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Full Length Research Paper

Effects of environmental factors on growth traits in Ghezel sheep

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The present study was carried out to study the effects of environmental factors on growth traits in Ghezel sheep breed. Growth related data (birth weight, weaning weight, month 6 weight, average daily gain from birth to weaning and weaning to month 6) were collected from lambs that have been born during 1994 - 2006 at Ghezel sheep breeding station in west Azerbaijan and data was analyzed using SAS software. The birth year and herd had a significant effect on all traits (P < 0.01) while the effect of birth type significantly (P < 0.01) affected all traits except birth weight and daily gain from birth to weaning periods. The lamb's sex had a significant effect on all traits except daily gain from weaning to month 6 weight periods. The effect of dam's age had a significant effect only on daily gain from weaning to month 6 weight periods. The interactions between birth year and lamb's sex, birth year and birth type, birth year and herd, lamb's sex and herd and also dam's age and herd were significantly affected on all traits (P < 0.01). The interactions between lamb's sex and dam's age and birth type and dam's age significantly affected weight of birth, daily gain from birth to weaning period and month 6 ages, respectively (P < 0.05). In all ages, 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.

Key words: Growth traits, body weight, daily gain, environmental factors, Ghezel sheep.

INTRODUCTION

The Ghezel sheep is a high weight Iranian breed which is raised in the western north of Iran. This animal has a good compatibility in cold condition and has a good capability for grazing and walking. Meat is the main source of income for farmers (Satari, 1999). When ever the weather condition is suitable, these animals feed after grazing pasture, alfalfa and clover, while in cold seasons they are fed manually, eating alfalfa, wheat straw, barley straw, barley barn and other extra forages (Nourian, 2000).

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; Osman and Bradford, 1965). 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.

Effect of birth year, lamb's sex and birth type has been reported significantly in breeds like Kermani (Rashidi et al., 2008), Merino (Dixit et al., 2001), Horro (Abegaz et al., 2005) and Sabi (Matika et al., 2003). The effect of dam age has been reported significantly more in breeds such as Baluchi (Yazdi et al., 1997), Zandi (Kalantar,

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Table 1. Basic statistical information about the examined traits of Ghezel sheep.

Trait	BW	WW	6MW	ADG1	ADG2
Number of records	9221	7206	6112	6514	4825
Mean (kg)	4.18	22.65	32.01	0.198	0.115
Standard deviation (kg)	0.83	3.12	5.39	0.049	0.059
Minimum (kg)	2.30	15.00	18.50	0.088	0.037
Maximum (kg)	6.80	33.50	43.68	0.413	0.352
Coefficient of Variation (%)	51.77	24.73	16.85	13.78	19.87

BW: birth weight, WW: weaning weight (month 3), 6 MW: month 6 weight, ADG 1: daily gain from birth to weaning, ADG 2, daily gain from weaning to month 6.

2003), Kermani (Rashidi et al., 2008), Merino (Dixit et al., 2001 and Ozcan et al., 2005) and Horro (Abegaz et al., 2005). Nourian (2000), Yazdi (1997) and Neser (2001) reported that herd affects body weight significantly. The objec-tive of this study was to identify the effects of environmental factors on weight traits and average daily gain in different ages of Ghezel sheep.

MATERIALS AND METHODS

In order to study the effect of environmental factors on growth traits in Ghezel sheep, we applied information that was collected from 1999 to 2007 (9 years) in Ghezel's Breeding Station. This includes number of animal, birth year, lamb's sex, birth type, age of dam and herd. In addition, records of birth weight (BW), weaning weight (WW), weight at month 6 (6 MW), average of daily gain from birth to weaning (ADG 1) and average of daily gain from weaning to weight at month 6 (ADG 2). Characteristics of the data structure are summarized in Table 1.

