Reproductive Performance of Three Iranian Sheep Breeds

M. R. Kiyanzad*, J. M. Panandam[1], N. Emamjomeh Kashan[2], Z. A. Jelan[1] and I. Dahlan[1]
Animal Science Research Institute of Iran, P. O. Box 31585-1483, Karaj, Iran

ABSTRACT : To evaluate the ewe reproductive performances of three Iranian local sheep breeds, namely Moghani, Chal and Zel, 27 rams and 473 ewes were used as the foundation flock in a crossbreeding program. The three breeds were crossed amongst themselves reciprocally. Ram breed and ewe breed showed a two-way interaction on apparent fertility. The Zel ewes showed higher fertility than the Chal and Moghani ewes (94.4 vs 77.3 and 84.6%). Prolificacy among main and individual mating groups were not significantly different (p>0.05). Zel ewes were 22.3 and 14.8% more reproductive (p<0.05) than Chal and Moghani ewes, respectively. Zel and Moghani ewes showed higher (p<0.05) ewe productivity than Chal ewes. Ram breed had a significant (p<0.05) effect on ewe efficiency. The Zel rams were not completely successful to mate with Chal ewes, this caused a to way-interaction between ram and ewe breeds. The Zel ewes mated with Chal and Moghani rams showed 26.1 and 28.5% more efficiency than those mated with Zel rams. This observation strongly supports the use of crossbreeding to improve the efficiency of the Zel ewes. With decreasing lamb mortality, through supplemented feeding of lambs in pre-weaning period, and increasing litter weight, through crossbreeding, it should be possible to improve the efficiency of Zel ewes even better than Chal and Moghani ewes. Small body size of Zel ewes that needs the lower maintenance requirements would be a well advantageous to using Zel ewes as the dam herd to produce commercial lambs in north area of Iran. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 1 : 11-14)***

Key Words : Iranian Sheep, Moghani, Chal, Zel, Ewe Efficiency, Reproductive Performances, Fat-tailed

INTRODUCTION

Sheep population in Iran is 50 million and meat production by sheep and goats amounts to 57% of the total red meat production in the country (Kiyanzad, 1999; FAO, 1998; Osfoori and Fesus, 1996). In Iran periodical drought, overgrazing, use of pasture plants by villagers as fuel and use of pastureland for cultivation has caused reduction in pasture capacity. On the other hand, increasing demand for red meat and increasing cost of production has become an impetus for producers to adopt the intensive or semi-intensive system of farming and to use more productive animals or breeds so as to achieve more efficient output per unit livestock. Improvement in the reproductive rate of the ewe flock is one of the most effective means of increasing the efficiency of lamb meat production (Nawaz et al., 1998; Bitante et al., 1997; Gabina, 1995). Weight of lambs at birth and weaning are important components of overall ewe productivity because of their effect on lamb survival, lamb growth rate and, therefore, total lamb market weight (Bordon, 2000; Iman and Slyter, 1996). The objective of this study was to evaluate the reproductive performance of ewe of three popular sheep breeds of Iran, which were used in a crossbreeding project.

* Corresponding Author: M. R. Kiyanzad. Tel: +98-261-4430010, Fax: +98-261-413258, E-mail: kiyanzad@yahoo.com
[1] Animal Science Department, Universiti Putra Malaysia, 43400 UPM Serdang, Malaysia.
[2] Animal Science Department, Aborihan Educational Center, Tehran University,Varamin, Tehran, Iran.
Received May 14, 2002; Accepted August 27, 2002

MATERIALS AND METHOD

Twenty seven rams (2 to 3 years of age) and 473 ewes (over 2 years of age) of three Iranian sheep breeds, namely the Moghani, Chal and Zel, were used as the foundation flock for the crossbreeding program (Table 1). The Chal and Moghani are big sized and fat-tailed, but Zel is a small breed and non fat-tailed. The study was carried out at the Animal Science Research Institute in Karaj, Iran. Sheep were selected and purchased from the Ram Pivot Project in the Golestan, Qazvien and Ardabil provinces. Selection was based on their physical condition, general health and age. The breeding design was three two-way crosses, with a one ram to 17-18 ewes ratio. The breeds were mated reciprocally. Each mating type was carried out in triplicate. All rams and ewes were allocated to the mating groups randomly. The mating was done naturally for 51 days (three estrous cycles).

