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In the name of Allah

CROSSBREEDING OF IRANIAN FAT-TAILED SHEEP. VI-REPRODUCTIVE PERFORMANCE AND LAMB PRODUCTION IN KARAKUL, MEHRABAN AND NAEINI BREEDS[1]

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ABSTRACT

The reproductive performance of 368 ewes of three fat-tailed Iranian breeds of sheep; Karakul, Mehraban and Naeini was studied. Fertility (percent ewes in estrus and percent ewes lambing of ewes mated), prolificacy (percent lambs born of ewes lambing), lamb livability (percent lambs born alive of total lambs born and percent lambs weaned of live lambs born) and productivity (percent lambs weaned of ewes mated and kg of lamb weaned per ewe mated) were measured.

Mating system (straightbred matings *vs* crossbred matings) was not a significant source of variation for the traits under consideration. Heterosis did not exist for most traits. Breed of ewe had a significant influence only on kg of lamb weaned per ewe mated. Mehraban ewes

تحقیقات کشاورزی ایران
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بنام خدا

جفتگیری بین گوسفندان دنبه دار ایرانی ۵- خصوصیات تولید مثل و بره زائی در گوسفندان نژاد قره گل، مهربان و نائینی

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خلاصه

خصوصیات تولید مثل در ۳۶۸ میش از سه نژاد گوسفند دنبه دار ایرانی (قره گل، مهربان و نائینی) مورد مطالعه قرار گرفت. باروری (درصد میشهائی که از کل میشهای گله فحلی نشان دادند و در صد میشهائی که نسبت به آنها ئیکه جفتگیری کردند زایش داشتند)، چندقلو زائی (درصد بره های حاصل از میشهائی که زایش داشتند)، قدرت زنده ماندن (درصد بره هائیکه از مجموع بره های متولد شده زنده بدنیا آمدند و درصد بره هائیکه نسبت به بره های زنده بدنیا آمده از شیر گرفته شدند) و بره زائی (درصد بره هائی که نسبت به میشهایی که جفتگیری کردند از شیر گرفته شدند و کیلوگرم بره از شیر گرفته شده به ازاء هر میش جفتگیری کرده) اندازه گیری شدند.

روش جفتگیری (جفتگیری بین قوچ و میشهای یک نژاد در مقایسه با جفتگیری بین قوچ و میشهای دو نژاد مختلف) بر خصوصیات مورد مطالعه تاثیر معنی داری نداشت، قدرت دورگه گیری در مورد غالب خصوصیات مشاهده نگردید. نژاد میش فقط بر کیلوگرم بره از شیر گرفته شده به ازاء هر میش جفتگیری کرده اثر

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were superior to Naeini ewes in this respect. Age of dam did not significantly affect the reproductive traits; however, 2.5 year-old ewes were superior to 1.5 year-old ewes in kg of lamb weaned per ewe mated. Breed of ram had a significant influence only on the percent lambs weaned of ewes mated. Karakul rams had lower fertility compared with the other two breeds. Sex did not have a significant effect on lamb livability.

معنی داری داشت. میشهای مهربان ازلحاظ این خصوصیت برمیشهای نائینی برتری داشتند. سن میش بر خصوصیات تولیدمثل تاثیرمشخصی نداشت هرچندمیشهای ۲/۵ ساله از لحاظ کیلوگرم بره ازشیرگرفته شده به ازاء هرمیش جفتگیری کرده بر میشهای ۱/۵ ساله برتری نشان دادند. نژادقوچ فقط بردرصدبره های ازشیر گرفته شده نسبت به میشهائی که جفتگیری کردنداثرمعنی داری داشت. قوچهای قره‌گل با مقایسه با قوچهای دونژاد دیگربا روری کمتری داشتند. جنسیت برقدرت زنده ماندن بره تاثیری نداشت.

INTRODUCTION

Information on the reproductive performance of native Iranian sheep breeds is very limited. There are, however, a few reports concerned with the ovulation rate and estrus pattern in some Iranian breeds (10, 12) indicating that the native breeds of sheep in Iran are mostly single ovulators.

The purpose of this study was to compare reproductive performance of three native breeds with special attention to the effect of crossbreeding on reproduction and lamb production traits.

