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ANIMAL MODEL ESTIMATION OF GENETIC AND PHENOTYPIC PARAMETERS OF SOME PRODUCTIVE TRAITS IN OSSIMI AND RAHMANI SHEEP

E. M. M. Shaat[1], H. M. K. Mansour[2], H. R. M. Metawi[1] and E. A. El-Tawil[2]

1- Animal Production Research Institute, Dokki, Giza, Egypt 2- Department of Animal Production, Faculty of Agriculture, Ain Shams University, Cairo, Egypt .

SUMMARY

Performance data were collected during the period from 1970 to 1993 on lamb weights at 120 (W120), and 180 (W180) days of age and number of lambs born per ewe joined (LB_j) from Ossimi and Rahmani flocks raised at four of the Ministry of Agriculture experimental stations .

Genetic and phenotypic parameters were estimated using multiple trait animal model program (MTDFREML) .

The heritabilities of LB_j were low (h^2=0.03 for Ossimi and 0.09 for Rahmani) and relatively high for W120 and W180, (h^2=0.26 and 0.24 in Ossimi and 0.13 and 0.26 in Rahmani, respectively).

The genetic correlation between W120 and W180 was high and positive (r_G=0.91 for Ossimi and 0.85 for Rahmani) . Negative and moderate genetic correlation was found between W120 and LB_j in Ossimi (r_G=-0.31).

Genetic correlation between LB_j and W180 were low in both Rahmani and Ossimi breeds .

Key words : Sheep, lamb body weights, fertility, heritability, genetic correlation.

INTRODUCTION

Response to selection to improve productive traits depends mainly on the values of heritability and genetic correlation of the concerned traits. The heritability indicates the proportion of the total variation which is responding to selection (Falconer, 1960).

Methods of estimating heritability depend on measuring the degree of resemblance between individuals related by linear or collateral descent after eliminating as much as possible the environmental contribution to this similarity (Lush, 1949). Estimates of the heritability of 120-day and 180-day weights were obtained by: paternal half-sib (PHS), Ashraf *et al.* (1975); daughter-dam regression (b_{od}), Aboul-Naga and Afifi, (1982) intra sire regression (ISR), intra sire correlation (ISC), Ragab and Asker (1954) and Restricted Maximum Likelihood (REML) under animal model (Waldron and Thomas, 1992; Nasholm and Danell, 1994 and Sakul *et al.* , 1994).

For fertility traits, heritability was estimated by paternal half-sib (PHS) and all or non-trait based method (AON), Forrest and Bichard, 1974 and Restricted Maximum Likelihood (REML) under animal model (Waldron and Thomas, 1992; Elsen *et al.* , 1994).

No clear trend could be observed in the various heritability estimates when comparing among methods but, mixed model methodologies under animal models have became the method of choice to estimate genetic parameters and breeding values, not only because they provide best linear unbiased predictors (BLUP) of breeding values, but because they also simultaneously estimate genetic and environmental effects, taking into account all the relationships among animals (Henderson, 1988; Kennedy *et al.* 1988 and Meyer, 1989). Kennedy *et al.* (1988) also concluded that animal models account for the effect of selection and non-random mating when the complete covariance matrix is used.

The objectives of this study were to calculate estimates of heretability for weights at 120, 180 days of age and number of lambs born per ewe joined and genetic and phenotypic correlations amang these traits in Ossimi and Rahmani Egyptian sheep breeds.

MATERIALS AND METHODS

Data were collected on Ossimi (O) and Rahmani (R) local Egyptian fat-tailed breeds over a twenty four years period, from 1970 to 1993, at four of the Ministry of Agriculture experimental stations. Ossimi flocks were raised in three experimental stations, Mehallet-Mousa (Mid Delta), Sids (Mid Egypt) and El-Gemmiza (South Delta), while Rahmani flocks were raised in two stations, Mehallet-Mousa and El-Serw (North Delta). The study involved 5511 Ossimi and 8280 Rahmani lambs, which were the progeny of 314 and 424 sires, respectively .