Diets of animals were formulated to provide nutrient requirements according to NRC (1985). The requirements were provided for different physiological periods (maintenance, flashing, non lactating-first 15 weeks gestation, last 4 weeks gestation and weeks lactation). Feed was in the form of total mixed ration and comprised of alfalfa, wheat straw, cotton seed cake, barley and wheat bran. Per kilogram dry matter of concentrate contained approximately 2.13 Mcal metabolizable energy, 11.50% crude protein concentration, 0.35% calcium and 0.65% phosphorus. The diet was also supplemented with commercial minerals and vitamins. Feeding was carried out under a standard management practice, according to average body weight of ewes of a mating group. The ewes

Table 1. Sample size of breeds used in the crossbreeding program

Sex	Breeds			
	Moghani	Chal	Zel	Total
Female	156	158	159	473
By age (years)				
2	38	41	32	111
3	43	40	35	118
4	38	39	47	124
5 and above	37	38	45	120
Male	9	9	9	27
Total	165	167	168	500

of the various genetic groups were fed separately. Lambs of each genetic group were allowed to feed on their dam's milk until weaning at three months of age. They were also given high quality alfalfa from four weeks of age. The traits studied are presented in Table 2.

The data was analysed using SPSS for Windows (SPSS, 1999). Apparent fertility (AF), prolificacy (P), ewe reproductivity (ER) and ewe productivity (EP) were analysed for ram and ewe breed effects using two-way ANOVA. For ewe efficiency (EE) ewe age was used as an additional effect. The statistical model assumed for the latter trait was:

$$Y_{ijkl} = \mu + R_i + E_j + A_k + (R \times E)_{ij} + (R \times A)_{ik} + \varepsilon_{ijkl}$$

where Y_{ijkl} was EE to the l-th ewe of k-th age and j-th breed, mated to the i-th ram breed. μ was the overall mean for EE, R_i was the effect of i-th ram breed {i=1 (Chal); 2 (Moghani) 3 (Zel)}, E_j was the effect of j-th ewe breed {j=1 (Chal); 2 (Moghani) 3 (Zel)}, A_k was the effect of k-th age of ewe (k =2, 3, 4, 5 years), $(R\times E)_{ij,}$ $(R\times A)_{ik}$ and (E×A) were the effects of two-way interactions between the independent, discrit variable, and ε_{ijkl} was the random error, assumed to be normally distributed with mean zero and common variance. The statistical model assumed for LW of the ewe breeds was:

Table 2. Description of traits studied

	Traits	Description
1	Apparent fertility (AF)	The percentage of ewes that lambed to the number of ewes exposed to rams.
2	Prolificacy (P)	The percentage of lambs born (dead and alive) to the number of ewes that lambed.
3	Litter weight (LW)	The total weight (kg) of all the live and dead lambs of a litter at birth.
4	Ewe reproductive performance (ER)	The percentage of lambs born (dead and alive) to ewes exposed.
5	Ewe productivity (EP)	The percentage of lambs weaned to ewes exposed.
6	Rearing ability (RA)	The percentage of lambs weaned to the number of lambing ewes.
7	Ewe efficiency (EE)	The total weight of lambs weaned to metabolic body weight (live weight$^{0.75}$) of ewe exposed.
9	Lamb mortality at birth (LMB)	The percentage of the number of death among the lambs at birth to the number of lambs born.
8	Lamb mortality at pre-weaning period (LMP)	The percentage of the number of lambs that died during the pre-weaning period (mortality at birth excluded)

$$Y_{ijklm} = \mu + R_i + E_j + A_k + L_l + (R\times E)_{ij} + (R\times A)_{ik} + (R\times L)_{il} + (E\times A)_{jk} + (E\times L)_{jl} + b(EW_{ijklm}) + \varepsilon_{ijklm}$$

where Y_{ijklm} was the weight of the m-th litter of the l-th litter type born to ewe mated to the i-th ram breed and j-th ewe breed of k-th age, μ was the overall mean for litter weight, R_i was the effect of i-th ram breed (i=1-3). E_j was the effect of j-th ewe breed (j=1-3), A_k was the effect of k-th age of ewe (k=2-5 years), L_l was the effect of l-th litter type {l=1 (single male), 2 (single female), 3 (twin males), 4 (twin females), 5 (twin male with female)}, $(R\times E)_{ij,}$ $(R\times A)_{ik,}$ etc. were the effects of two-way interactions between independent, discrete variables, b (W_{ijklm}) was the regression of litter weight on postpartum ewe weight corresponding to Y_{ijkl}, and ε_{ijklmn} was the random error, assumed to be normally distributed with mean zero and common variance.

