The Bioscan 7(2) : 185-188, 2012
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

ENVIRONMENTAL AND GENETIC FACTORS ON GROWTH TRAITS OF BLACK BONI SHEEP IN YEMEN

ABED AL-BIAL*, JAI SINGH, D. P. SINGH AND RAM NIWAS
Department of Animal Husbandry and Dairying,
Institute of Agricultural science, Banaras Hindu University, Varanasi - 221 005, INDIA
E-mail: albialbhu@gmail.com

KEY WORDS
Environmental Effects
Genetic Parameters
Growth Traits
Yemen

Received on :
28.02.12

Accepted on :
13.05.12

***Corresponding author**

ABSTRACT

The data were collected from 1992 to 2009 of Black Boni sheep maintained at the Regional Research Station in the Central Highlands of Yemen. Data were analyzed to study the effects of environmental and genetic factors on body weight and growth rate from birth to weaning. The overall least-square means for body weights were 2.18 kg, 10.58 kg 98.68 g for birth, weaning and growth rate respectively. Year of birth effects were significant ($p < 0.05$) on BW, WW and growth rate. Also, analysis of variance showed that the sex of the lambs and type of birth were important sources of variation ($p < 0.05$) for all traits. The size of the ewe during lambing had also significant effect ($p < 0.01$) on birth. The results show direct heritability for all traits was 0.38 of BW, 0.30 of WW and 0.26 of growth rate. Higher estimates of heritability for growth performance traits refers to of presence of more additive genetic variance.

INTRODUCTION

Sheep population of the Yemen is estimated to be 9.08 million head in 2009 (Yemen Agricultural Statistics, 2009).Eleven traditional sheep breed is recognized in Yemen of which 5 are wool and 6 are hair types (Wilson, 2003). All sheep breeds in the country were indigenous with fat tail whose conformation varied considerably (Hasnain *et al.,* 1994).

Black Boni sheep, a local breed of central and northern highland region of Yemen, despite having lower growth rates, they are characterized by the ability to survive and reproduce normally in the range without supplementary feeding.

The early growth traits (birth and weaning weight) are important in productivity and are the major selection traits in sheep breeds known to be influenced by genetics and environmental factors (Mandal *et al.,* 2003; Behzadi *et al.,* 2007).

Information on the relative performance of indigenous sheep breeds in Yemen may vary from year to year. It is, therefore, important to investigate the effects of various factors on the variation among animals in order to find efficient breeding plans to improve production. Very little information on the genetic and environmental aspects of productive and reproductive performance of sheep in Yemen is available, Therefore the objective of this study was to evaluate the environmental and genetic effects on growth traits for Black Boni sheep in the central and northern highlands region of Yemen.

MATERIALS AND METHODS

The sheep in this study were raised at Regional Research Station in the central highlandsof Yemen, located at 14°38 north by 44°21east and a latitude of over 2,400 meters, about 10 kilometres north of the Dhamar town, directly west of the Sana'a–Taiz road. The region is semi-arid with an annual rain fall between 350 to 400 mm and temperature varying 29°C and -4°C.

Animal management

The management system used the traditional method of sheep husbandry in the area, in terms of grazing and supplementation. A controlled mating scheme was used with three mating periods over two years. The ewes were mated with unrelated rams, with each ram mated to a group of 30 to 40 ewes; mating continued for 54 days. After lambing each ewe was put separately with their lamb into a lambing pen for about 2 to 7 days. Ewes and their lambs were weighed and ear-tagged. All the lambs were tattooed on the fat tail after weaning. Male and female lambs were allowed to remain with their mother until weaning. The weaning of lambs took place at an average of 91 days of age with a range in age from 79 to 98 days.

All ewes grazed together during the day for about 6-8 hours and were housed in covered pens with free access to grass hay, water and mineral lick blocks. During the mating season ewes were supplemented with fresh alfalfa, alfalfa hay or with fresh barley or barley hay and occasionally sorghum stover. Also a supplementary concentrate ration of 250-500 g/head/ day, depending on season and physiological status, was fed to animals in the morning before grazing.

