ESTIMATES OF GENETIC PARAMETERS FOR GROWTH TRAITS OF LOCAL HAMRA BREED THREATENED WITH EXTINCTION IN SOUTHWESTERN ARID RANGELAND OF ALGERIA

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Abstract: The data base for body weights and growths of 411 Hamra lambs were used to estimate genetic parameters. These lambs were obtained from 31 rams and 493 ewes between 2012 and 2017. Traits analysed were weights at birth (B_W), 30 days (W_{30}), 90 days (W_{90}) of age, and average daily gains from 10 to 30 (ADG_{10-30}) and30-90 (ADG_{30-90}) days. REML estimates of variance and covariance components were obtained assuming animal models that included the fixed effects for year-type of birth (2012 single, 2012 twin, . ., 2017 single, 2017 twin), sex (male, female), and ewes age at lambing (< 18, 18-30, 30-42, 42-54, >54 months). Heritabilities were 0.12, 0.06 and 0.11 respectively for B_W, $W_{3O}$and $W_{90}$and the average daily gains were 0.05 and 0.17 for $ADG_{0-30}$and ADG_{30-90}. The estimates of genetic correlations showed no genetic antagonisms among the growth traits. The genetic correlations estimated were positive and medium to high, except those between ADG_{30-90} and ADG_{0-30} and between ADG_{30-90} and W_{30} which were slightly negative. Phenotypic correlations were positive and ranged from 0.12 to 0.85. They were high between adjacent weights and between ADG and their corresponding weights.

Keywords: Heritability, Genetic correlation, Growth Traits, Sheep

Introduction

The small ruminants contribute substantially to the livelihoods and food security of rural Mediterranean farms in dry areas of the North Africa region (*Bengoumi et al., 2013*).However, because of instability of resources and inputs,

climatic challenges, conflicts and security, livestock rearing in the marginal dry areas is challenged by low productivity and poor access to markets. On a global scale and in animal production in general, the competition looks terrible and any country which will not be able to organize itself is condemned to know serious economic and social problems. Local breeds represent an important component of farm animal diversity to be maintained and exploited. The Modern breeding animals involve genetic improvement of animals by applying the basic principles of quantitative genetics. In order to achieve this genetic improvement, it is necessary to properly select the superior parents of future generations. For all this it is necessary a good knowledge of genetic parameters heritability, correlation, covariance and variance *(Thompson et al., 2005)*.Otherwise knowledge of the genetic parameters for economically important traits of animals is necessary, is essential in order to evaluate the breeding values of individuals, made an effective plan and program breeding, and evaluate effects of selection. Algerian country is home to sheep genetic resources that renown all over with 6 principal breeds and 28 millions of heads sheep (*Yerou, 2013; MADR, 2017*).The diversity of local breeds is valuable asset for the development of agriculture and territories in Algeria and this diversity of breeds constitute a good insurance for the future. Small ruminant production throughout the region is mainly based on traditional systems where animals are managed through an agro-pastoral and extensive system with large flocks grazing in pastoral and mixed farming environments with varying degrees of livestock movement from nomadic to transhumance. However, breeding techniques currently used are generally rudimentary and limit considerably the productive capacity of this species leading to a mow productivity rate (*Yerou, 1998; Dekhili and Aggoun, 2006*) thus contributing to a lack of red meat production. Genetic diversity found in Algerian domestic breeds favored the adaptation of livestock to various environmental conditions and stresses, including disease, parasites, temperature, humidity and many other factors. Though, the programs undertaken by government for the development of this genetic resources capital were confronted to a limited knowledge of the basic genetic material and the inexistence of in situ conservation strategies, as illustrated by the case of the reduction of more than 50 % for the Hamra sheep breed (*Yerou, 1998, 2013*).The Hamra or Daghma breed is native to eastern Morocco; its extension area is between ChottEch-Chergui in the east, of Saharian Atlas in the south-east, Morocco in the west and the Tlemcen and Saida mountains in the North. Many authors agree that it has several advantages: good maternal skills, good reproductive qualities, good resistance to harsh conditions, good use of coarse foods and good walking skills (*Chellig, 1992; Benyoucef et al., 1995; Yerou, 1991*). Despite its good conformation and excellent quality meat, the effect never ceases to regress. It was estimated at 6 million in 1969s more than 2.5 million head in the 1980s, is at present only about 0.5 million head. The downsizing of Hamra puts this breed in a situation of breed at risk (*IANO, 2007*; *Yerou, 2013*). The work done on the Hamra

breed is rare; the existing ones have been limited in numbers and for short periods. However, there is no report of genetic parameters for traits in this breed, calculated using animal model methodology and accounted for maternal genetic effect.The risk of disappearance of this population among breeders of steppe and pre-saharian rangeland is a priority in research programs because they are animals well adapted to environmental conditions that take a particular interest in the context of global warming. It is a national genetic heritage which must be able to manage and maintain. There is no published research on genetic traits of Hamra sheep, to date. Thus, this paper analyzed data from ITELV (StationNational breeding technicalinstitute), and estimated genetic parameters of growth traits of lamb weights and daily gains from birth to weaning, providing a scientific evidence for breed selection in futureat the station.

