daily gain were found to be high.

Key words: Awassi, genetic parameters, growth, progeny test

RESUME - *Au total 1090 d'agneaux mâle et femelle de races Awassi ont été analysés afin de constater la performance de croissance pré-sevrée et les paramètres génétiques. Les resultats obtenus indiquent que la progéniture des béliers israéliens est plus lourde que celle de la race pure Awassi Turque à la naissance et au sevrage (70 jours). Le gain de poids quotidien au post-sevrage étant légèrement plus élevé pour les descendances des béliers israéliens n'a pas été trouvé significatif. Les héritabilités estimées à partir des donnés du demi-sang paternal ont été trouvées de 0.16, 0.22 et 0.20 pour le poids a la naissance, le poids au sevrage et la gain de poids quotidien au pré-sevrage. Le poids à la naissance peut avoir un niveau moyen de la corrélation génétique avec la poids au sevrage (61.6%) et le gain de poids au pré-sevrage (49.5%). La corrélation génétique entre le poids au sevrage et le gain de poids au pré-sevrage est de l'ordre de 99%. La performance de croissance au post-sevrage et les paramètres génétiques ont été*

estimés en employant les donnés d'engraissement des 309 d'agneaux mâles engraissés avec 11 000 d'agneaux mâles de la Ferme de l'Etat. Les lignées mâles n'ont pas été trouvées significatives et les agneaux mâles des béliers israéliens sont 1,27 kg de plus lourd que les agneaux pures de la race pure Awassi Turque. L'héritabilité du poids final dans 129 jours a été trouvé de 0,35 et le gain de poids quotidien de 0,10 au post-sevrage est faible d'une façon étonnante. Les corrélations génétique et phénotypique entre le poids final et le gain de poids au post-sevrage ont été trouvés hautes.

Mots-clés : *Awassi, paramètres génétiques, croissance, test de la descendance.*

INTRODUCTION

Awassi is a dairy sheep breed and is the predominant breed in Southeast Anatolia as well as the Arabian peninsula, Palestine and Israel. Awassi sheep, imported from Turkey, were found to produce more milk and grow faster than the local varieties in Iraq and Syria (Al-Rawi et al,1994; Bahhady et al, 1994a; Bahhady et al,1994b). The Awassi olso It proved to be a good sire breed in improving milk production of the crosses with other local breeds in different countries (Epstein,1985; Eliçin and Ertuğrul,1994).

Breeding efforts have been concentrated on milk rather than growth. In recent studies, lambs from the Ceylanpinar population in Turkey showed feedlot performance of over 325 g daily gains (Görgülü and Öztürkcan,1994; Özcan et al, 1994). These results indicate that mean growth performance is comparable to many well known meat breeds. Thus the Awassi is not only a good milker but may also be considered as being a good fattening material.

A reasonably fast growth is the key to profitability of the sheep operations. Under harsh conditions of the South Eastern Turkey, Syria, Iraq, Jordan and Israel Awassi can solve meat shortages if their growth and reproductive performance are improved not. Growth performance in Awassi, measured as postweaning weight gain (feed lot trials) shows great variation as is the case in lactation yields (97.5 - 469.0 kg). Hence selection for growth performance may yield better performing Awassi because heritability of growth is known to be higher than milk production. A better idea may be the inclusion of growth performance in the selection index of the rams along with the milk production.

In the ongoing project on "Genetic Selection for Milk Yield in Awassi Sheep" candidate rams are being tested using AI. Growth performance of the progeny of the tested rams were recorded. The objective in this study was to estimate heritabilities,genetic and phenotypic correlations of birth weight,weanining weight(70 days) and feedlot final weight (129 days), preweaning and postweaning daily gain (feedlot).

MATERIALS AND METHODS

Data were obtained from Awassi sheep flock kept at Ceylanpinar State Farm (CSF) in Sanliurfa province of Turkey. Beginning in 1992, a progeny testing scheme was initiated using genetic selection for milk yield in Awassi sheep, after determining the existence of high variation in lactation yields of the Ceylanpinar population

(Gürsoy et al.1992). In the selection programme, lamb growth data were also recorded and used for the analysis of growth performances of Awassi sheep.