The sheep shed was cleaned every two to three days with removal of sicks from their pens and treated separately. All animals were dipped for external parasite control once per year and were vaccinated once against rinderpest and sheep pox and drenched twice against internal parasites.

Statistical analysis

The data in the study was obtained from records of weights of 812 and 710 lambs at birth and weaning respectively over 18 years period (1992-2009) which was maintained at Regional Research Station of the Central highlands,in Dhamar, Yemen.

Data were first analysed using the General Linear Models Procedures of the Statistical Analysis Systems (SAS, 2003) to identify the environmental factors affecting lambs weights and growth rate from birth to weaning in this breed.

Statistical model included lamb's gender in 2 class (male and female), birth type in 2 class (single and twin), dam weight at lambing in 3 class ≤ 24, 25-33 and > 33), season of birth 3 class (summer from March to June, autumn from July to October and winter frz

Analyses were conducted according the following model for each breed.

$Y_{inkpmrs} = \mu + A_n + S_k + T_p + X_m + W_r + D_j + E_{inkpmrs}$

Where $Y_{inkpmrs}$ is the observation on the trait, μ, the overall mean, A_n is effects of the n[th] period of lambing (n= 1 to 6), S_k is the effects of the k[th] season of lambing (k= summer, autumn ,winter), T_p is the effects of the p[th] type of birth (p= single , twin), $X_{m,}$ the effects of the m[th] sex of lamb (m= male , female), W_r is the effects of the r[th] dam of weight during lambing (r = ≤ 24kg, 25-33 kg, ≥ 31kg), D_j is the effects of the j[th] parity number of dam (j=1 to 6), $E_{inkpmrs}$ represent the random error associated with each observation.

(Co) variance components were estimated by restricted maximum likelihood procedures using MTDFREML program (Boldman et al., 1995). Single trait animal models were fitted for all traits to obtain heritability estimates. The general representation of the animal model used is as follows

$y = Xb + Z_a a + e$

Where **y** is a N × 1 vector of records, b denotes the fixed effects in the model with association matrix X, a is the victor of direct genetic effects with association matrix Za. Additive direct effects were assumed to be normally distributed with mean 0 and variance $A\sigma^2_a$ where A is the additive numerator relationship matrix and σ^2_a is additive direct variance. Residual effects were assumed to be normally distributed with mean 0 and variances $I_n\sigma^2_e$, respectively, I_n are identity matrices with orders equal to the number individual records and σ^2_e are residual variances. Estimates of heritabilities were calculated as ratios of estimates of additive direct (σ^2_a) to the phenotypic variance (σ^2_p).

RESULTS AND DISCUSSION

Environmental effects, Birth weight (BW)

The overall least square means for lamb at birth weight were 2.18, kg (Table 1). The value of birth weight observed for period ranged from1.92 to 2.22 kg and the differences between periods were statistically significant (p<0.01). Differences in body weight from year to year is mostly due to variation in climatic, feeding and management condition, which either affects the lambs directly or indirectly through their effects on dams. The result of this study are similar to the result of Albial *et al.* (2010) for White Boni sheep. Also similar results were found by Abbas *et al.* (2010), Thiruvenkadan *et al.* (2009), Mandal *et al.* (2003) and Petrovic *et al.* (2011).

Season of lambing in this study had significantly effect on BW. Lambs born in autumn had higher of body weight than those born in winter and summer at BW. The significant of body weight at birth between these seasons can be interpreted as the influence of moderate weather conditions and a viability of green forage during pregnancy and growth stages for lambs. The similar results were found by Albial *et al.* (2010), Dixit *et al.* (2001) and Mandal *et al.* (2003) .