Materials and methods

Animals and management

The data used in this study to estimate genetic parameters of growth traits were obtained from flocks in ITELV of Ain El Hadjar. An initial database of 441Hamralamb's progeny of 493 ewes, collected during six years (from 2012 to 2017), were used. The station is situated 11 km in west-South of Saida at 1015 m average altitude, cordoned 34-35 of Latitude and 0-8^{E}longitude. Climate is arid; the maximum temperature recorded is approximately 39°C in summer (august), while the temperature drops to -2°C in January. The mean annual rainfall is around 437 mm. Ewes were managed in extensive lambing rhythm to lamb in autumn (September, October, and November). The lambs had complete records for all traits from birth to weaning. The environmental, nutritional, and management conditions were the same for all of the animals. The rams were 2-5 years of age and kept separated from ewes, generally. The mating season start from 10 April to 20 May. The lambs were weighed, early after birth, the date; sex and type of birth were recorded and at average age of 90 days the lambs were weaned. Supplemental feeding was offered during mating and late pregnancy. During lambing and suckling periods, the experimental herd receives sheep concentrate and ground barley and oat forage. An annual program of vaccination, deworming and dipping was carried out for all animals. Lambs were weighed individually every 20 days, until weaning at around 90days of age. Lambs birth weight (B_W), age-standardized weights at 30 days (W_{30}), and 90 days (W_{90}) of age and average daily gains from 10 to 30 (ADG_{10-30}) and 30 to 90 days (ADG_{30-90}) were analysed.

Statistical analysis

Recorded data were statistically analysed using, fixed linear models with the proc GLM for General Linear Model in SAS software (SAS Institute, 2000).

Fixed model included effects for year-type of birth (2012 single, 2012 twin, .., 2017 single, 2017 twin), sex (male, female), and ewes age at lambing (< 18, 18-30, 30-42, 42-54, >54 months) for B_W, W_{30} and ADG_{10-30}, and the same fixed effects, except year-type of birth effect was replaced by year-type of rearing for W_{90} and ADG_{30-90}. To estimate the genetic parameters, the same fixed effects were integrated in mixed model together with the random animal effects. The estimation of covariance components was obtained using the software MTDFREML (*Boldmanand et al., 1993*). Heritabilities were initially estimated using single-trait analyses. Then, genetic correlations between all traits were estimated using two-trait analyses which accounts for only one random genetic effect, direct genetic effect, in the model. The standard errors of genetic correlations were calculated using the approximate formula given by *Falconer and Mackay (1996).*

Results and discussion

Non genetics factors effects

Average weights and daily gains, standard deviations, and the proportion of variation explained by the models (R^2) are given in Table 1. The analyses of variance showed that the fixed models explained 35to 51% of the phenotypic variances in all traits, and that effects of year-type of birth, the sex were important environmental sources of variation for all growth traits ($p<0.01$) but the age of ewe was only significant for traits B_W and W_{30} of age, Table 2.

Table1. Variation of Average weights (Kg) and Average daily gains (g) of lambs

Traits	B_w	W_{30}	W_{90}	ADG_{10-30}	ADG_{30-90}
µ	3.4	7.8	15.1	132	141
SD	0.48	1.2	1.8	32	29
R^2 of the model (%)	41	49	51	35	48

µMean, (SD) standard deviations, (R^2, %) of total variance explained by model

Table 2.Significance of model for weights and Average daily gains of lambs

Effects	B_w(kg)	W_{30}(kg)	W_{90}(kg)	ADG_{10-30}(g)	ADG_{30-90} (g)
Sex	**	**	**	**	**
Ewe age	**	**	NS	**	NS
Year-birth type	**	**	**	**	**

B_W: Birth weight, W_{30}, W_{90}: weights at 30, 90 days age, ADG_{10-30}, ADG_{30-90}: average daily gain.