MATERIALS AND METHODS

Breeds

This study involved three fat-tailed, carpet-wool Iranian breeds of sheep; Karakul, Mehraban and Naeini. The flock establishment and the characteristics of the breeds are described by Farid and Makarechian (3). In brief, Karakul and Naeini are range sheep, whereas Mehraban is a farm sheep. Range sheep refers to those which are managed under a migratory system and for which rangelands are the only source of feed. Farm breeds also have access to ranges as the main feed source but they also utilize farm residuals (mainly barley and wheat stubbles) and are hand-fed during

the late fall and winter months. Karakul and Mehraban are medium for body weight (mature ewes average 52 kg at mating) and Naeini is a light breed (average weight of mature ewes 43 kg) (4).

Location

This study was conducted at Bajgah, 16 km north of Shiraz, at 29° 43' N latitude and at 52° 35' E longitude. The area is 1641 meters above sea level. The maximum temperature is approximately 35°C during summer and the minimum temperature does not usually fall below -10°C in winter.

Flock Management and Source of Data

The sheep involved in this study were maintained under farm conditions in the Animal Experiment Station of the College at Bajgah. These sheep were generally grazed as two flocks, about 200 each, on range which was poor in vegetation. To prevent overgrazing, barley pasture was provided in the early spring for about one month. Also there were some barley, wheat, and corn stubbles available during the summer and early fall. The range became dry and unpalatable during the late fall and winter months and consequently, the animals received supplemental feed or were hand-fed completely for about seven months of the year. The basic diet consisted of alfalfa hay, corn silage and dried sugar beet pulp. During the last months of pregnancy and early lactation, about 300 g barley per ewe per day were added to the ration until the ewes were placed on barley pasture. The ewes were maintained in excellent condition and at no time were they thin except around weaning time.

The breeding period extended from July 20 to September 10, 1972. During this period ewes were flushed with 300 g barley and 400 g alfalfa hay as supplemental feed, starting 15 days before mating. Rams were assigned randomly to the ewes in each breed-age subgroup. Four teaser rams were used

for each ewe flock of approximately 200 head for about one hr, during the early morning to detect ewes in estrus. One and occasionally two estrous ewes were placed with one ram in a mating pen for 24 hr. Eight Karakul, eight Mehraban and six Naeini rams were used.

The data on 368 ewes were used, including those ewes which were present in the mating season and alive at lambing time. Unhealthy ewes were culled before breeding began. Ewes which died in the period between breeding and lambing were excluded. The number of live and dead lambs born was recorded. The lambs were creep-fed and weaned at 75 ± 10 days of age. Details of lamb management and their growth performance to weaning have been reported in an earlier publication (5).

Statistical Analysis

The data were analyzed by the least squares procedure (7). To analyze percent of ewes mated (showing estrus) of total ewes exposed, constants were fitted for breed and age of ewe. Since there were few 4.5 year-old ewes, all 3.5 and 4.5 year-old ewes were grouped into one classification. In order to analyze percent ewes lambing of ewes mated, prolificacy (percent lambs born of ewes lambing) and productivity (percent lambs weaned of ewes mated and kg of lamb weaned per ewe mated), breed of ewe, age of ewe, breed of ram, breed of ewe by breed of ram interaction and individual ram within breed of ram effects were considered. Sex of lamb was added to the previous model to analyze lamb livability (percent lambs born alive of total lambs born and percent lambs weaned of live lambs born). The results are summarized in Table 1. The influence of heterosis was evaluated by using models in which constants were fitted for mating system (straightbred matings *vs* crossbred matings) and age of ewe. In another analysis, breed of ewe, breed of ram and the interaction between these two factors were replaced by breed group effect (3 straightbred and 6 crossbred

Table 1. Least-squares analysis of variance for reproduction and lamb production traits (Mean squares).