Ewes in these flocks were bred under an accelerated lambing system by mating every eight months. Mating seasons were May, January and September, each lasting for 35 days. Ewes and rams were first mated at about 18 months of age. Ewes were assigned to ram breeding groups at random. Each 30-35 ewes were exposed to a fertile ram in separate mating pens. If the ram was unable to serve the ewes, he was substituted by another ram after one week of his removal. The corresponding lambing seasons took place in October, June and February. Lambs were weaned at approximately eight weeks of age.

In the period from December to May, the flocks grazed Egyptian clover (Berseem) *Trifolium alexandrinum* . In summer and autumn seasons they were fed on hay or by grazing stubble, whenever possible , and supplemented with pelleted concentrate mixture. At lambing, new born lambs were identified and their type of birth, sex and pedigree were recorded. Weights were recorded within twenty four hour of birth and at 30-days intervals.

Traits studied lamb weights at 120 (W120) and 180 (W180) days of age and number of lambs born per ewe joined (LB_j) from the first parity of ewes. Most ewes had information on their first parity, also ewe data analysis showed that LBj at first parity had the highest heritability estimate. Weights at 120 and 180 days of age were measured as individual traits on the lambs and number of lambs born per ewe joined was measured as a reproductive trait on the dams of the lambs. However, lamb birth weight was not included in this study, because Abdel-Aziz *et al.* (1979) found that when birth weight was dropped from the index, the efficiency was reduced by 1.5% only .

Genetic and phenotypic parameters were estimated by a multiple trait animal model program (MTDFREML), the program considers all the pedigree information available when calculating the inverse of the numerator relationship matrix, and a multivariate normal distribution was assumed (Boldman *et al.* , 1993).

The following linear animal model was used :

$$Y = X\beta + Zu + e,$$

where,

X is the incidence matrix for fixed effects,

β is the vector of an overall mean and fixed effects of farm, age of dam, season of birth, block of year, sex and type of birth for lamb weight traits; or the fixed effects of farm, season of lambing and block of years, for LB_j,

Z is the incidence matrix for random effects,

u is the vector of random effects (animals additive genetic effects) associated with the incidence matrix Z and

e is a vector of random errors assumed to be normally and independently distributed with zero mean and variance σ^2_e.

The variance-covariance structure of the random effects were :

$$Var \begin{bmatrix} u \\ e \end{bmatrix} = \begin{bmatrix} A\sigma^2_a & 0 \\ 0 & I\sigma^2_e \end{bmatrix},$$

where,

σ^2_a is the additive genetic variance,

A is the relationship symmetrical matrix of order n, (n = No. of animals)

I is the identity symmetrical matrix of order n

RESULTS AND DISCUSSION

Variance component estimates for W120, W180 and LB_j for both Ossimi and Rahmani breeds are presented in Table 1. The Table depicts the increasing trend of estimates of genetic and residual components of variance (σ^2_a and σ^2_e) with increasing age of lambs for lambs weight traits in both studied breeds. These results are in agreement with those of Mousa (1989) who found that, the rate of increase in log genetic variance with degree of maturity appeared to be roughly linear in all measurements.

Heritability estimates for each of the three studied traits are presented in Tables 2 and 3 for Ossimi and Rahmani sheep, respectively. The heritabilities were estimated as .26 and .13 for weight at 120-day and .24 and .26 for weights at 180-d in Ossimi and Rahmani, respectively. Heritability estimates of body weights varied greatly in pervious studies depending on the model used in the aand the associated assumptions, regarding breed and population. Reported h^2 estimates ranged from -.10 (Ashraf *et al.* , 1975) to .76 (Daflapurker *et al.* , 1980) for W120 and from -.42 (Ragab and Asker, 1954) to .70 (Chopra and Acharya, 1971) for W180. Many estimates, for W120 are in the neighborhood of .26, by Gonzalez, (1983) and for W180 by Nasholm and Danell (1994) which correspond to the estimates found in the present study. On the other hand, higher estimates of h^2 for W180 were reported by Mousa (1989) and Waldron and Thomas (1992).

Table 1. Estimates of additive genetic variance (σ^2_a) and residual variance (σ^2_e) for 120-day (W120), 180-day (W180) weights and number of lambs born per ewe joined (LB_j) in Ossimi and Rahmani sheep .