These effects of non-genetic factors are in accord with those signalled in other south Mediterranean studies on growth traits in Ouled Djellal (*Allaoui* and al, 2013; *Dekhili and Aggoun, 2006a, b*), Beniguil *(Boujenane and Mharchi, 1992)*,Timahdit *(EL Kihal, 1990,Tijani and Boujenane, 1993)* breeds. As a result,

growth records should be adjusted for these non-genetic factors in subsequent analyses.

Genetics factors effects

Heritability parameter

The estimated values of heritability's for growth traits using the variance and regression components methods are presented in Table 3.In general estimated values were generally low to medium. As regards, the standard errors related to h^2werewider. Heritabilities of B_W, W_{30}, at W_{90}, average daily gain ADG_{0-30} and ADG_{30-90} are respectively equal to 0.12 and 0.06, 0.11 and 0.05, 0.17. The set of heritability values estimated in our study coincide with those indicated by *Fogarty et al. (1985)*; *Khaldi et al. (1987)*; *Nacir (1987); Abdulkhauqa et al. (1989)*; *El kihal (1990)*; *Boujenane* and *Mharchi (1992)*.The low h^2 estimates for B_W fall within the range of values reported for Mediterranean breeds in Beniguil lambs ($h^2 = 0.15$) *Boujenane and Mharchi (1992)*, and in D'man ($h^2 = 0.34$) *Boujenane et al.* (2013).

Table 3. Estimated values of heritability's (h^2)and genetic correlations (r)of growth traits

Traits	$h^2 \pm SD.$	r_{WB}	r_{w30}	r_{w90}	$r_{ADG\ 0-30}$	$r_{ADG30-90}$
$B_W(Kg)$	0.12±0.08	-	0.39	0.37	0.12	0.11
$W_{30}(Kg)$	0.06±0.09	0.69±0.19	-	0.67	0.85	0.24
$W_{90}(Kg)$	0.11±0.08	0.36±0.33	0.28±0.31	-	0.57	0.73
ADG_{0-30} (g)	0.05±0.06	0.22±0.35	0.72±0.07	0.12±0.32	-	0.28
ADG_{30-90}(g)	0.17±0.09	0.10±0.31	-0.13±0.35	0.83±0.08	-0.18±0.23	-

B_W: Birth weight ,W_{30},W_{90}: weights at 30, 90 days age, ADG_{10-30} and ADG_{30-90}: average daily gain.

On the other hand, heritabilities of daily average weights and gains, estimated increase with age. These estimates highlight the existence of a mother effect on growth performance and show that this effect decreases with the advancing age of the lamb. The value of the heritability obtained by the variance components gives an idea about the sum of direct and maternal effects. Otherwise in sheep, *Burfening and Kress (1993)* found important h^2, ranging from 0.30 to 0.65, depending on the model applied, for B_W in Rambouillet, Targee and Columbian breeds. *Poivey et al. (1994)* reported medium h^2 estimate of 0.30 for W30 in Ile de France lambs. Our estimates of h^2 were higher than those reported by (*Maria et al., 1993; Tosh and Kemp, 1994*) for B_W and $W_{90}$of Romanov lambs respectively 0.22, 0.01, and of 0.13 and 0.02. These differences are probably due to

the conditions of the breeding environment, the genetic potential of each breed and the size of the experimental sample and the estimation model. For average daily gains, the h^2 estimates were lower than those reported for other breeds *Tijani and Boujenane (1993)* for Timahdit lambs, and *Boujenane and Mharchi,(1992*) for Beniguil lambs.Our h^2 estimates for $ADG30_{-90}$ were higher than those observed by *Khaldi and Boichard, (1989)* and *Maria et al. (1993)*, who reported low estimates of maternal heritability ranged from 0.01 to 0.06 for growth traits in Barbarine and Romanov sheep.

Genetic correlations

The values of genetic correlations obtained in this estimation for Hamra breed are generally positive and average. Otherwise under breeding systems conditions similar to our country the results of genetics correlation for local breeds obtained for the Moroccan breeds (*Boujenane and Mharchi, 1992; Djemali et al., 1994*) were ranged from 0.59 to 0.92 between W_{30} and the first month of suckling, and from 0.79 to 0.98 between W_{90} and ADG_{30-90}.The highest genetic correlation (0.83) was recorded between W_{90} andADG_{30-90} day, while the lowest was found between W_{90} and ADG_{0-30} (0.12). Two negative correlations were obtained between W_{30} and ADG_{30-90} (-0.13) and between ADG_{0-30} and ADG_{30-90} daily gain (-0.18).The genetic correlation between (W_{30}, ADG_{0-30}) was higher (0.85) and those between (B_W and ADG_{0-30}) was lowest value (0.12). The values of the genetic correlations between (ADG_{30-90} W_{30}) and (ADG_{30-90} ,ADG_{0-30}) which are negative, the other estimated values are positive and indicate that selection on a character will guide to the improvement of other characters. The negative correlation value gives an idea of the lamb's earliness, and the value of ADG_{0-30}, used as a decisive factor for assessing the dairy value, the maternal comportment and aptitude of suckling of the ewe, shows that the improvement of one of the two characters without deteriorating the other requires the selection of lambs on the basis of a selection index combining both characters at a time. Positive genetic correlations are in the range of the values indicated by the authors cited above. The correlations between the different characters are between 0.11 and 0.85. They are higher between the close weights and between the weights and the corresponding gains.