The significance of the differences between means of the various genotypes was tested with Duncan's new multiple range test (Steel and Torrie, 1980).

RESULT AND DISCUSSION

Means and standard errors of the traits studied are presented in Table 3. Ram breed and ewe breed showed significant ($p<0.05$) two-way interaction effect on AF, ER and EP, but this interaction effect were non significant for P, and RA. The significant ram breed x ewe breed interaction effect on AF, ER and EP may be attributed to weakness of Zel rams in mating ewes of the bigger sized and fat-tailed breeds, especially the Chal ewes. The Zel rams were able to cause conception in only 41.2% of the Chal ewes. The Zel rams were able to achieve better AF with Moghani ewes probably because the fat-tail of this latter breed has a split that allows easier penetration and, therefore, better mating success. Although this weakness may be overcome by using artificial insemination this technique would not be feasible in the near future in the present system of sheep keeping in Iran (nomadic and semi-nomadic).

When the mating of Chal and Moghani ewes with Zel rams were excluded, AF was not significantly ($p>0.05$) different among the three ewe breeds. The observed AF for purebred Moghani matings, tallies with the 93% AF reported by Monem and Esmaily Rad. (1981). No reported values are available of purebred Chal and Zel matings or for any of the crosses for comparison.

Table 3. Means (standard error) of reproductive performance of the three sheep breeds

Ewe breed	Ram breed	AF (%)	P (%)	LW (kg)	ER (%)	EP (%)	EE (kg)	RA (%)	LMB %	LMP %
C		**77.34 (1.97)^{ns}**	**111.36^{ns} (2.7)**	**5.70^{A} (0.21)**	**87.91^{B}(3.55)**	**82.87^{B} (3.35)**	**1.21^{A} (0.05)**	**106.98^{ns} (3.7)**	**2.82**	**2.09**
	C	96.39^{a} (3.4)	113.51^{ns} (4.7)	5.75^{a} (0.31)	109.38^{ab} (6.1)	100.01^{ab} (5.8)	1.60^{a} (0.09)	103.70^{ns} (3.3)	1.69	3.45
	M	94.44^{ab} (3.4)	120 59^{ns}(4.7)	6.08^{a} (0.22)	113.18^{b} (6.1)	105.45^{a} (5.8)	1.55^{a} (0.09)	112.48^{ns} (3.3)	3.33	1.72
	Z	41.17^{d} (3.4)	100.00^{ns}(4.7)	4.85^{c} (34)	41.18^{d} (6.1)	43.14^{d} (5.8)	.52^{d} (0.09)	104.76^{ns} (3.3)	4.35	4.55
M		**84.64 (1.97)^{ns}**	**110.45^{ns} (2.7)**	**5.40^{B} (0.28)**	**93.64^{B} (3.55)**	**87.84^{A} (3.35)**	**1.34^{A} (0.05)**	**103.36^{ns} (2.3)**	**2.05**	**2.80**
	C	83.33^{bc} (3.4)	108.47^{ns} (4.7)	5.48^{b} (33)	90.74^{bc} (6.1)	87.04^{bc} (5.8)	1.42^{ab} (0.09)	104.31^{ns} (3.5)	0.00	2.04
	M	92.16^{ab} (3.4)	110.42^{ns} (4.7)	5.62^{b} (0.27)	101.96^{abc} (6.1)	96.08^{bc} (5.8)	1.42^{ab} (0.09)	104.17^{ns} (3.3)	3.85	2.00
	Z	78.43^{c} (3.4)	112.45^{ns} (4.7)	5.11^{c} (0.32)	88.24^{c} (6.1)	80.39^{c} (5.8)	1.13^{c} (0.09)	102.20^{ns} (3.3)	2.22	4.55
Z		**94.37 (1.97)^{ns}**	**113.77^{ns} (2.7)**	**4.44^{C} (0.31)**	**107.55^{A}(3.55)**	**93.82^{A} (3.35)**	**1.36^{A} (0.05)**	**99.57^{ns} (3.9)**	**1.73**	**8.24**
	C	92.59^{ab} (3.4)	112.13^{ns} (4.7)	4.31^{e} (0.36)	107.70^{abc} (6.1)	94.44^{bc} (5.8)	1.43^{ab} (0.09)	102.20^{ns} (3.3)	3.57	3.70
	M	94.12^{ab} (3.4)	119.59^{ns} (4.7)	4.75^{d} (0.29)	113.29^{b} (6.1)	101.63^{ab} (5.8)	1.50^{a} (0.09)	107.94^{ns} (3.3)	1.69	6.90
	Z	96.39^{a} (3.4)	109.59^{ns} (4.7)	4.15^{f} (31)	105.65^{abc} (6.1)	85.38^{bc} (5.8)	1.18^{bc} (0.09)	88.56^{ns} (3.3)	0.00	13.79
Total		***85.44 (1.8)***	***111.86 (2.1)***	***5.43 (0.18)***	***96.35 (4.1)***	***88.17 (3.4)***	***1.31 (0.03)***	***103.34 (3.1)***	***2.12***	***4.77***