Traits	Ossimi		Rahmani	
	σ^2_a	σ^2_e	σ^2_a	σ^2_e
W120	4.53	12.80	1.35	8.87
W180	5.89	18.45	3.90	11.36
LB_j	0.05	1.56	0.13	1.34

Table 2. Estimates of heritability (on the diagonal), genetic correlations (above the diagonal) and phenotypic correlations (below the diagonal) among 120-day (W120), 180-day (W180) weights and number of lambs born per ewe joined (LB_j) in Ossimi, sheep.

Traits	W120	W180	LB_j
W120	.26	.91	-.31
W180	.85	.24	-.01
LB_j	-.03	-.04	.03

Comparing the h^2 estimates obtained in the present study with those estimates using the sire model by Mousa (1989) would be of interest, the estimates obtained by Mousa (1989) were .55 and .53 in Rahmani; .57 and .61 in Ossimi for weights at 120 and 180 days, respectively. Mousa adjusted the data to the involved fixed effects and reanalyzed, the data utilizing a random effects model. This procedure may result in biased estimates of variance components (Mansour, 1995). However, in this study, the relationships among all involved animals were utilized in the animal model and seems to overcome the problem of disconnectedness that Mousa's data suffered from.

The heritability estimates for W120 in the present study were .13 in Rahmani and 0.26 in Ossimi. These estimates were considerably lower than h^2 estimates of W180. This would indicate that environmental factors had more influence on W120 than on

W180. During the early life of the lamb its rate of gain is influenced more by its dam's milk production than in later stage in his life.

Estimates of heritability of number of lambs born per ewe joined LB_j were .03 for Ossimi and .09 for Rahmani. It is recognized that Rahmani sheep is the most prolific breeds in Egypt . So, more genetic variation for litter size are expected in Rahmani sheep. Some of the high heritability estimates for ovulation rate are from Finn sheep (.50; Hanrahan and Quike, 1985) and Romanove (.39; Ricodean *et al.* , 1986), which are breeds that are known for their high ovulation rate (Haresign, 1985). The Merino in Australia have a relativily low ovulation rate (Pejer *et al.* , 1984) and a low estimate of heritability (.07) .However, heritability estimates for LB_j are generaly low, ranging from .0 to .2 (Shelton and Menzies, 1968 ; Waldron and Thomas, 1992; Smith *et al.* , 1992; Burfening *et al.* , 1993 and Elsen *et al.* , 1994) for forigen breeds and Aboul-Naga *et al.* , (1985) and Almahdy (1987) for local breeds. The variation among these estimates of heritability may be influenced by breed differences, population, environment factors considerd in the statistical model and the analysis method.

Estimates of genetic correlation between the studied traits are shown in Tables 2 for Ossimi and 3 for Rahmani breeds. Estimates of genetic correlation between weights at 120 and W180 days were higher than those between LB_j and those weights. The high genetic correlation between W120 and W180 being .91 for Ossimi and .85 for Rahmani indicate that both of them are affected by common genes. However, this high genetic correlations were reported by many authors between lamb weights at various ages (Aboul-Naga and Afifi, 1982; Shrestha *et al.* , 1985 & 1986 and Stobart *et al.* , 1986). So, in order to minimize the effect of selection for weight at birth and possibility of increasing frequency of dystocia, selection would be better directed towards weights at later ages. However, selection for 120-day weight is expected to increase birth and 180-day weights. The present estimates of genetic correlation between W120 and W180 are in general agreement with those reported by Martin *et al.* (1980) and Mousa (1989). The genetic correlations between W120 and LB_j were of little magnitude being positive in Rahmani (.08) and negative in Ossimi (-.31). Estimates of genetic correlations between W180 and LB_j were -.01 in Ossimi and .02 for Rahmani. These estimates of genetic correlation are less than the estimates reported by Ch'ang and Rae (1972) between body weight at six months and litter size which were .38 (using paternal half-sib method) and .43 (using an average of estimates from paternal half-sib, daughter-dam regression and dam-offspring covariance). On the other hand, Waldron and Thomas (1992) working on Rambouillet estimated the genetic correlation coefficient between 180-day body weight and litter size as .22 (obtained by the same procedure used in the present study).