Analysis of variance showed that the sex of the lambs and type of birth were important sources of variation ($p < 0.05$). Male lambs were heavier ($p < 0.05$) than female lambs. The levels of advantages of male over female lambs were similar (3%). The differences may by attributed to difference in metabolic rate during embryonic stage of life (Mishra *et al.*, 2007) and to difference in the endocrine profile of the two sexes (Gamasaee *et al.*, 2010). This significant difference was confirmed by many authors (Dixit *et al.*, 2001; Mandal *et al.*, 2003; Mishra *et al.*, 2007).

The birth weight of single born lambs was significantly heavier ($p < 0.01$) than twin. The levels of advantages of single lambs have been reported in almost all studies (Dixit *et al.*, 2001; Mishra *et al.*, 2007; Thiruvenkadan *et al.*, 2009; Abbas *et al.*, 2010; Al-Bial *et al.*, 2010). Gamasaee *et al.* (2010) stated that the effect of birth type was significant on birth weight of lambs and can be explained by limited uterine space and nutrition of lamb during pregnancy.

The size of the ewe which was reflected by dam weight during lambing had also significant effect ($p < 0.01$) on birth weight of the lamb born. Similar positive relationships have been reported by (Dixit *et al.*, 2001; Al-Bial *et al.*, 2010).

Ewe parity did not influence ($p > 0.05$) on lamb birth weight. The variation within breed was very small. The interpretation of parity effects seems to be complicated by external confounding factors such as feeding during pregnancy, and selection and culling strategies that may influence birth weight. Similar results were reported by Thiruvenkadan *et al.* (2009).

Weaning weight (WW)

Factors affecting the weaning weights are shown in Table 1. Weaning weight ranged 9.28kg to 10.58kg. Period/year of birth effects were significant ($p < 0.05$) for weaning weights. Our results are in accordance with those reported by Mandal *et al.* (2003) and Thiruvenkadan *et al.* (2009).

Season of lambing in this study had significant effect ($p < 0.05$) on WW as shown in Table 2. Lambs born in the autumn lambing season were the heaviest body weight at weaning as compared to lambs born in summer and winter seasons. This finding was in agreement with those reported by Albial *et al.* (2010) for White Boni sheep and Thiruvenkadan *et al.* (2009) for Mecheri and their crossbred lambs. The higher weaning weight of lambs born during autumn might be due to the carryover effect of birth weight, because they were heavier at birth. Similar seasonal effect on weaning weight was also observed by Dixit *et al.*, (2001) and Abbas *et al.* (2010).

Table 1: Number of records and least square means (± S.E.) for affecting birth weight, weaning weight and growth rate in Black Boni sheep