Conclusions

All over the world, local small ruminant breeds such as sheep are playing key roles in the lives of farming systems in arid area; no serious consideration is given to sheep genetic assets management policies in Algeria. The current investigation was conducted to evaluate the genetic parameters for growth traits in the endangered local Hamra breed. The results reveal the presence effects of some

non-genetic factors on growth traits. In the light of the results obtained, it can be conclude that the growth performanse achieved by the lambs at ITELV station is satisfactory but remain below the potentialities of the breed cited in literature. The heritability estimates obtained in this study indicated that it would be possible to improve growth traits through genetic selection at all ages. The estimates of genetic correlations were high and showed no genetic antagonisms among the growth traits. However, estimates of genetic correlations were high and negative but the accuracy of such estimates is low due to the small data set in the present study. In addition the growth performance of Hamra breed is largely influenced by the age of ewe, sex and mode of birth. Thus any breeding program aimed at improving these performances must eliminate the effect of these factors through the use of appropriate adjustment factors

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Procene genetskih parametara za osobine porasta kod ugrožene lokalne rase hamra u jugozapadnoj pustinji Alžira

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Rezime

Baza podataka za težinu tela i porast 411 jagnjadi rase hamra korišćena je za procenu genetskih parametara. Ova jagnjad su dobijena od 31 ovna i 493 ovce u periodu između 2012. i 2017. godine. Analizirani su sledeće osobine: težina na rođenju (B_w), uzrastu od 30 dana (W_{30}), 90 dana (W_{90}) starosti i prosečni dnevni prirasti od 10 do 30 (ADG_{10-30}) i 30-90 (ADG_{30-90}) dana. REML procene komponenti varijanse i kovarijanse dobijene su pod pretpostavkom da su životinjski modeli uključivali fiksne efekte za godinu-tip rođenja (2012 jedinaca, 2012 blizanac, ... 2017 jedinaca, 2017 blizanaca), pol (muški, ženski) i uzrast ovce na jagnjenju (<18, 18-30, 30-42, 42-54,> 54 meseci). Heritabiliteti su bili 0,12; 0,06 i 0,11 za B_w, W_{30} i W_{90}, a prosečni dnevni prirasti su bili 0,05 i 0,17 za ADG_{10-30}i ADG_{30-90}. Procene genetskih korelacija nisu pokazale genetske antagonizme između osobina porasta. Procenjene genetske korelacije su bile pozitivne i srednje do visoke, osim onih između ADG_{30-90} i ADG_{0-30} i između ADG_{30-90} i W_{30} koje su bile negativne. Fenotipske korelacije su bile pozitivne i

kretale su se od 0,12 do 0,85. Bile su visoke između susednih težina i između ADG i njihovih odgovarajućih težina.

Ključne reči: heritabilnost, genetička korelacija, osobine porasta, ovce

References

ABDULKHAUQA A.M., HARVEY W.R., PARKER C.F. (1989): Genetic parameters for ewe productivity traits in the co1umhia, Suffolk and Targhee. Animal Science, 67, 3250-3257.

ALLAOUI A., SAFSAF B., DJAALIB I., LAGHROUR W., TLIDJANE M: (2013): Efficiency of ovine artificial insemination in Ouled Djellal breed. Option Mediterranean, A: n 108.61-65.

BENGOUMI M., AMEZIANE EL HASANI T. (2013): Evolution and efficiency of transfer of technology in small ruminant production systems in North Africa. Option Mediterranean, A; n 108.15-24.

BENYOUCEF M. T., ZAHAF A., BOUTEBILA, S. (1995): Aspects organisationnels et techniques d'un programme d'étude génétique de la race ovine Hamra dans la région de l'ouest (Algérie). Ciheam-Iamz, 11, 215-224.

BOLDMAN K.G., KRIESE A., VAN VLECK L.D., KACHMAN S.D. (1993): A manual for use of MTDFREML.USDA, ARS, Washington, DC, 114 pp.