Researchers in Israel report the existence of improved Awassi flocks with mean lactation yields exceeding 500 kg (Epstein,1985). So 5 improved rams were imported from Israel for comparative purposes. During the mating season 4 Israeli Awassi rams and 17 Ceylanpinar yearlings from the top producing Ceylanpinar ewes were used for artificially inseminating approximately 150 yearlings per ram at random in July/August 1992. The number of ewes lambing per 100 ewes mated was approximately 60%.

All the lambs were reared under similar conditions until weaning. Following weaning the male lambs were put on feedlot along with the 11000 male lambs of the production flocks. The lambs were born between mid December 1992 and end of January 1993. Birth weights were recorded within 24 hours of birth. For preweaning evaluation, the studied traits were birth weight (BW), weaning weight (WW) and pre-weaning daily gain (PWDG) for both sexes of lambs. Since weighings were made on fixed days rather than at fixed ages, weaning ages varied between 54 and 101 days. Therefore, adjustments were made to standard (mean) age of 70 days for the traits of weaning weight and pre-weaning daily gain. Pre-weaning daily gain was calculated as difference between weaning and birth weight divided by weaning age. After excluding twins and triplets a total of 1090 male and female lamb records were avaliable for the analysis of pre-weaning traits.

In order to evaluate post weaning performance, 309 male lambs were taken to a feedlot experiment after weaning. The weaning weight taken on a fixed date for all the lambs was considered as the initial feedlot weight. The feedlot period lasted between 44 and 61 days due to the varying ages of lambs. At the end of feedlot period the lambs were weighed and recorded as final weight (FW). Feedlot daily gain (FLDG) was calculated as the difference between initial weight (weaning weight) and final weight divided by the days in feedlot.

Analysis of variance

The mixed model least squares analysis and maximum likelihood computer programme written by Harvey (1987) was used to analyse the data. In order to estimate the effects of sire line and sex of lamb on birth weight, weaning weight and pre-weaning daily gain the following mixed model (Model 1) was used:

$$Y_{ijkl} = \mu + L_i + S_{j:i} + C_k + e_{ijkl}$$

For analysis of the feedlot traits, the following mixed model was used (Model 2):

$$Y_{ijl} = \mu + L_i + S_{j:i} + b_1 (X_{ijl} - \bar{X}) + b_2 (Z_{ijl} - \bar{Z}) + e_{ijl}$$

In the models above:
Y_{ijkl} : Observed pre-weaning traits recorded on l^{th} lamb with k^{th} sex, sired by j^{th} sire of i^{th} line,

Trait 1 (BW) : Birth weight (kg),
Trait 2 (WW) : Weaning weight adjusted to standard age of 70 days (kg),

Trait 3 (PWDG) : Pre-weaning daily gain (g),

Y_{ijl} : Observed feedlot traits recorded on l^{th} lamb with sired by j^{th} sire of i^{th} line,
Trait 4 (FW) : Final weigth at the end of feedlot period (kg),
Trait 5 (FLDG) : Feedlot daily gain (g),
μ : Oerall mean,
L_i : Fixed effect of i^{th} sire line,
$S_{j:i}$: Random effect of j^{th} sire nested within i^{th} line, $S_{j:i} \sim (0, \sigma^2_s)$,
C_k : Fixed effect of k^{th} sex of lamb,
b_1 : Regression coefficient of initial feedlot age for Model 2,
b_2 : Regression coefficient of days on feed for Model 2,
X_{ijkl} : Initial feedlot age (days),
Z_{ijkl} : Days on feed (days),
e_{ijkl} : Random residual term, $e_{ijkl} \sim (0, \sigma^2_e)$.

In the models studied, line difference was tested against the sire within line effect. The significance of all other terms were tested against the error mean squares.

Heritabilities, phenotypic and genetic correlations

Heritabilities, phenotypic and genetic correlations between traits were estimated from paternal half-sib data, sire components of variance (σ^2_s) and covariance (Cov_sXY) with 17 degrees of freedom and residual components of variance (σ^2_e) and covariance (Cov_eXY) with 1071 degrees of freedom. In order to estimate genetic parameters considered, the principles employed were similar to the "Model 3" given by Harvey (1987).