	^{b}BW(kg)		WW(kg)		Growth rate(g)	
Items	n	Mean ± SE	n	Mean ± SE	n	Mean ± SE
Overall	812	2.18 ± 0.051	710	10.58 ± 0.44	761	98.68 ± 5.43
Period (Year of birth)						
P1(1992-1994)	169	$1.92^{d} \pm 0.04$	144	$9.95^{bc} \pm 0.26$	130	$89.02^{bc} \pm 3.61$
P2(1995-1997)	140	$2.02^{c} \pm 0.04$	127	$10.08^{b} \pm 0.27$	170	$91.49^{bc} \pm 3.65$
P3(1998-2000)	219	$2.18^{b} \pm 0.03$	194	$10.44^{ab} \pm 0.24$	177	$96.32^{ab} \pm 3.32$
P4(2001-2003)	159	$2,21^{b} \pm 0.03$	140	$10.58^{a} \pm 0.24$	156	$105.24^{a} \pm 4.60$
P5(2004-2006)	93	$2.18\ ^{b} \pm 0.05$	74	$10.46^{ab} \pm 0.34$	103	$92.03^{ab} \pm 4.60$
P6(2007-2009)	35	$2.22\ ^{a} \pm 0.07$	31	$9.28^{c} \pm 0.47$	25	$84.88^{c} \pm 6.51$
		***		*		**
Season						
Autumn	329	$2.18^{a} \pm 0.03$	289	$11.21^{a} \pm 0.21$	272	$101.44^{a} \pm 2.95$
Summer	229	$2.09^{b} \pm 0.03$	200	$10.02^{b} \pm 0.25$	174	$94.86^{b} \pm 3.46$
Winter	254	$2.11^{b} \pm 0.03$	221	$9.28^{c} \pm 0.23$	315	$83.20^{b} \pm 3.21$
		*		***		***
Sex						
Female	396	$2.\ 28^{b} \pm 0.03$	341	$10.02^{a} \pm 0.21$	380	$91.90^{b} \pm 2.89$
Male	416	$2.34^{a} \pm 0.03$	369	$10.24^{a} \pm 0.21$	381	$94.43^{a} \pm 2.92$
		***		n.s		**
Type of Birth						
Single	628	$2.31^{a} \pm 0.02$	571	$10.97^{a} \pm 0.19$	735	$101.69^{a} \pm 2.57$
Twin	184	$1.94^{b} \pm 0.03$	139	$9.29^{b} \pm 0.26$	26	$84.64^{b} \pm 3.52$
		***		***		***
Weight of Dam						
< 24	155	$1.92^{c} = 0.04$	128	$8.75^{c} \pm 0.27$	64	$82.00^{b} \pm 3.74$
25-33	602	$2.12^{b} = 0.02$	534	$10.02^{b} \pm 0.16$	660	$93.72^{a} \pm 2.23$
>33	56	$2.34^{a} = 0.05$	48	$11.64^{a} \pm 0.37$	37	$103.77^{a} \pm 5.03$
		***		***		**
Parity						
1	315	$2.07^{a} \pm 0.031$	277	$9.97^{a} \pm 0.20$	288	$90.52^{b} \pm 2.79$
2	196	$2.19^{a} \pm 0.037$	178	$10.26^{a} \pm .24$	172	$93.23^{b} \pm 3.25$
3	133	$2.14^{a} \pm 0.04$	117	$10.12^{a} \pm 0.25$	104	$91.89^{b} \pm 3.47$
4	90	$2,11^{a} \pm 0.05$	71	$10.10^{a} \pm 0.33$	71	$91.43^{b} \pm 4.47$
5	44	$2,15^{a} \pm 0.06$	40	$10.29^{a} \pm 0.41$	53	$92.03^{b} \pm 5.57$
6	34	$2.09^{a} \pm 0.07$	27	$10.08^{a} \pm 0.50$	73	$99.88^{a} \pm 6.81$
		n.s		n.s		**

^{a}means with different letters in each subclass within a column differ significantly at ($p < 0.05$). **Significant effect at $p<0.01$; * Significant effect at $p < 0.05$; ns: not significant; ^{b}BW: Birth weight, WW: Weaning weight,: Growth rate :from birth to weaning

Sex of lambs effects were ($p > 0.05$) not significant on weaning weight (Table 1). The average weights of the both sexes were similar. Such results are in accordance with those results reported by Petrovic *et al.* (2011).

Type of birth also has significant effect ($p<0.05$) on body weight of lambs at weaning. The variation in weaning weight ranged from 9.29 kg (twin) to 10.97 kg (single). Similar results were reported by Abbas *et al.* (2010) and Dixit *et al.* (2001). This indicates that lower of twin lambs at weaning may be due to low birth weights and the competition between the twins for limited quantity of milk available from the dam.

The effect of dam weight at lambing on live weight of lambs at weaning were significantly effect ($p<0.01$) higher (Table1). Similar this results as reported by Dixit *et al.* (2001) and Al-Bial *et al.* (2010). Weight of dam reflects the size of dam and its nutritional condition on prenatal lamb growth (Gamasaee *et al.,* 2010).

The effect of parity had consistently showed no significant effect ($p<0.05$) on weaning weight of this study (Table 1). Similar with the reports by Thiruvenkadan *et al.* (2009).