BOUJENANE I., MHARCHI A. (1992): Estimation des paramètres génétiques et phénotypiques des performances de croissance et de viabilité des agneaux de race Beniguil. Actes Institut. Agronomique. Veterinaire, 12 (4), 15-22.

BOUJENANE I., CHIKHI A., SYLLA M., IBNELBACHYR M. (2013): Estimation of genetic parameters and genetic gains for reproductive traits and body weight of D'man ewes. Small Ruminant Research, 113: 40-46.

BURFENING P.J., KRESS D.D. (1993): Direct and maternal effects on birth and weaning weight in sheep. Small Ruminant Research, 10, 153-163.

CHELLIG R. (1992): Les races ovines algériennes.Office des Publications Universitaires. Ben-Aknoun, Alger.

DEKHILI M., AGGOUN A. (2006a): Paramètres génétiques de la productivité numérique des brebis Ouled-Djellal. 13es Rencontres autour des Recherches des Ruminants. INRA, 13: 221.

DJEMALI M., ALOULOU, R., BENSASSI, M. (1994): Adjustment factors and genetic and phenotypic parameters for growth traits of Barbarine lambs in Tunisia. Small Ruminant Research, 13, 41-47.

EL KIHAL (1990) : Analyse des performances de croissance et de reproduction chez la raceTimahdit à l'UREO de Sidi Aissa. Mémoire de 3ème Cycle Agronomie, Institut. Agro -Veterinaire. Hassan II, Rabat.

FALCONER D.S., MACKAY T.F.C. (1996): Introduction to quantitative genetics, 4th Edition. Longman, London, 464 pp.

FOGARTY N.M., DICKERSON G.E., YOUNG L.D. (1985): Lamb production and its components in pure breeds and composite lines. III. Genetic parameters. Journal. Animal Science, 66: 40-57.

IANO (2007): Le standard de la race Hamra. Institut Algérienne de Normalisation n°2 édition: Date 2007. 6p Cinfo@ianor.org.

KHALDI G., BOICHARD D. (1989): Effets directs et maternels sur les caractères de croissance en race ovine Barbarine. INRATARIANA (Tunisie) 62 (2), 3-20.

KHALDI G., BOICHARD D,. TCHAMITCILLAN L. (1987): Facteurs de variation des paramètres de croissance des agneaux la race barbarine annales de 'INRA. Tunisie, 60, 5-18.

KUCHTÍK J., DOBEŠ I. (2006): Effect of some factors on growth of lambs from crossing between the Improved Wallachian and East Friesian. Czech Journal of Animal Science, 51, 2, 54–60.

MADR. (2017): Statistique du ministère de l'agriculture et du développement rural.

MARIA G.A., BOLDMAN K.G., VAN VLECK, L.D. (1993): Estimates of variances due to direct and maternal effects for growth traits of Romanov sheep. Journal of Animal Science, 71, 845-849.

NACIR O. (1987): Estimation des paramètres génétiques des performances de reproduction et de croissance chez les races d'man et sardi mémoire 3ème cycle agronomie, I.A.V. Hassan II, rabat. Maroc

POIVEY J.P., JULLIEN E., BIBE B. (1994): Utilisation du modèle animal chez les ovins allaitants. In: Foulley, J.L., Molenat, M. (Eds.), Séminaire modèle animal, 26-29 septembre 1994.

SAS. (2000). User's Guide, Release 6.12 Ed., SAS Institute, Cary, NC.

THOMPSON R., BROTHERSTONE S., WHITE I. M. S. (2005): Estimation of quantitative genetic parameters. Philosophical Royal Society B, 360, 1469–1477.

TIJAN A., BOUJENANE I. (1993): Estimates of genetic and phenotypic parameters for growth traits of Timahdit lambs in Morocco. The 44th Annual Meeting of the European Association for Animal Production (1), 176-177.

TOSH J.J., KEMP R.A. (1994): Estimation of variance components for lamb weights in three sheep populations. Journal of Animal Science, 72, 1184-1190.

YEROU H. (1991): Contribution a l'étude des performances laitières de la race Hamra élevée a ITEBO- Ain El Hadjar. Mémoire Ingénieur Institut national Agronomique-Alger.

YEROU H. (1998): Caractérisation des systèmes d'élevage ovin dans la steppique de la commune de Maamora Wilaya de Saida Thèse de Magister 110p Institut national Agronomique-Alger.

YEROU H. (2013): Dynamique des systèmes d'élevage ovin et leurs impacts sur l'écosystème steppique cas de la Wilaya de Naama.Thèse doctorat Es Science 107p. Université de Tlemcen. Algérie.