RESULTS AND DISCUSSION

Pre-weaning traits

The effect of sire lines was found to be highly significant for birth weight ($p<0.001$) and significant for weaning weight ($p<0.05$). However, it was non-significant for pre-weaning daily gain (Table 2). As it is seen in Table 1, mean birth weight of the lambs sired by Israeli rams exceeded by 0.43 kg the lambs sired by Turkish Awassi rams. At weaning the difference between sire lines was 0.90 kg and relatively lower than that of birth weight indicating that the sire effect decreased significantly as lambs got older. The difference between the sire lines may have originated from the relatively greater size of the Israeli rams either selected for size or rared intensively. Their average weight at mating time was 117 kg as compared to the 77 kg of the Ceylanpinar Awassi which are fed very little supplement after weaning until their first mating at 18 months.

As expected,sex of lambs had also highly significant effect on all the pre-weaning traits ($p<0.001$; Table 2). Indicating that adjustment of pre-weanning data for sex of lamb is a necessary procedure for correct estimation of the genetic parameters and precise selection of the best rams.

Table 1. Least squares means and standard errors for birth weight (BW), weaning weight (WW) and pre-weaning daily gain (PWDG).

Effect	n	BW (kg)	WW (kg)	PWDG (g)
Overall Line	1090	4.35 ± .04	16.89 ± .20	181.89 ± 2.55
Israel	269	4.56 ± .06	17.34 ±.36	185.71 ± 4.58
Turkish	821	4.13 ± .03	16.44 ± .20	178.06 ± 2.51
Sex				
Male	534	4.47 ± .04	17.48 ± .22	187.53 ± 2.77
Female	556	4.22 ± .04	16.29 ± .22	176.23 ± 2.74

Table 2. Least squares analysis of variance for birth weight (BW), weaning weight (WW) and pre-weaning daily gain (PWDG).

		Level of significance		
Source of variance	d.f.	BW	WW	PWDG
Sire lines	1	***	*	ns
Sires	17	***	***	***
Sex of lambs	1	***	***	***

***: p<0.001, *:p<0.05, ns: not significant

The use of Israeli rams at Ceylanpinar was based on the assumption that the high performance of Israeli Awassi for milk yield was due to superior genetic component for this trait. The results reported in this paper are a first step to investigating the extend of this assumed genetic superiority.

In the current study, the use of genes from Israeli Awassi was limited to half those in the recorded rowing lambs. At young ages lamb growth is dominated by the maternal environment, particularly milk yield of the mother, and the genetic potential of the lamb for early growth is masked by these somewhat greater Influences.

Table3. Heritabilities, phenotypic and genetic correlations between pre-weaning traits[1]

Traits	BW	WW	PWDG
BW	.16 ±.07	.30	.11
WW	.62 ±.23	.22 ±.10	.99
PWDG	.50 ±.28	.99 ±.01	.20 ±.08

1) Heritabilities, genetic and phenotypic correlations are shown on, below and above diagonal, respectively.

As it is seen in Table 3, estimates of heritability, genetic and phenotypic

correlations were significant for all pre-weaning traits. The heritability estimate of birth weight was higher than those found in the studies by Bowman and Broadbent (1966); Thrift et al. (1973); Gjedrem(1967); Erkje (1974), and lower than those found by Olson et al.(1976); Vogt et al. (1967); Osman and Broadford (1965); Owen et al. (1978); Mavrogenis et al. (1980); Qureshi et al., (1987), however, nearly similar to found by Martin et al. (1980) and Shelton & Campbell (1962).

The heritability for weaning weight standardized to 70 days of age was found to be low when compared to the findings in many previous studies carried out on various sheep breeds. However, it seemed to be higher than those found by Thrift et al. (1973); Vogt et al. (1967); Mavrogenis et al. (1980).

The heritability estimate for pre-weaning daily gain was found lower than those found in the other studies. Mavrogenis et al. (1980) found a higher estimate (0.36) in Chios sheep and Qureshi et al.(1987) found 0.27 for Awassi sheep. Birth weight had a moderate genetic correlations with weaning weight and pre-weaning daily gain whereas it was found to be very high between the latter traits.

The heritabilities of the early growth traits were low but consistent with other reports from similar flocks analysed by paternal half-sib least squares techniques. There is clearly some genetic influence of the lamb on its own growth but recent studies using animal model techniques and an additional maternal component of variance have highlighted the effects of the ewe on these traits. Under the conditions of Ceylanpinar the greatest response in early lamb growth will come from selecting ewes for improved milk production and rams for post-weaning growth rate.

The genetic correlations between the early lamb traits are consistent with other reports, the closer the weights in time the higher the the correlations. The very high correlation between weaning weight and pre-weaning daily gain is not surprising since they are almost the same trait., differing only in the the inclusion of birth weight in weaning weight.

