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Investigation of Environmental Factors Influence on Pre-Weaning Growth Traits in Zandi Lambs

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Abstract: The present study was carried out to investigate the effects of environmental factors on pre-weaning growth traits in Zandi sheep. Data (birth weight, weaning weight and average daily gain from birth to weaning) were collected from lambs that have been born during 1993-2008 in Khojir Research Station (Tehran-Iran) and analyzed using SAS 9.1 software. Birth year, birth type, lamb's sex and dam's age were highly significant sources of variation on Birth Weight (BW), Weaning Weight (WW) and Average Daily Gain from birth to weaning (ADG) ($p<0.001$). The interaction effects between birth year and birth type and dam's age and birth type were significantly affected on these traits ($p<0.001$). At birth and weaning, the male and single lambs were heavier than female and twin lambs. Results showed that environmental factors have an important role in expressing of genetic potential in the lambs. Average weights were 4.23±0.012, 21.17±0.060 and 0.174±0.00 kg for BW, WW and ADG, respectively.

Key words: Zandi sheep, growth traits, environmental factors, body weight, WW, ADG, Iran

INTRODUCTION

Native Sheep population of Iran mainly includes fat tailed and carpet-wool breeds. Zandi sheep are fat tailed breed, which rearing in Khojir Research Station of Tehran-Iran. In these sheep, the main purpose is lamb and mutton production.

For genetic progress, selection must be based on genetic merits instead of phenotype (Rashidi *et al*., 2008). Environmental factors influence the estimation of breeding value. Investigation and determination of environmental factors that have effect on traits and correction of records for these factors cause estimated genetic parameters and breeding value to show animal's genetic potential (Rashidi *et al*., 2008). Therefore, correction of the records before the animal evaluation is necessary. Study of these factors was looked in more in other published reports. The significant influences of environmental factors on body weight at the various ages can be explained in part by differences in years, male and female endocrine system, limited uterine space and inadequate availability of nutrients during pregnancy, competition for milk between the twins, maternal effects and maternal ability of dam in different ages.

Effects of birth year, lamb's sex and birth type has been reported significantly in breeds like Merino (Dixit *et al*., 2001), Sabi (Matika *et al*., 2003), Horro (Abegaz *et al*., 2005) Kermani (Rashidi *et al*., 2008) and Arabi (Rahmatnejad *et al*. 2009). The effect of dam's age has been reported significantly more in breeds such as Baluchi (Yazdi *et al*., 1997), Merino (Dixit *et al*., 2001), Horro (Abegaz *et al*., 2005), Kermani (Rashidi *et al*., 2008) and Arabi (Rahmatnejad *et al*., 2009). The aim of the current study was to identify and investigate the effect of environmental factors on pre-weaning growth traits in Zandi sheep.

MATERIALS AND METHODS

In order to study the effect of environmental factors on growth traits in Zandi sheep, we applied information that was collected from 1993-2008 (16 years) in Animal Breeding Center (Tehran Province, Iran). This includes number of animal, birth year, lamb's sex, birth type and dam's age, records of Birth Weight (BW), Weaning Weight (WW) and Average Daily Gain from birth to weaning (ADG). Characteristics of the data structure are shown in Table 1.

The Zandi sheep are rearing in Khojir Research Station. This station is situated in Khojir national park between Tehran and Abali at 35°45'E and 51°40'N, 1547 m above see level. In this Station, Maiden ewes were exposed to rams at about 18 months of age and kept in the flock until death or the apparent infertility. Rams were used for 3 or 4 breeding years and kept separated from ewes, except in the mating season. In the mating season

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(commenced in August), each group of the ewes (detected in estrus) was allotted to one fertile ram in a separate mating pen. At birth, lambs were weighed, tagged, sexed and identified to their parents. Birth date was also recorded.

During the suckling period, lambs were kept indoors and allowed to nurse their mothers twice a day. The suckling stage lasted for 90 days on average. Animals were kept on natural pasture during the spring, summer and autumn seasons and indoors during the winter.

The data were sorted, processed and prepared for the analysis, using General Linear Model (GLM) procedure (SAS, 2003). The data of traits was normal. Statistical model for studying the effect of these factors were:

$$y_{ijklmn} = \mu + Y_i + A_j + S_k + T_l + I_m + e_{ijklmn}$$

Where:

y = Records on the traits
μ = Mean
Y_i = Effect of birth year in 16 class (1993-2008)
A_j = Effect of dam age at lambing in 7 class (2-8 years old)
S_k = Effect of lamb's sex in 2 class (male and female)
T_l = Effect of birth type in 2 class (single and twin)
I_m = Interaction between factors
e_{ijklmn} = Residual effects