After birth, the lambs feed manually on alfalfa mill, high quality forage and dams accompany their ewes during grazing in pasture. Weaning was at approximately age of month 3 (Nourian, 2000). Mating was controlled and at the birth of lambs register pedigree information (animal code, sire and dam), birth information (date of birth, lambs' sex, birth type) and records (birth weight, weaning weight, and month 6 weight).

A univariate procedure of SAS was used to check for normality. The SAS software was used for normality test. The data of all traits was normal. Statistical model for studying the effect of these factors were:

$$\mathbf{y}_{ijklm} = \mu + Y_i + A_j + S_k + T_l + H_m + \text{interaction between factors} + e_{ijklm}$$

Where y is records on the different traits, μ = mean, Y_i = effect of birth year in 9 class (1999 - 2007), 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), A_j = effect of dam age at lambing in 6 class (2 - 7 years old), H_m = effect of herd in 14 class and e_{ijklm} is residual effects.

The age of weighting was used as covariable for correcting phenotype observation of weaning weight and month 6 weight. This is because the lambs did not give birth at the same time but they were weighted together. Therefore they have different ages.

Analysis of variance of environmental factors and estimation of least square means with their standard error was carried out by general linear model procedure in SAS software.

RESULTS AND DISCUSSION

The analysis of variance results, least square means and standard error for BW, WW, 6MW, ADG 1 and ADG 2 and estimation of environmental factors including birth year, lamb's sex, birth type and age of dam are given in Tables 2 and 3.

Birth year

Birth year was significant for all traits. Interaction effects were significant between birth year and lamb's sex, birth year and birth type, birth year and herd. Interaction effect between birth year and age of dam was significant with the exception of ADG2.

Our results confirmed other reports (Abegaz et al., 2005; Ahmadi et al., 2004; Kalantar, 2003; Matika et al., 2003; Ozcan et al., 2005).

We observed genetic development (low/high) and consistent increase in the amount of phenotypic at trait in the herds that selection was on the basis of science. Least square means (Table 3) shows that changes of phenotypic of traits was not ordered during studying years. Selection in herds was not useful because of selection performed on the basis of the phenotypic amount of traits and these phenotypic records were not corrected for variance creator factors; hence heavier animals might not depend on high genetic potential, therefore high production is due to desirable environmental factors.

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 average daily gain from birth to weaning 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

Table 2. Analysis of variance of environmental factors on growth traits in Ghezel sheep.

Source of variation	BW	WW	6MW	ADG1	ADG2
Birth year	0.031**	46.42**	234.09**	0.0306**	0.0233**
Lamb's sex	0.017**	270.89**	378.54**	0.0168**	0.0000^{ns}
Birth type	0.002^{ns}	516.62**	305.51**	0.0025^{ns}	0.0038**
Dam's age	0.000^{ns}	0.93^{ns}	10.37^{ns}	0.0005^{ns}	0.0029**
Herd	0.040**	312.89**	2271.93**	0.0401**	0.2002**
Birth year * Lamb's sex	0.003**	20.70**	69.95**	0.0031**	0.0045**
Birth year * Birth type	0.011**	29.93**	40.89**	0.0113**	0.0026**
Birth year * Dam's age	0.003**	6.77**	10.32*	0.0028**	0.0007^{ns}
Birth year * Herd	0.049**	199.20**	383.40**	0.0495**	0.0321**
Lamb's sex * Birth type	0.000^{ns}	7.43^{ns}	9.52^{ns}	0.0001^{ns}	0.0003^{ns}
Lamb's sex * Dam's age	0.002**	4.94^{ns}	10.61^{ns}	0.0023**	0.0005^{ns}
Lamb's sex * Herd	0.005**	29.69**	82.28**	0.0045**	0.0030**
Birth type * Dam's age	0.000^{ns}	7.05^{ns}	36.31**	0.0007^{ns}	0.0009^{ns}
Birth type * Herd	0.013**	135.39**	238.93**	0.0131**	0.0005^{ns}
Dam's age * Herd	0.002**	5.75**	11.93**	0.0019**	0.0009**
Error	0.001	3.52	6.80	0.0009	0.0006
Coefficient of Determination	0.60	0.65	0.77	0.60	0.84

BW: birth weight, WW: weaning weight (month 3), 6MW: month 6 weight, ADG1: daily gain from birth to weaning, ADG 2, daily gain from weaning to month 6.
*, ** are significant at $P \leq 0.05$, $P \leq 0.01$ and ns is not significant.

reasons for the effect of birth year on body weight in different ages (Ahmadi et al., 2004; Shahroudi et al., 2003; Osman and Bradford, 1965; Vaez torshizi et al., 1992).