Source of variation	d.f.	Fertility		Prolif-icacy	Lamb livability		Productivity	
		% ewes mated of ewes exposed	% ewes lambed of ewes mated	% lambs born of ewes lambing	% lambs born alive of total lambs born	% lambs weaned of live lambs born	% lambs weaned of ewes mated	Kg lambs weaned per ewe mated
Breed of ewe	2	174.5	251.5	15.0	104.0	2.0	99.5	152.1*
Age of ewe	2	404.5	401.0	10.5	55.5	397.5	1246.5	116.0*
Breed of ram	2		1419.5	45.5	140.5	182.5	2294.0*	47.1
Breed of ewe X breed of ram interaction	4		168.2	124.0	124.5	149.7	461.5	32.7
Sex of lamb	1				106.0	164.0		
Individual ram within breed of ram	19		692.5	54.5	31.8	191.5	687.8	25.8
Error	a	159.8	517.9	58.4	57.3	170.7	660.7	36.4

* Significant at 5% probability level.

[a] Error degrees of freedom are 363 for % ewes mated of ewes exposed, 332 for % of ewes lambed of ewes mated, 312 for prolificacy, 313 for % lambs born alive of total lambs born, 311 for % of lambs weaned of live lambs born and 322 for productivity.

groups).

The percent heterosis exhibited by each crossbred group was estimated as the percent superiority of the mean of the cross over the average of the two straightbreds making up the cross.

RESULTS AND DISCUSSION

The estimated overall means of fertility and lamb livability as shown in Table 2 are similar to those in the European and North American breeds (6, 8, 13, 14, 15, 17). The high livability of lambs may be partly attributable to the effect of single born lambs (almost all of the ewes gave birth to single lambs) and partly to good management practices.

Prolificacy among the native breeds was very low compared with that of the European and North American breeds (8, 13, 14, 15, 17).

Breed of Ewe

The observed differences between breeds of ewe were very small for all the reproductive and survival traits but significant ($P<0.05$) for kg of lamb weaned per ewe mated (Table 1). Mehraban ewes weaned significantly more kg of lamb than Naeini ewes, but Karakul ewes were intermediate (Table 2). The differences between breeds for this trait was due mainly to the difference in the average weaning weight of lambs rather than the number of lambs at weaning. The ranking of the breeds for kg of lamb weaned per ewe mated was the same as their ranking for the average weaning weight of lambs (3).

Breed of Ram

Breed of ram was a significant source of variation only for percent lambs weaned of ewe mated (Table 1). Karakul rams were inferior to Mehraban and Naeini rams for this trait (Table 2). The low fertility of the Karakul rams was

Table 2. Least-squares means for reproduction and lamb production traits.

Classification	Ewes exposed	Ewes lambed	Fertility: % ewes mated of ewes exposed	Fertility: % ewes lambed of ewes mated	Prolificacy: % lambs born of ewes lambing	Lambs born	Lamb livability: % lambs born alive of lambs born	Lamb livability: % lambs weaned of live lambs born	Productivity: % lambs weaned of ewes mated	Productivity: Kg lambs weaned per ewe mated
Overall mean	368	342	98.7	93.7	100.8	344	99.4	98.1	92.1	18.5
Breed of ewe:										
Karakul	117	108	99.9a*	91.7a	100.3a	108	100.0a	98.2a	90.9a	18.8ab
Mehraban	138	130	99.1a	94.8a	101.0a	131	98.5a	98.2a	92.2a	19.8a
Naeini	113	104	96.9a	94.5a	101.2a	105	99.7a	97.9a	93.3a	17.0b
Breed of ram:										
Karakul		110		89.4a	99.9a	110	100.0a	96.3a	86.3a	17.7a
Mehraban		121		94.6a	101.4a	122	100.0a	98.9a	95.1b	19.2a
Naeini		111		97.0a	101.2a	112	98.2a	98.9a	95.0b	18.6a
Age of ewe (years):										
1.5	163	149	96.6a	93.6a	101.1a	150	98.6a	96.2a	89.7a	17.7a
2.5	103	99	99.3a	96.2a	100.4a	99	99.8a	99.9a	96.2a	19.7b
3.5 & 4.5	102	94	100.0a	91.3a	101.0a	95	99.9a	98.1a	90.5a	18.2ab
Sex of lamb:										
Female						159	100.0a	97.4a		
Male						185	98.8a	98.8a		

*All means within a particular subclass differ significantly ($P<.05$) except those followed by the same letter.

demonstrated by the relatively low lambing percentage of the ewes mated to Karakul rams compared with those mated to Mehraban or Naeini rams. The contribution of ram breed to the total variation was higher than that of ewe breed in all the traits concerning the number of lambs produced (Table 1). Non-significant effects of ram breed on reproductive performance have also been reported by several investigators (1, 2, 8, 9). Galal *et al.* (6) and Hohenboken *et al.* (8) reported that sire breed did not significantly influence lamb survival to weaning.