Estimate of phenotypic correlation between weights at 120 and 180 days was higher in Ossimi (.85) than in Rahmani (.61) and tended to be lower than those for the genetic correlations. These results are in general agreement with those reported by Mousa (1989). On the other hand, phenotypic correlation between number of lambs born and 120-day body weight was very low being .004 in Rahmani and -.03 in Ossimi. No estimates of phenotypic correlation between W120 and LB_j could be found in the literature. However, many authors reported estimates of phenotypic correlation between lambs born and weaning weight (ranging from 2 to 4 months) ranging from .02 to .10 (Shelton and Menzies, 1968 and Basuthakur *et al.* , 1973).

Table 3. Estimates of heritability (on the diagonal), genetic correlations (above the diagonal) and phenotypic correlations (below the diagonal) among 120-day (W120), 180-day (W180) weights and number of lambs born per ewe joined (LB_j) in Rahmani, sheep.

Traits	W120	W180	LB_j
W120	.13	.85	.08
W180	.61	.26	.02
LB_j	.004	-.03	.09

Estimates of phenotypic correlation between number of lambs born and weight at 180-day, (-.04) in Ossimi and (-.03) in Rahmani, were in disagreement with the previously reported estimate (.08) of Waldron and Thomas (1992) which was based on an animal model analysis of Rambouillet sheep.

CONCLUSION

Utilizing the multiple trait animal model methodology in the estimation of variance components makes use of all available information and could lead to more precise estimates. Different breeding plans are needed to the local sheep breeds since different genetic parameters were obtained for the two studied breeds.

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تقدير المعالم الوراثية والمظهرية لبعض الصفات الإنتاجية فى الأغنام الأوسيمى والرحمانى باستخدام نموذج الحيوان

إيهاب مصطفى محمد شعت[١] - حسين مصطفى كمال منصور[٢] - حلمى رشاد مطاوع[١] - عصام عبد السلام الطويل[٢]

١- معهد بحوث الإنتاج الحيوانى ، دقى ، جيزة ، مصر ٢- قسم الإنتاج الحيوانى ، كلية الزراعة ، جامعة عين شمس ، القاهرة .

أجريت هذه الدراسة لتقدير بعض المعالم الوراثية والمظهرية في الأغنام المحلية (الاوسيمى والرحمانى) و ذلك لصفتى وزن الجسم عند عمر ١٢٠ و ١٨٠ يوماً وكذلك صفة عدد الحملان المولودة لكل نعجة قدمت للكباش للتلقيح .

استخدمت فى هذه الدراسة السجلات المتاحة لعدد ٥٥١١ من الحملان الاوسيمى ، ٨٢٨٠ من الحملان الرحمانى حيث تم تجميع السجلات المستخدمة خلال الفترة من سنة ١٩٧٠ إلى سنة ١٩٩٣ من أربع قطعان ربيت فى المحطات التجريبية التابعة لوزارة الزراعة .

تم تحليل البيانات لتقدير مكونات التباين باستخدام برنامج نموذج الحيوان المتعدد الصفات مستخدماً الحيوان نفسه كتأثير عشوائى .

كانت تقديرات المكافئ الوراثى هي ٢٦,. ، ٢٤,. ، ٣,.. فى الأغنام الاوسيمي ، ١٣,. ، ٢٦,. ، ٩,.. فى الأغنام الرحمانى وذلك بالنسبة لصفات وزن الجسم عند ١٢٠ ، ١٨٠ يوما من الميلاد وعدد الحملان المولودة لكل نعجة قدمت للكباش للتلقيح على الترتيب .

كانت جميع معاملات الارتباط الوراثى و المظهرى عالية بين صفتى وزن الجسم عند ١٢٠ ، ١٨٠ يوم فى كل من أغنام الاوسيمى والرحمانى .

أما معاملات الارتباط الوراثى و المظهرى بين صفة عدد الحملان المولودة لكل نعجة قدمت للكباش للتلقيح وأى من صفات الأوزان فكانت منخفضة جدا فى أغنام الرحمانى أما فى أغنام الاوسيمى فكانت تلك المعاملات كلها سالبة بالنسبة لنفس الصفات .