Lamb's sex

Lamb's sex was significant for all traits except ADG 2. Interaction effects were significant between sex of lambs and birth year and also sex of lambs and herd for all traits. Interaction effect was only significant to the age of dam and birth weight as well as ADG 1, but for all traits it was not significant between sex of lamb and type of birth. The results were confirmed by prior reports. For all traits amount of body weight and average daily gain in male was more than female. Differences in body weight between male and female could happen for these reasons (Abegaz et al., 2005; Ahmadi et al., 2004; El Fadilli et al., 2000; Matika et al 2003; Nourian, 2000; Shahroudi et al., 2003; Osman and Bradford, 1965; Rashidi at al., 2008; Vaez torshizi et al., 1992).

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 (Rashidi et al., 2008; Shahroudi et al., 2002, 2003; Vaez torshizi et al., 1992).

Birth type

In this study, type of birth was significant over weaning and month 6 weight traits. Interaction effect was significant between type of birth year for all traits and also type of birth with herds for all traits except ADG 2. Interaction effect of type of birth and age of dam was only significant on weaning weight. But interaction effect of type of birth was not significant on lamb's sex for all traits. Single lamb's body weight in all ages and their average daily gain were more than twins (Table 3). 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 and their average daily gain is higher. Higher weaning weight in singles and high correlation between these traits with month 6 weight can be the reason of more weight in month 6 in singles against twins (Vaez torshizi et al., 1992; Kalantar, 2003; Dixit et al., 2001). But Shahroudi et al. (2003) and Matika et al. (2003) reported that birth type have no significant effect on body weight in Kurdish (birth and weaning weights) and Sabi (birth weight and ADG 1) breeds, respectively.

Age of dam

Age of dam was significant on ADG 2. Interaction effect was significant between the age of dam and birth type on month 6 weight and also age of dam with lamb's sex on birth weight and ADG 1. But interaction effect of age of

Table 3. Least squares means and their standard error of mean for different levels of factors for traits.

