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Estimation of Individual Heterosis for Lamb Growth in Ghezal and Mehraban Sheep

Research Article

H. Atashi[1*] and J. Izadifar[1]

[1] Department of Animal Science, Shiraz University, Shiraz, Iran

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*Correspondence E-mail: atashi@shirazu.ac.ir

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ABSTRACT

Data on 361 lambs of Mehraban (n=90), Ghezel (n=92), Ghezel × Mehraban (n=87), and Mehraban × Ghezel (n=92, sire breed listed first) were used to estimate individual Heterosis for lamb growth. The obtained results demonstrated that lambs of purebreds of Ghezel and Mehraban showed the highest and the lowest birth weight, respectively (P<0.05). Crossbred lambs of Mehraban × Ghezel showed significantly higher (P<0.05) average birth weight per ewe than Ghezel × Mehraban. Purebred Mehraban lambs showed the lowest total and average six month old weight per ewe (P<0.05) but the average and total six month old weight per ewe of Ghezel was not different than crossbreds groups of Ghezel × Mehraban and Mehraban × Ghezel lambs (P≥0.05). Individual heterosis for the average birth weight, total birth weight, average six month old weight and total six month old weight was estimated to be -0.37, -0.30, 0.22 and -1.03%, respectively (P≥0.05).

KEY WORDS crossbreeding, individual heterosis, Iranian sheep.

INTRODUCTION

Although in recent years there has been an increasing demand for lamb and mutton in Iran, meat production from the sheep does not cover the increasing consumer demand. Mismanagement and overgrazing of the natural ranges have practically eliminated the possibility of increasing the sheep population in the near future (Rashidi *et al*. 2008). One of the likely ways of alleviating the problem of insufficient meat production is that of increasing the productivity using crossbreeding procedure. Crossbreeding, the mating of two individuals with different breed makeups is widely used in commercial beef and sheep production because of the benefits it has to offer to producers. Most important crossbreeding benefit arises from heterosis, which is often referred as hybrid vigor (Willham and Pollak, 1985).

Although, information on combining ability, maternal and individual heterosis is needed to make the proper choice of breeds employed in a crossbreeding system, little information is available on the results of crossbreeding for the native sheep breeds of Iran. Ghezel and Mehraban are of the predominant sheep breeds in Iran and being very well adapted to harsh environmental conditions. They are fat-tailed sheep used mainly for meat production. The breeding area of Ghezel sheep is East Azarbayjan province, northwest of Iran.

They are light brown to dark brown, with adult weight of 65-80 and the birth weight of 4.5-4.7 kg. The Mehraban sheep is originated in Hamadan province, the west of Iran. They are brown to light brown, with adult weight of 60-70 and the birth weight of 3.8-4.1 kg (Bathaeu 1994; Zamiri and Izadifard, 1997). The objectives of this study were to

estimate individual heterosis, maternal and direct effects on crossing of Ghezel and Mehraban sheep.

MATERIALS AND METHODS

This experiment was carried out in the Experimental Animal Farm Station of the College of Agriculture, Shiraz University, Shiraz, Iran. Shiraz is located in the southwest of Iran, has a moderate climate, regular seasons with average rainfall between 14 and 18 inches. In the study, Mehraban (n=13) and Ghezel rams (n=8) were randomly assigned to the ewes of Mehraban (n=211) and Ghezel (n=212) to construct population of F1 using reciprocal cross. Data on 361 lambs of Mehraban, MM, (n=90), Ghezel, GG, (n=92), Ghezel × Mehraban, GM, (n=87), and Mehraban × Ghezel, MG, (n=92, sire breed listed first) were used in the analysis.

Traits of the total birth weight per ewe (TBW), average birth weight per ewe (ABW), total six month old weight per ewe (T6MW) and average six month old weight per ewe (A6MW) were measured. Weight of the ewe at mating was measured as well and considered as a covariate effect to analyze the data. The following equations were used to compute the values for Heterosis (kg), Heterosis (%), maternal and direct effects (Sandelin *et al*. 2002).