^{ns} non significant.

Means that do not share any of the superscripts (A, B, C for overall means of ewe breed, and a, b, c, etc. for means of ewe breeds of particular crosses) are significantly different at 5 percent probability level.

The ewe breeds did not differ significantly (p>0.05) for P. The P values, however, was lower than those reported by Gatenby et al. (1997), Imman and Slyter (1996) and Klewiec and Gabryszuk (1996) for other sheep breeds elsewhere. This may be because Chal, Moghani and Zel breeds of very low twining rates (Monem and Esmaili-Rad, 1981; Yalcin, 1979). A contributing factor would have been the non-existence of breeding program to improve reproductive ability of Iranian sheep.

Ewe breed and litter type showed a two-way interaction effect on LW. This was probably due to differences in litter types between the ewe breeds. Chal ewes bore lesser male lambs than females (42 vs 63). The single male and female lambs within difference ewe breeds were not significantly (p>0.05) different in birth weight. However, Chal ewes bore significantly (p<0.05) heavier lambs than Moghani and Zel ewes, and Moghani bore heavier lambs than Zel. LW increased significantly (p<0.05) with age of ewe. This is related to the more extended body capacity, physiological maturity and experience of these older ewes that enabled them to provide a more favourable uterine environment and pre-natal care for foetal development.

Zel ewes had 22.3 and 19.9% higher overall ER than Chal and Moghani ewes, respectively (p<0.05). This may be related to the reduced overall AF of Chal and Moghani. When individual mating types were considered, the Chal ewes mated with Zel rams showed the lowest ER (41.18%), followed by Moghani ewes mated with Zel rams (88.24%). When crosses of Zel rams with Chal and Moghani ewes were excluded, there was no difference among the ewe breeds for ER. Zel and Moghani ewes showed higher (p<0.05) overall EP than Chal ewes. This is due to the overall value being strongly bias as a result, the low EP of Chal ewes mated with Zel rams (43.14%). Generally, EP observed in this study was lower than that reported in studies of other sheep breeds (Imman and Slyter, 1996; Mavrogenis, 1996). This difference was probably due to the lower P of the ewes in the present study.

There was significant (p<0.05) two way-interaction between ram and ewe breeds for EE. The three ewe breeds differed in EE only because of the matings with Zel rams. The Zel rams had lower success in impregnating Chal ewes, resulting in the lower EE of Chal. The significantly lower LW from matings with Zel rams also reduced the EE of the three ewe breeds of these mating types. Zel ewes mated with Chal and Moghani rams had EE comparable to Chal and Moghani ewes mated to non Zel rams despite their lighter litters because of their lower body weights. The ewe age had a significant effect on EE and this may be associated with litter size. Chal ewes mated to Zel rams had significantly (p<0.05) lower EE (0.521 kg) than the ewe breeds of other mating types. The three ewe breeds did not differ significantly (p>0.05) in EE when mated to Chal or Moghani rams. Moghani and Zel ewes mated to Zel rams were not significantly (p>0.05) different. Despite the relatively high P of the ewes studied by Imman and Slyter (1996) (175-211%), the EE reported was not much different in comparison with the results of the present study. It was probably due to the higher weaning weight of the lambs in the present study. It may be concluded that EE would be a better index for evaluating the ewe performance compared to the number of weaned lambs.