Factor		BW	WW	6 MW	ADG 1	ADG 2
Birth year	1999	$3.87^{a} \pm 0.02$	$22.46^{b} \pm 0.09$	$31.35^{de} \pm 0.18$	$0.191^{ef} \pm 0.002$	$0.111^{c} \pm 0.002$
	2000	$3.84^{a} \pm 0.01$	$21.43^{d} \pm 0.07$	$31.55^{d} \pm 0.18$	$0.178^{g} \pm 0.001$	$0.154^{a} \pm 0.001$
	2001	$3.74^{b} \pm 0.02$	$21.66^{c} \pm 0.07$	$31.73^{d} \pm 0.16$	$0.195^{de} \pm 0.002$	$0.119^{b} \pm 0.002$
	2002	$3.83^{a} \pm 0.02$	$21.12^{e} \pm 0.12$	$34.26^{a} \pm 0.10$	$0.172^{h} \pm 0.002$	$0.123^{b} \pm 0.001$
	2003	$3.56^{c} \pm 0.04$	$22.39^{b} \pm 0.13$	$33.23^{b} \pm 0.21$	$0.205^{bc} \pm 0.003$	$0.120^{b} \pm 0.002$
	2004	$3.73^{b} \pm 0.03$	$23.01^{a} \pm 0.11$	$33.06^{b} \pm 0.22$	$0.221^{a} \pm 0.002$	$0.121^{b} \pm 0.002$
	2005	$3.67^{b} \pm 0.03$	$21.80^{c} \pm 0.15$	$31.46^{d} \pm 0.22$	$0.206^{b} \pm 0.003$	$0.107^{c} \pm 0.002$
	2006	$3.84^{a} \pm 0.03$	$21.78^{c} \pm 0.14$	$30.88^{e} \pm 0.22$	$0.199^{cd} \pm 0.002$	$0.109^{c} \pm 0.002$
	2007	$3.89^{a} \pm 0.03$	$22.51^{b} \pm 0.10$	$32.16^{c} \pm 0.11$	$0.190^{f} \pm 0.001$	$0.121^{b} \pm 0.002$
Gender	Male	$3.88^{a} \pm 0.01$	$22.47^{a} \pm 0.06$	$32.88^{a} \pm 0.09$	$0.199^{a} \pm 0.001$	$0.123^{a} \pm 0.001$
	Female	$3.67^{b} \pm 0.01$	$21.57^{b} \pm 0.05$	$31.49^{b} \pm 0.09$	$0.191^{b} \pm 0.001$	$0.118^{b} \pm 0.001$
Birth type	Single	$4.22^{a} \pm 0.01$	$22.63^{a} \pm 0.04$	$33.21^{a} \pm 0.07$	$0.199^{a} \pm 0.001$	$0.123^{a} \pm 0.001$
	Twin	$3.33^{b} \pm 0.01$	$21.40^{b} \pm 0.07$	$31.17^{b} \pm 0.12$	$0.191^{b} \pm 0.001$	$0.118^{b} \pm 0.001$
Dam's age (year)	2	$3.76^{b} \pm 0.02$	$21.65^{a} \pm 0.08$	$31.71^{c} \pm 0.12$	$0.190^{c} \pm 0.001$	$0.118^{c} \pm 0.001$
	3	$3.82^{c} \pm 0.02$	$22.04^{b} \pm 0.07$	$32.17^{b} \pm 0.11$	$0.193^{b} \pm 0.001$	$0.119^{c} \pm 0.001$
	4	$3.74^{b} \pm 0.02$	$22.15^{b} \pm 0.07$	$32.55^{a} \pm 0.11$	$0.199^{a} \pm 0.001$	$0.124^{a} \pm 0.001$
	5	$3.81^{c} \pm 0.02$	$22.03^{bc} \pm 0.08$	$31.94^{bc} \pm 0.13$	$0.195^{b} \pm 0.001$	$0.118^{c} \pm 0.001$
	6	$3.67^{a} \pm 0.02$	$21.84^{cd} \pm 0.09$	$32.11^{b} \pm 0.13$	$0.199^{a} \pm 0.002$	$0.123^{ab} \pm 0.001$
	7 and more	$3.84^{c} \pm 0.02$	$22.39^{a} \pm 0.09$	$32.65^{a} \pm 0.13$	$0.195^{b} \pm 0.001$	$0.121^{bc} \pm 0.001$
Herd	1	$3.0^{i} \pm 0.03$	$22.18^{f} \pm 0.09$	$31.92^{f} \pm 0.16$	$0.209^{g} \pm 0.002$	$0.107^{e} \pm 0.002$
	2	$3.75^{f} \pm 0.03$	$20.83^{g} \pm 0.14$	$26.42^{j} \pm 0.18$	$0.198^{e} \pm 0.002$	$0.069^{g} \pm 0.002$
	3	$4.46^{a} \pm 0.03$	$19.89^{i} \pm 0.16$	$39.16^{a} \pm 0.26$	$0.165^{a} \pm 0.003$	$0.234^{a} \pm 0.003$
	4	$4.31^{cd} \pm 0.03$	$19.79^{i} \pm 0.18$	$38.77^{a} \pm 0.31$	$0.174^{b} \pm 0.003$	$0.217^{b} \pm 0.004$
	5	$4.39^{b} \pm 0.02$	$19.93^{i} \pm 0.09$	$38.94^{a} \pm 0.21$	$0.161^{a} \pm 0.002$	$0.208^{c} \pm 0.002$
	6	$3.15^{h} \pm 0.03$	$20.30^{h} \pm 0.12$	$27.87^{h} \pm 0.18$	$0.189^{cd} \pm 0.002$	$0.087^{f} \pm 0.002$
	7	$3.19^{h} \pm 0.03$	$23.03^{e} \pm 0.13$	$26.98^{i} \pm 0.18$	$0.193^{de} \pm 0.002$	$0.051^{h} \pm 0.002$
	8	$3.17^{h} \pm 0.03$	$22.14^{f} \pm 0.14$	$24.63^{l} \pm 0.18$	$0.185^{c} \pm 0.002$	$0.038^{i} \pm 0.002$
	9	$3.35^{g} \pm 0.03$	$24.51^{c} \pm 0.12$	$29.45^{g} \pm 0.20$	$0.218^{h} \pm 0.002$	$0.071^{g} \pm 0.003$
	10	$2.97^{j} \pm 0.03$	$22.21^{f} \pm 0.12$	$25.42^{k} \pm 0.18$	$0.209f^{g} \pm 0.002$	$0.043^{i} \pm 0.002$
	11	$4.39^{bc} \pm 0.03$	$19.02^{j} \pm 0.18$	$37.84^{b} \pm 0.26$	$0.162^{a} \pm 0.003$	$0.227^{a} \pm 0.003$
	12	$4.24^{d} \pm 0.02$	$25.15^{b} \pm 0.12$	$34.80^{d} \pm 0.18$	$0.203^{f} \pm 0.002$	$0.118^{d} \pm 0.002$
	13	$4.33^{bc} \pm 0.02$	$25.83^{a} \pm 0.17$	$35.62^{c} \pm 0.25$	$0.256^{i} \pm 0.003$	$0.109^{e} \pm 0.003$
	14	$4.07^{e} \pm 0.02$	$23.45^{d} \pm 0.07$	$32.81^{e} \pm 0.11$	$0.211^{g} \pm 0.001$	$0.111^{e} \pm 0.001$