The age of weighting was used as covariable for correcting phenotype observation of weaning weight. This is because the lambs did not give birth at the same time but they were weighted together. Therefore, they have different ages. Genetic assumptions in current study were as follow:

- Almost, all sheep were from a pure breed
- All sheep had definite pedigree and parents
- Selection criteria in this population were performed on based of phenotypic selection
- The breeding and feeding management of sheep were similar
- Mating system was controlled

Table 1: Basic statistical information about the examined traits of Zandi sheep, Khojeir Research Station (1993-2008)

Characters	BW	WW	ADG
No. of records	4309	3199	2881
Mean (kg)	4.23	21.17	0.174
Standard deviation (kg)	0.808	3.431	0.037
Maximum (kg)	7.10	39.40	0.330
Minimum (kg)	1.70	13.40	0.080
Coefficient of variation (%)	19.083	16.209	21.05

BW: Birth Weight, WW: Weaning Weight, ADG: Average Daily Gain from birth to weaning

RESULTS AND DISCUSSION

The analysis of variance results, least square means and standard error for BW, WW and ADG and estimation of environmental factors including birth year, lamb's sex, birth type and age of dam are given in Table 2 and 3.

Table 2: Variance analysis of environmental factors on pre-weaning growth traits of Zandi lambs

	BW		WW		ADG	
SOV	df	MS	df	MS	df	MS
Dam's age	6	34.03***	6	156.49**	6	0. 1967**
Birth type	1	403.72***	1	497.31**	1	0. 0688**
Lamb's sex	1	165.60**	1	2236.50**	1	0. 0006^{ns}
Birth year	15	10.19**	15	87.08**	15	0.1846**
Birth type x Dam's age	6	1.41*	6	29.40*	6	0.0231*
Birth type x Lamb's sex	1	2.30^{ns}	1	20.80^{ns}	1	0.0265^{ns}
Birth type x Birth year	15	5.10*	15	26.44*	14	0.0200*
Lamb's sex x Birth year	15	0.19^{ns}	15	10.42^{ns}	15	0.0016^{ns}
Lamb's sex x Dam's age	6	0.70^{ns}	6	32.00^{ns}	6	0.0016^{ns}
Error	4242	0.42	3126	9.81	1374	0.0017
CV	-	15.35	-	14.79	-	15.70
R^2	-	0.36	-	0.18	-	0.66

*** = Significant in 0.01 ($p<0.01$), * = significant in 0.05 ($p<0.01$) and NS = Non Significant, BW: Birth Weight, WW: Weaning Weight, ADG: Average Daily Gain from birth to weaning; SOV = Source of Variation, DF = Degree of Freedom, MS = Mean of Squares, CV = Coefficient of Variation, R^2 = coefficient of correlation

Table 3: Least squares means and standard error for pre-weaning growth traits in Zandi lambs

	Traits		
Factors investigated	BW (kg)	WW (kg)	ADG (kg)
Overall mean	4.23±0.01	21.17±0.06	0.174±0.00
Gender			
Male	4.42±0.01^{a}	22.04±0.07^{a}	0.183±0.00^{a}
Female	4.05±0.1^{b}	20.04±0.09^{b}	0.166±0.00^{b}
Birth type			
Single	4.40±0.01^{a}	21.32±0.06^{a}	0.176±0.00^{a}
Twin	3.68±0.02^{b}	20.15±0.16^{b}	0.161±0.00^{b}
Dam's age (Year)			
2	3.93±0.02^{d}	20.56±0.10^{d}	0.164±0.00^{e}
3	4.22±0.02^{c}	20.77±0.12^{cd}	0.170±0.00^{d}
4	4.28±0.02^{bc}	21.26±0.15^{bc}	0.172±0.00^{d}
5	4.34±0.02^{ab}	21.57±0.16^{ab}	0.179±0.00^{c}
6	4.40±0.03^{a}	22.02±0.19^{a}	0.186±0.00^{b}
7	4.39±0.04^{a}	22.05±0.21^{a}	0.191±0.00^{ab}
8	4.36±0.07^{ab}	21.94±0.30^{a}	0.193±0.00^{a}
Birth year			
1993	3.91±0.06^{hi}	20.74±0.24^{bc}	0.167±0.00^{bc}
1994	3.97±0.04^{hi}	20.67±0.27^{bcd}	0.159±0.00^{cd}
1995	4.36±0.05^{bcd}	21.39±0.27^{ab}	0.157±0.00^{d}
1996	4.15±0.04^{fg}	21.67±0.40^{a}	0.163±0.00^{bcd}
1997	4.43±0.04^{bc}	19.87±0.34^{e}	0.156±0.00^{d}
1998	4.28±0.04^{de}	20.58±0.19^{cd}	0.166±0.00^{bc}
1999	4.18±0.04^{ef}	20.79±0.21^{bc}	0.167±0.00^{bc}
2000	3.87±0.05^{i}	21.81±0.24^{a}	0.169±0.00^{b}
2001	4.30±0.04^{cde}	21.89±0.29^{a}	0.184±0.00^{a}
2002	4.42±0.04^{bcd}	22.08±0.27^{a}	0.182±0.00^{a}
2003	4.14±0.02^{fg}	19.98±0.26^{e}	0.162±0.00^{bcd}
2004	4.31±0.04^{cde}	20.64±0.32^{bcd}	0.161±0.00^{bcd}
2005	3.97±0.04^{hi}	21.66±0.20^{a}	0.186±0.00^{a}
2006	4.46±0.04^{ab}	22.13±0.19^{a}	0.183±0.00^{a}
2007	4.57±0.04^{a}	20.75±0.15^{bc}	0.181±0.00^{a}
2008	4.03±0.05^{gh}	20.82±0.16^{bc}	0.184±0.00^{a}