LMB in Chal, Moghani and Zel ewes were 2.82, 2.05 and 1.73%, respectively. The crossbreed lambs of Chal rams mated to Moghani ewes and Zel rams mated to Zel ewes showed no LMB. The crossbreed lambs of Zel rams mated to Chal ewes had the highest LMB, 4.35%. Zel ewes had the highest overall LMP (8.24% vs 2.80 and 2.09% for Moghani and Chal ewes). For all three ewe breeds, ewes crossed to Zel have the highest LMP. The lambs of Zel ram crossed with Zel ewes showed the highest LMP (13.79%).

For the purebreed crosses (Chal×Chal, Moghani× Moghani and Zel×Zel), the AF, P, ER, EP and RA was not significantly ($p>0.05$) different among the ewe breeds. Zel ewes, however, showed higher ($p<0.05$) values for overall AF, ER and EP than Chal and Moghani ewes. This may be attributed to the problems encountered by the small Zel rams in impregnating the bigger and fat-tailed Chal and Moghani ewes, giving rise to their lowered AF. The Zel ewes due to their small body size would be expected to have lower maintenance requirements, and therefore, better EE. The Zel ewes, however, showed significantly lower RA and EE. This may be attributed to the relatively high LMP and the lower weaning weights of their lambs. LMP may be decreased through supplemented feeding and this would also increase weaning weight to some extent and thereby the EE as well.

REFERENCES

Bourdon, R. M. 2000. Understanding Animal Breeding. Prentice Hall, Inc USA.

FAO. 1998. Food and agriculture organization of the united nations. Quarterly Vol. 11.

Gabina, D. 1995. Genetic improvement of mutton sheep. Cahiers Options Mediterraneennes 6:87-99.

Gatenby, R. M., M. Doloksaribu, G. E. Bradford, E. Romjali, A. Batubara and I. Mirza. 1997. Comparison of Sumatra sheep and three hair sheep crossbreds. II. Reproductive performance of F1 ewes. Small Ruminant Research. 25(2):161-167.

Iman, N. Y. and A. L. Slyter. 1996. Lifetime lamb and wool production of Targhee or Finn-Dorset-Targhee ewes managed as farm or range flock: I. Average annual ewe performance. J. Anim. Sci. 74(8):1757-1764.

Kiyanzad, M. R. 1999. Application of ultrasound and body measurements for prediction of carcass physical and chemical components of live Iranian sheep. Project report, Animal Science Research Institute of Iran.

Klewiec, J. and M. Gabryszuk. 1996. The effect of different proportions of Merino in the genotype of Merino×Booroola crossbreds. Prace I Materialy Zootechniczne 48:7-16.

Mavrogenis, A. P. 1996. Environmental and genetic factors influencing milk and growth traits of Awassi sheep in Cyprus. Heterosis and maternal effects. Small Ruminant Research 20(1):59-65.

Monem, M. and E. Esmailiy-Rad. 1981. Recognition of Iranian sheep (Moghani sheep). Project report, Animal Science Research Institute of Iran.

Nawaz, M., M. Khan, M. Qureshi and E. Rasool. 1998. productive and reproductive performance of Kajli and Lohi ewes. Asian-Aust. J. Anim. Sci. 11:176-184.

NRC. 1985. Nutrient Requirement of Sheep. National Academy Press, Washington, DC.

Osfoori, R. and L. Fesus. 1996. Genetic relationships of Iranian sheep breed using biochemical genetic marker. Arch. Tierz. Dumme Rstorf 39(1):33-46.

SPSS. 1999. SPSS for Windows. Release 10.05, Standard version. Inc., 1989-1999.

Yalcin, B. 1979. The breeds of Afghanistan, Iran and Turkey. FAO/UNEP project FP/1108-79-02 (833).