Breed of Ewe by Breed of Ram Interaction

The interaction between breed of ewe and breed of ram was not significant for the traits studied. This is partly in agreement with the report of Hohenboken *et al.* (8) who indicated that this interaction was not significant for fertility, prolificacy and lamb survival but was significant for kg of lamb weaned per ewe joined. Galal *et al.* (6) reported a significant sire breed X dam breed interaction effect on survival to weaning in Fleisch Merino, Egyptian Ossimi and Barki breeds of sheep.

Age of Ewe

Variation due to age of the ewe was significant only for kg of lamb weaned per ewe mated. This seems to be due to the influence of age of dam on weaning weight of lambs and to some extent lower fertility of 1.5 year-old ewes. The 2.5 year-old ewes weaned significantly more kg lamb than 1.5 year-old ewes. In contrast to the results of this study, significant effects of ewe age on percent ewes showing estrus (11), on fertility (13, 16), on prolificacy (2, 11, 13, 14. 15, 16, 17, 18), on lamb survival to weaning (8, 13, 15), on lambs weaned per ewe bred (13, 14, 15, 16, 18) and on kg of lamb weaned per ewe bred (8, 17) have been reported. On the other hand, non-significant effects of ewe age on fertility (14, 15, 17, 18) and lamb survival to weaning

or to market (14, 16, 17) have been also reported.

Sex of Lamb

Sex did not influence the survival rate of lambs. The finding is in agreement with some other reports (15, 16, 17).

Mating System and Heterosis

The least-squares means for straightbred ewes mated to the rams of their own breed or to the rams of the other breeds and estimates of percent heterosis for crossbred matings are presented in Table 3. Differences between the two types of matings were negligible for the traits studied. Fertility was studied in two phases; percent of ewe mated of ewes exposed and percent of ewes lambing of ewes mated. Mating system could not have influenced percent of ewes showing estrus, but it could have influenced prolificacy through the degree of compatibility between ova and sperms of the breeds, the relative size of ewe and ram in natural mating (which is especially important in fat-tailed breeds where the tail of the ewe must be lifted by the ram), and embryo survival during early stages of development. The non-significant effect of mating system indicated that none of these factors were important in this study. The results are in agreement with the findings of some other investigators (9, 13, 16), but Hohenboken *et al.* (8) reported that fertility was affected by crossbreeding.

Although four of six crosses showed positive heterosis, differences were small. Sidwell and Miller (14) reported that 15 of 20 two-breed crosses exhibited positive heterosis for fertility, with values ranging from -42% to +28%.

Crossbred matings exceeded straightbred matings for prolificacy, but again the difference was very small. Non-significant differences between purebred matings and two-breed cross matings for prolificacy have been reported by Land *et al.* (9), Vesely and Peters (16) and Hohenboken *et al.* (8). Whereas Sidwell *et al.* (13) reported that ewes

Table 3. Least-squares means for straightbred and crossbred matings and estimates of % heterosis for crossbred matings.

Mating	% ewes lambed of ewes mated	Prolificacy: % lambs born of ewes lambing	Lamb livability: % lambs born alive of lambs born	Lamb livability: % lambs weaned of live lambs born	Productivity: % lambs weaned of ewes mated	Productivity: Kg lambs weaned per ewe mated
Straightbred matings	94.1	100.0	100.0	99.0	93.3	18.2
Crossbred matings	94.7	101.2	99.2	97.8	92.9	18.8
Crossbred groups (Ram X ewe):						
Karakul X Mehraban	1.2	0.0	.0	-.9	.2	5.2
Mehraban X Karakul	3.2	.1	.0	2.0	5.2	2.1
Karakul X Naeini	-1.9	-.3	-.1	-1.3	-4.2	-2.3
Naeini X Karakul	1.9	.1	.1	2.0	4.3	17.0
Mehraban X Naeini	1.1	3.9	.1	-4.1	.9	-.5
Naeini X Mehraban	-.3	3.4	-6.2	-3.0	-6.3	3.7

in a two-breed cross mating system were significantly less prolific than ewes in purebred matings.