BW: birth weight, WW: weaning weight (month 3), 6MW: month 6 weight, ADG 1: daily gain from birth to weaning, ADG 2, daily gain from weaning to month 6. Within column, within each factor, least square means with different superscripts are different at $P < 0.05$

dam with herd was significant for the whole trait. Results were the same as some of other researchers (Vaez torshizi et al., 1992; Shahroudi et al., 2002, 2003; Kalantar, 2003; Dixit et al., 2001; Matika et al., 2003; Ozcan et al., 2005; Rashidi et al., 2008), but have some contradictions with others (Rashidi, 1994; Abegaz et al., 2005; Vaez torshizi et al., 1992; El Fadilli et al., 2000).

Least square means of traits are mentioned in the Table 3. The lambs produced by dams of 4 years and more have more weight than other lambs. This difference is not significant for some traits but it can be related to higher capacity of milking in association with 4 years and more ewes in comparison to younger ewes (Shahroudi et al., 2002, 2003; Nourian, 2000; Dixit et al., 2001; Matika et al., 2003; Rashidi et al., 2008).

Herd

Herd and its interaction effect with birth year, lamb's sex and age of dam were significant for all traits. Interaction effects of herd with birth type were significant for all traits except ADG 2.

Herd can have a significant effect on body weight in different ages and average daily gain because of difference in management and environmental conditions.

High phenotypic differences between herds in this study (Table 3), expressed diversities of managements (hygiene and nutrition) have a great importance on weight and growth traits in sheep. The same results were shown by the researchers who investigated the effects of herd on body weight (Yazdi et al., 1998; Nourian, 2000; Neser et al., 2001)

Conclusion

Environmental factors were significant sources of variation for growth traits Including body weight and average daily gain 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 Ghezel lambs.

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