Growth rate

Period /year had a significant ($p<0.01$) effect on growth rate (Table 1). The effects of years lambing on growth rate. Similar with reported by Al-Bial *et al.* (2010) for White Boni sheep, Thiruvenkadan *et al.* (2009) in Mecheri sheep and Mandal *et al.* (2003) in Muzaffarnagari sheep. The significant differences in growth rate of lambs in different periods maybe attributed to differences in management, selection of rams and environmental condition such as ambient temperature, humidity, rainfall, and other factors.

Results also show that season of lambing had effect ($p<0.05$) on growth rate of lambs. Lambs born in the autumn season were faster in growth rate than lambs born in summer and winter seasons. These results are in agreement with the finding of Gbangboche *et al.* (2006), Ditx *et al.* (2001) and who obtained a significant effect of season on this trait.

There had significant different ($p<0.05$) on growth rate of lambs of different sexes (Table 1). Male lambs had growth rate faster than female lambs. Several authors have also reported that male lambs grow faster than female from birth to weaning (Dixit *et al.,* 2001; Mishra *et al.,* 2007; Abbas *et al.,* 2010).

Single born lambs were superior to lambs born as twins in growth rate and the different between them was highly significant ($p<0.01$).The values were 101.69 ± 2.57vs.

Table 2: Variance component ratios for lamb birth weight, weaning weight and growth rate in Blak Boni sheep

Item[a]	Traits BW	WW	Growth rate
s^2_a	0.06631	2.06175	283.79538
s^2_e	0.10714	4.85173	812.90632
s^2_p	0.17345	6.91348	1096.70170
h^2	0.38 (0.103)	0.30 (0.108)	0.26 (0.092)

[a] σ^2_a, σ^2_e, σ^2_p are additive direct, residual variance, and phenotypic variance, respectively, h^2 is heritability.[b]BW: Birth weight, WW: Weaning weight,: Growth rate at pre-weaning

84.64 ± 3.52 g/ day. finding is in agreement with those reported by some authors (Mandal *et al.,* 2003; Abbas *et al.,* 2010).

Growth rate were significantly ($p < 0.01$) affected by weight of dam at lambing (Table 1). Similar positive relationships has been reported by Dixit *et al*. (2001). Ewe of Parity was significant effect ($p < 0.05$) on average growth rate of lambs. These results are in agreement with the reports by Mishra *et al*. (2007) who found a significant effect of parity on this trait.

Genetic parameters

Variance component ratios and the genetic parameter estimates for this breed are given in Table 2. The birth weight in various sheep breeds have ranged from 0.04 to 0.49 (Mandal *et al.,* 2003; Thiruvenkadan *et al.,* 2009). Heritability estimates resulted from Model 1 corresponded well with those reported by Rashidi *et al*. (2008) for Kermani sheep. Higher heritability estimates were reported by Al-Shorepy (2001) who found an estimate of 0.48 for crossbred lambs.The current h^2 estimates for this breed agreed well with those observed by Al-Bial *et al*. (2010) for White Boni sheep and Dixit *al*. (2001) for Bharat Merino lambs, whose estimate of h^2 was 0.18 and 0.23 respectively for both breeds. The moderate to high additive heritability estimates found in this study can be explained by uniformity of management at the sheep breeding station, creating small environmental variations.

The estimates of heritability of weaning weights was higher (0.30) and is in agreement with those reported by several authors (Ghafouri Kesbi *et al.,* 2008; Rashidi *et al.,* 2008). More over, Behzadi *et al*. (2007) working with Kermani sheep reported estimates of h^2 to be between 0.22-0.62 for weaning weight and also reported that heritability for body weights have a tendency to increase with age (Behzadi *et al.,* 2007).

Parameter estimates for growth rate from birth to weaning for this breed are shown in Table 2. Heritability estimates in the present study for growth rate was 0.26. Similar to those observed by Dixit *et al*. (2001) in Bharat Merino. Estimate of heritability in White Boni lambs was similar to the estimate of 0.28 reported by Albial *et al*. (2010) in White Boni lambs.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Regional Research Station of the Central Highlands, Agriculture Research and Authority, (AREA) Dhamar, Yemen for providing all facilities to conduct this study. The author thanks Dr. Dale Van Vleck, Department of Animal Sciences, University of Nebraska – Lincoln for granting permission to use the MTDFREML program.