BW: Birth Weight, WW: Weaning Weight. Within column, within each factor, least square means with different superscripts are different at $p<0.05$

Birth year: The effect of birth year on pre-weaning growth traits was significant ($p<0.001$), also Interaction effect between birth year and birth type was significant ($p<0.01$).

The results confirmed other reports (Matika *et al*., 2003; Ahmadi *et al*., 2004; Abegaz *et al*., 2005). Birth year causes vacillations over body weight in different ages by the effect of climate condition (rate of rainfall, humidity and temperature), environmental and management conditions. Climate and environmental changes have effect on the quality and quantity of pasture forages, which also affect the provision of food and other requirements for animals. These changes in lambs have more effect on weaning traits and in their dams. The main effect will show on amount of milk production (increase or decrease). It has a direct influence on weaning weight and has an indirect effect on birth weight due to changes in dam's environment and difference in feeding in the last weeks of pregnancy at different years. Differences in nutrition (especially during pregnancy), management and hygiene in the various years are reasons for the effect of birth year on body weight in different ages (Shahroudi *et al*., 2001; Ahmadi *et al*., 2004).

Lamb's sex: Lamb's sex was highly significant on all traits ($p<0.001$). Interaction effect was not significant between Lamb's sex and birth year. For BW, WW and ADG amount of body weight in male (4.42±0.01 kg, 22.04±0.07 and 0.183±0.00 kg, respectively) was more than female (4.05±0.01, 20.04±0.09 and 0.166±0.00 kg, respectively).

The results were confirmed by prior reports (Elfadili *et al*., 2000; Matika *et al*., 2003; Abegaz *et al*., 2005; Rashidi *et al*., 2008). Differences in sexual chromosomes, probably in the position of genes related to growth, physiological characteristics, difference in endocrinal system (type and measure of hormone secretion especially sexual hormones) lead to difference in animal growth. In relation to endocrinal system, estrogen hormone has a limited effect on the growth of long bones in females. That could be one of the reason in which females have smaller body and lighter weight against males (Shahroudi *et al*., 2001; Rashidi *et al*., 2008).

Birth type: In this study, birth type was significant over BW, WW and ADG ($p<0.001$), also the interaction effects between birth type and dam's age was significant ($p<0.01$) for these traits. The means single lamb's body weight at BW, WW and ADG (4.40±0.01, 21.32±0.06 and 0.176±0.00 kg, respectively) were more than twins (3.68±0.02, 20.15±0.16 and 0.161±0.00 kg, respectively).

Competence between twins to feed with their dam's milk causes them to receive less milk than singles. Therefore, it is a good reason that singles are heavier than twins when weaning (Dixit *et al*., 2001; Rashidi *et al*., 2008). But Shahroudi *et al*. (2001) and Matika *et al*. (2003) reported that birth type has no significant effect on body weight in Kurdish and Sabi breeds, respectively.

Dam's age: Dam's age was significant on all traits ($p<0.001$). Results were the same as some of other researchers (Dixit *et al*., 2001; Matika *et al*., 2003; Rashidi *et al*., 2008) but have some contradictions with others (Elfadili *et al*., 2000; Abegaz *et al*., 2005).

The lambs produced by dams of 5 years and more have more weight than other lambs. It can be related to higher capacity of milking in association with 5 years and more ewes in comparison to younger ewes (Dixit *et al*., 2001; Matika *et al*., 2003; Rashidi *et al*., 2008).

CONCLUSION

Environmental factors were significant sources of variation for growth traits and play an important role in expression of genetic potential. Therefore, effects of environmental factors need to account for the estimate of the Best Linear Unbiased Predicted value (BLUP) of Zandil lambs.

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