Heterosis equation (kg)= [((GM+MG)/2)-((GG+MM)/2)]
Heterosis equation (%)= [((((GM+MG)/2)-((GG+MM)/2))/(
GG+MM)/2] × 100
Direct effect, Ghezal – Mehraban comparison,
(U)= [(GG+GM)-(MM+MG)]
Maternal effects, difference between reciprocals,
(U)= (GM-MG)

Heterosis, maternal effects and direct effects were estimated using the LSMEANS option in MIXED procedure of SAS (SAS, 1990).

RESULTS AND DISCUSSION

The estimated least square means (±SE) of potential factors affecting examined traits are presented in table 1. The results demonstrated that lambs of purebreds of GG and MM showed the highest and the lowest birth weight (ABW and TBW) per ewe, respectively (P<0.05). Crossbred lambs of MG showed significantly higher (P<0.05) ABW per ewe than GM. There was no significant difference (P≥0.05) between crossbred lambs of MG and GM for TBW per ewe (Table 1).

The lambs of MM showed the lowest T6MW and AT6MW per ewe (P<0.05). The A6MW and T6MW per ewe of lambs of GG were not different from crossbreds groups of GM and MG (P≥0.05).

The results showed that there was no difference between lambs of crossbred groups of GM and MG for T6MW and A6MW per ewe (Table 1). Direct effects or sire breed effects, Ghezel-Mehraban, for ABW, TBW, A6MW and T6MW was significant (Table 2). Maternal effects, difference between reciprocals, was non-significant (P≥0.05) and were estimated to be -0.111 (±0.09), -0.116 (±0.1), -0.46 (±1.20) and -0.76 (±1.71) kg, for ABW, TBW, A6MW and T6MW, respectively (Table 2). Some of the obtained results in this study can be explained based on this fact that Ghezel is a heaver sheep breed than Mehraban. Zamiri and Izadifard (1997) reported that at age of 17 to 18 months, Ghezel rams were on average 4.5 kg heavier than Mehraban. The difference between average performance of pure breed (GG and MM) and crossbreed (GM and MG) lambs was not significant (P≥0.05) for any examined traits (Table 2). Individual heterosis (%) for ABW, TBW, A6MW and T6MW per ewe was estimated to be -0.37, -0.30, +0.22 and -1.03%, respectively. Rastogi *et al.* (1982) reported that individual heterosis for birth weight, pre weaning average daily gain, weaning weight and post weaning average daily gain, in Columbia, Suffolk and Targhee sheep are between 1.4 to 6.9, -3.6 to 3.1, -1.6 to 3.4 and -5.5 to 2.4%, respectively. Long *et al*. (1989) reported that individual heterosis for 90-d weight in Suffolk and Targhee sheep is 2.8%. Notter (1978) reported that average heterosis effects in the crossbred lamb for birth weight, weaning weight, pre-weaning daily gain, post-weaning daily gain and yearling weight were 3.2, 5, 5.3, 6.6 and 5.2 % respectively. Since the genetic makeup of the exotic breeds is quite different from that of the native breeds, crossbreeding is expected to increase the productivity as a result of heterosis. Several studies in Iran have shown improved performance when native ewes were mated with rams of exotic breeds. Crossing Suffolk rams with Ghezel ewes, resulted in improved birth weight, weaning weight, daily gain and final weight (Taleghani *et al*. 1975). Crossing Iranian fat-tailed Karakul, Mehraban and Naeini ewes with Corriedale and Targhee rams resulted in improved significant birth weights, weaning weights, pre-weaning average daily gains, post-weaning average daily gains, feed conversions and market weights (Makarechian *et al*. 1977). Crossing Iranian fat-tailed Karakul, Mehraban and Baluchi ewes with Corriedale and Targhee rams resulted in improved significant slaughter weight and carcass weight (Farid, 1991). In a review paper, Vatankhah *et al.* (2004) concluded that crossing between Iranian sheep breeds would have no considerable advantage for most economical traits, but crossing Iranian fat-tailed breeds with the Zel breed (the only Iranian breed which is not fat-tailed) may reduce fat-tail significantly.