REFERENCES

Abbas, S. F., Abd Allah., M. Allam, F. M. and Abooul-Ella, A. A. 2010. Growth performance of Rahmni and Chios Lambs weaned at different ages. *Australin J. Basic and Applied Science.* **4:** 1583-1589.

Al-Bial, A. M., Al-Karmah, A., Al-Ashwal, M., Alazazie, S., Alshami, A. and Sharaf, R. 2010. Performance of White Boni sheepYemeni 1. Some of non-genetic factors influencing growth traits. *Egypt J. Applied Science.* **25:** 432-442.

Al-Shorepy, S. A. 2001. Estimates of genetic parameters for direct and maternal effects on birth weight of local sheep in United Arab Emirates. *Small Rumin. Res.* **39:** 219- 224.

Behzadi, R., Shahroudi, F. E. and Van Vleck, L. D. 2007. Estimates of genetic parameters of growth traits in Kermani sheep. *J. Animal Breeding and Genetic.* **5:** 296- 301.

Boldman, K. G., Kriese, L. A., Van Vleck, L. D. Van Tassell,C. P. and Kachman, S. D. 1995. A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances (DRAFT), U.S. Department of Agriculture, Research Service.

Dixit, S. P., Dhillon, J. S. and Singh, G. 2001. Genetic and non-genetic parameters for growth traits of Bharat Merino lambs. *Small Rumin Res.* **42:** 101-104.

Gamasaee, V. A., Hasan, S., Ahmadi, H. A., Baneh, H., Farhadi, A. and Mohamadi, A. 2010. Estimation of genetic parameters for body weight at different ages in Mehraban sheep. *Afr. J. Biotechnol.* **32:** 218-223.

Ghafouri Kesbi, F., Eskandearinasab, M. and Hassanabadi, A. 2008. Estimaation of genetic parameters for lamb wieght at various age in Mehraban sheep. *Ital. J. Anim. Sci.* **23:** 95-103.

Hasnain, H. U., Alnokhaif, A. A. and Aliryani, A.R. 1994. sheep and cattle in yemen. Anim.Gen. Res.Info., No. 13, F.A.O. ,Rom.

Mandal, A., Pant, K. P., Nandy, D. K., Rout, P. K. and Roy, R. 2003. Genetic analysis of growth traits in Muzaffarnagari sheep. *Tropical Animal Health and Production.* **35:** 271-284.

Mishra, A. K., Arora, A. L., Kumar, S. and Singh, V. K. 2007. Improving productivity of Malpura breed by crossbreeding with prolific Garole sheep in India. *Small Rumin Res.* **70:** 159-164.

Petrovic, M. P., RMuslic, D., Petrovic, V. C. and Makshimovic, N. 2011. Influence of environmental factors on birth weight variability of indigenous Serbian breeds of sheep. *Afr. J. Biotechnology.* **10:** 673-676.

Rashidi, A., S.Mokhtarib, M., Safi Jahanshahic, A. and Abadid, M.R. 2008. Genetic parameter estimates of pre-weaning growth traits in Kermani sheep. *Small Rumin Res.* **74:** 165-171.

SAS. 2003. User's Guide. Statistical analysis system institute, Inc. Cary, NC, USA.

Thiruvenkadan, A. K., Karunanithi, K. Muralidharan, J. and Narendra Babu, R. 2009. A comparative study on geowth performance of crossbred and purebred Mecheri sheep raised under dry land farming condition. *Afr. J. Anim. Sci.* **39:** 121- 125.

Wilson, R. T. 2003. Biodiversity of domestic of livestock in republic of Yemen. *Tropical Animal Health and Production.* **35:** 27-46.

Yemen Agricultural statistics year book 2009. General Department of statistics and documentation. Ministry of Agriculture and water resource. Republic of Yemen.