Mating system did not improve lamb livability to weaning. This is in agreement with the findings of Sidwell *et al.* (13), but Vesely and Peters (16) reported a highly significant difference between crossbred mating (83.4%) and purebred mating (75.3%) for lamb survival rate. The positive heterosis for lamb survival to weaning was also reported by Galal *et al.* (6).

Two of six crosses showed positive heterosis for both measurements of lamb livability. Sidwell *et al.* (13) reported that 5 of 7 two-breed crosses examined exhibited positive heterosis for percent lambs born alive of total lambs born and percent lambs weaned of live lambs born with the average of 1.9 and 2.6%, respectively. In another study, Sidwell and Miller (14) found 13 and 14 of 20 crosses showed positive heterosis for the two measurements of lamb livability. Hohenboken *et al.* (8) reported that heterosis for lamb survival from birth to weaning was 3.2% which was not significant, when all crossbreds were compared with all purebred matings.

Mating system did not influence productivity of the breeds. Four of six crosses showed positive heterosis with the highest value of 17% (Naeini X Karakul) for kg of lamb weaned per ewe mated.

Considering the above results it may be concluded that crossbreeding among these breeds would not improved reproduction and lamb production substantially.

Breed Groups

No significant differences were observed between breed groups for any of the traits except for kg lamb weaned of ewes mated. Mehraban ewes when mated to a ram of their own breed weaned significantly more kg of lamb compared with Karakul and Naeini ewes mated to rams of their own breed and to Karakul rams mated with Naeini ewes (Table 4).

Table 4. Least-squares means for kg lambs weaned per ewe mated.

Breed of ram	Breed of ewe		
	Karakul	Mehraban	Naeini
Karakul	17.5b*	19.9ab	16.6b
Mehraban	19.3ab	20.3a	18.3ab
Naeini	19.9ab	19.1ab	16.6b

*Means differ significantly (P<.05) except those followed by the same letter.

Estrus Exhibition

Least-squares means for percent of ewes exhibiting first estrus at 7-day intervals are shown in Table 5. No significant breed difference was observed for percent of ewes which showed first estrus during the first three weeks, although Mehraban ewes were superior to the other breeds during the first two weeks. This resulted in mating of a higher proportion of Mehraban ewes during the early stages and consequently, a lower percentage of Mehraban ewes showed estrus during the fourth and sixth periods. The duration of the mating season could be reduced by 18 days for Mehraban ewes without a marked decline in lamb production.

Age of ewe did not have an important effect on the incidence of estrus, although 2.5 year-old ewes tended to show estrus sooner than the other two age groups.

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Table 5. Least-squares means for % ewes exhibiting estrus at weekly intervals.

Classification	No. of ewes exposed	July 20 to July 26	July 27 to August 2	August 3 to August 9	August 10 to August 16	August 17 to August 23	August 24 to August 30	August 31 to Sept. 10[†]
Overall means	368	16.8	16.8	30.9	24.0	5.3	3.8	.6
Ewe breed:								
Karakul	117	15.4a[*]	16.4a	27.1a	25.3ab	7.2a	7.8a	.0a
Mehraban	138	22.1a	22.7a	31.7a	15.8a	4.5a	1.3b	.9a
Naeini	113	12.9a	11.4a	34.1a	30.9b	4.2a	2.2ab	1.0a
Ewe age (years):								
1.5	163	14.9a	12.8a	29.3a	29.9a	4.7a	4.8a	.0a
2.5	103	20.5a	20.8a	29.8a	20.2a	5.1a	.7a	1.2a
3.5 & 4.5	102	15.0a	16.9a	33.8a	21.9a	5.9a	5.7a	.6a

[†]This period was 11 days.

[*]All means within a particular subclass differ significantly (P<.05) except those followed by the same letter.

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