Heterosis is determined by the genetic distance between parent breeds. Mehraban sheep breed is originally located

Table 1 Estimated least square means (±SE) of mating groups, gender of lamb and twinning on birth weight and six month old weight of the lambs

Breed	TBW[1]	ABW[2]	T6MW[3]	A6MW[4]
GG	4.82(0.07)[a]	6.24(0.07)[a]	43.2(0.60)[a]	33.31(0.55)[a]
GM	4.42(0.07)[c]	5.84(0.07)[b]	41.09 (0.68)[ab]	31.84(0.62)[ab]
MG	4.57(0.07)[b]	5.97(0.07)[b]	41.14(0.66)[ab]	31.93(0.61)[ab]
MM	4.20(0.07)[d]	5.62(0.07)[c]	39.50(0.72)[b]	29.99(0.66)[b]
Birth kind and lamb (s) gender	TBW[1]	ABW[2]	T6MW[3]	A6MW[4]
Single and male (n=152)	4.91(0.05)[a]	4.91(0.08)[b]	37.47(0.47)[b]	37.52(0.43)[a]
Single and female (n=171)	4.54(0.05)[b]	4.54(0.08)[c]	30.64(0.44)[c]	30.60(0.40)[b]
Twin birth (n=38)	4.05(0.10)[c]	8.25(0.1b)[a]	55.60(1.02)[a]	27.17(0.93)[b]

1. Total birth weight per ewe; 2. Average birth weight per ewe; 3. Total six month old weight per ewe; 4. Average six month old weight per ewe. The means within the same columns that have at least one common letter, do not have significant difference (P>0.01).

Table 2 Heterosis (kg), maternal effects and direct effects for the average birth weight, total birth weight, average six month old weight and total six month old weight of the lambs along with their standard errors

	TBW[1]	ABW[2]	T6MW[3]	A6MW[4]
Heterosis (kg)	-0.017 (0.07)[ns]	-0.018 (0.07)[ns]	0.069 (0.77)[ns]	-0.43 (1.01)[ns]
Direct effect (kg)	0.24 (0.07)*	0.24 (0.07)*	1. 56 (1.02)*	1.83 (1.02)*
Maternal effect (kg)	-0.111(0.09)[ns]	-0.116 (0.10)[ns]	-0.46 (1.20)[ns]	-0.76 (1.71)[ns]

1. Total birth weight per ewe; 2. Average birth weight per ewe; 3. Total six month old weight per ewe; 4. Average six month old weight per ewe.
ns: not significant at α= 0.05; * Significant at α= 0.05.

in Hamedan province that is not geographically far from East Azerbaijan which Ghezel is originally located in, and the climates of these two provinces are mainly similar. Therefore, both breeds have passed the same natural selection processes and evolution history, resulting in same genetic makeup and considerable genetic distance are not expected between these breeds. In addition, the used populations in this study were under same management and environmental condition for long time at the Experimental Animal Farm Station of the College of Agriculture, Shiraz University, passed similar selection plan resulting in reduced genetic distance between them and consequently reduced the heterosis.

Gender of the lambs significantly affected birth weight and six month old weight (P<0.05). In the singletons, male lambs were found to be heavier than female for TBW, ABW, T6MW and A6MW per ewe (Table 1). The ABW and A6MW of twin born lambs, were shown to be significantly less (P<0.05), and the TBW and T6MW of twin born lambs, were shown to be significantly more (P<0.05), than single born lambs (Table 1). The significant effect of lamb's sex on body weight at different ages has been reported in various breeds of sheep (Dixit *et al*. 2001; Kalantar, 2003; Rashidi *et al*. 2008) and can be explained by differences in endocrinal system between sexes.

Significant effect of birth type on body weight has been reported in other sheep breeds (Dixit *et al*. 2001; Kalantar, 2003; Rashidi *et al*. 2008; Gamasaee *et al*. 2010). The significant effect of birth type on body weight can be explained by limited uterine space during pregnancy, nutrition of dam especially during last pregnancy and competition for milk suckling between multiple birth lambs during birth to weaning. High correlation between pre-weaning weight and six month old weight is one of the reasons for significant effect of type of birth on six month old weight.

CONCLUSION

The heterosis is determined by the genetic distance between parents. Ghezel and Mehraban are two different breeds originated from two different places, but there is no large genetic distance between these breeds. The used populations in this study are under the same management for long time resulting in reduced genetic distance between them and consequently reduced the heterosis. This research demonstrates that crossbred lambs generally have no considerabl advantage over their purebred contemporaries under same environmental conditions.

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