Feedlot traits

In the feedlot experiment only the male lambs were considered because in Ceylanpinar female lambs are not fattenned. So the actual weaning weights were taken as the initial feedlot weight. The lambs had arying ages, between 54-101 days with a mean of 73 days at weaning. The lambs were weight once at the end of the feedlot period of 44-61 days with a mean lamb age of 129 days.

The effect of sire line was significant for weights at birth and weaning, whereas it was non-significant for feedlot final weight and feedlot daily gain ($p>0.05$). As seen in Table 5, sire effect was also insignificant for feedlot daily gain ($p>0.05$) but significant for final weight ($p<0.05$). Unlike the pre-weaning traits a ecreasing influence of sire line was observed. As the lambs grow, effects of line on growth in the post-weaning (feedlot) period become non- significant.. This may be partly due to the level ofprecision of the trial with limited numbers on the feedlot trial and considerable variation in age and weight at the start of the feedlot. However, it may also be the result of the limiting influence of the ewe and the environment at Ceylanpinar not allowing the full potential of the Israeli bred lambs to show. In a

recent study at the Univrsity of Cukurova Görgülü and Öztürkcan, (1994) reported fairly high daily gains (300-350 g) for the weaned lambs purchased at random from Ceylanpinar. Daily gains of approximately 230 g obtained in this study indicate that the feeding regime provided to the mass number of lambs (11 000) at the feedlot failed to meet the nutritional requirements of the lambs. Despite this, Israeli-bred lambs were 1.27 kg heavier at the end of the feedlot period and showed consistently superior, but non-significant, growth throughout the trial.

Table 4. Least squares means and standard errors for final weight (FW), and daily gain in feedlot period (FLDG) for the male lambs.

Effect	n	FW (kg)	FLDG (g)
Overall Lines	309	31.85 ± .47	232.45 ± 4.17
Israeli	78	32.48 ± .83	233.75 ± 7.27
Turkish	231	31.21 ± .47	231.14 ± 4.18
Regressions			
Initial feedlod age		.509 ± .02	2.068 ± .296
Days on feed		.308 ±.04	-0.068 ± .517

The regression of initial feedlot age on the final weight indicates that for every day increase in the initial feedlot age final weight increased by .509 kg. It also had an effect on the feedlot daily gains by roughly 2 g. Days on feed had

Table 5. Least squares analysis of variance of final weight at the end of feedlot (FW) and feedlot daily gain FLDG) for the male lambs.

		Level of significance	
Source of variance	d.f	W	FLDG
Sire lines	1	ns	ns
Sires	17	***	ns
Regressions Coef.(Linear)			
Initial feedlot age	1	***	***
Days on feed	1	***	ns

***: p<0.001, *:p<0.05, ns: not significant

an effect of .308 kg on the final weight but very little negative effect on the feedlot daily gain.

The heritability for feedlot daily gain was very low (Table 6) compared to values reported in other studies. This may be due to the small variance of the sire component found for this trait.

Table 6. Heritabilities, phenotypic and genetic correlations between feedlot traits[1].

Traits	FW	FLDG
Final weigth (FW)	.35 ± .18	.77
Daily gain in feedlot(FLDG)	.94 ± .22	.10 ± .11

1) Heritabilities, genetic and phenotypic correlations are shown on, below and above diagonal, respectively.

The genetic and phenotypic correlations were found to be high indicating close relation between these two traits.

CONCLUSIONS

Israeli Awassi rams, assumed to be superior to Turkish rams for lactation traits, were found to be superior for birth and weaning weights, however, they were not superior for feedlot traits. Another trial with higher nutritional status may be necessary in order to test their feedlot performance along with the contemporary pure Turkish Awassi. A more eloborate analyses of 1992/93, 1993/94 and 1994/95 data will give better picture of their actual merits.

According to the results, since the heritabilities were low for both pre-weaning and feedlot (postweaning) traits it will not be appropriate to select according to individual merits. Therefore progeny testing may be more effective in improving growth performance in Awassi sheep.

The high estimates of genetic correlations between weaning weight and pre-weaning daily gain point that selection based on weaning weight can provide enough progress for the pre-weaning daily gain. Similar remarks are valid for the traits of feedlot final weight and feedlot daily gain.

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