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Some production characteristics of Bafra, Akkaraman, Bafra × Akkaraman F_1 and B_1 sheep genotypes

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Abstract: The present study was carried out to identify the reproductive characteristics, survival rate, growth traits and some body measurements of Bafra (B), Akkaraman (A), Bafra × Akkaraman F_1 (BAF_1) and Bafra × Akkaraman B_1 (BAB_1) sheep genotypes. The research was performed at Gözlü State Farm, belonging to the General Directorate of Agricultural Enterprise (TİGEM), during the years of 2014-2016. In the study, lambing rates of B×B, A×A, B×A and B×BAF_1 mating groups were 55.25, 69.97, 67.25 and 64.91%; the lamb production were 92.27, 88.93, 87.54 and 122.81% and the litter sizes were 1.67, 1.27, 1.30 and 1.89, respectively. The survival rates of B, A, BAF_1 and BAB_1 lambs were calculated as 89.89, 94.23, 88.79 and 98.36% in the 90th day, respectively (P<0.05). The least square means of these lambs were 3.65±0.05, 4.71±0.07, 4.56±0.06 and 4.03±0.10 kg (P<0.001) for birth weight and 23.51±0.30, 31.39±0.37, 30.00±0.35 and 25.16±0.53 kg (P<0.001) for the 90th day weight (weaning weight), respectively. Body measurements of these genotypes on the 90th day were 56.79±0.45, 61.75±0.54, 60.98±0.59 and 61.73±0.62 cm (P<0.001) for the withers height; 55.76±0.32, 55.18±0.39, 56.91±0.42 and 57.43±0.45 cm (P<0.01) for the body length; 63.05±0.73, 71.88±0.89, 60.89±0.96 and 61.92±1.02 cm (P<0.001) for the chest girth; and 16.63±0.50, 40.45±0.62, 28.33±0.67 and 18.33±0.70 cm (P<0.001) for the widest tail circumference, respectively. In conclusion, the reproductive performance of the BAF_1 genotype was satisfactory; BAF_1 lambs were partially similar to A lambs, but BAB_1 lambs were partially similar to B lambs in terms of growth characteristics.
Keywords: Crossbreeding, growth, reproductive traits, sheep, survival rate.

Bafra, Akkaraman, Bafra × Akkaraman F_1 ve G_1 genotiplerinde bazı verim özellikleri

Özet: Bu araştırma Bafra (B), Akkaraman (A), Bafra × Akkaraman F_1 (BAF_1) ve Bafra × Akkaraman G_1 (BAG_1) genotiplerinde döl verimi, yaşama gücü ile büyüme ve gelişme özelliklerini belirlemek amacıyla yapılmıştır. Araştırma Tarım İşletmeleri Genel Müdürlüğü'ne bağlı Gözlü Tarım İşletmesi'nde 2014-2016 yıllarında yürütülmüştür. Araştırmada B×B, A×A, B×A ve B×BAF_1 tohumlama gruplarında doğum oranı sırasıyla 55,25; 69,97; 67,25 ve 64,91; kuzu verimi sırasıyla 92,27; 88,93; 87,54 ve 122,81; bir doğuma kuzu sayısı sırasıyla 1,67; 1,27; 1,30 ve 1,89 olmuştur. B, A, BAF_1 ve BAG_1 kuzularda 90. gün yaşama gücü sırasıyla % 89,89; 94,23; 88,79 ve 98,36 (P<0,05) hesaplanmıştır. Kuzularda en küçük kareler ortalamaları genotip sırasına göre doğum ağırlığı için 3,65±0,05; 4,71±0,07; 4,56±0,06 ve 4,03±0,10 kg (P<0,001); 90. gün canlı ağırlığı için 23,51±0,30; 31,39±0,37; 30,00±0,35 ve 25,16±0,53 kg (P<0,001) olmuştur. 90. gün vücut ölçüleri değerlendirildiğinde cidago yüksekliği sırasıyla 56,79±0,45; 61,75±0,54; 60,98±0,59 ve 61,73±0,62 cm (P<0,001); vücut uzunluğu 55,76±0,32; 55,18±0,39; 56,91±0,42 ve 57,43±0,45 cm (P<0,01); göğüs çevresi 63,05±0,73; 71,88±0,89; 60,89±0,96 ve 61,92±1,02 cm (P<0,001); kuyruk çevresi 16,63±0,50; 40,45±0,62; 28,33±0,67 ve 18,33±0,70 cm (P<0,001) olmuştur. Sonuç olarak, BAF_1 genotipinde döl verim özelliklerinin iyi düzeyde olduğu büyüme ve gelişme özellikleri bakımından ise BAF_1 kuzuların kısmen A'ya, BAG_1 kuzuların kısmen B'ye benzer olduğu tespit edilmiştir.
Anahtar sözcükler: Büyüme, döl verimi, koyun, melezleme, yaşama gücü.

Introduction

Sheep breeding is an important sector of the livestock industry in Turkey because of the geography, climate, social, cultural and economic structure of the country. The importance of lamb meat in Turkey has been increasing day by day. The meat yield from sheep production, however, is not at the desired level, and the meat yield per animal has not changed much over the years because carcass weights of sheep have been around 16 kg since 1995 (7, 8).

Akkaraman has been the most common reared sheep breed of Turkey. This breed has been well adapted to the climate conditions of the steppe. In addition, it has good growth characteristics and survival rates in these conditions (2, 12). The Bafra (Chios × Karayaka B_1) breed was obtained via the crossbreeding of Chios (75%) and Karayaka (25%) breeds. The desired yield traits of Chios and Karayaka sheep were combined in the B breed. Because of the crossbreeding, this breed has a high reproductive performance, good adaptation ability, sufficient amount of milk yield and meat quality (2, 4, 5, 21, 22, 24, 25).

In Turkey sheep breeding system mainly focuses on meat production. Although meat production depends on the fertility and growth rate, it is necessary to have a high adaptation ability and survival rate to benefit from these positive aspects. Therefore, the fertility level of the ewes, the survival rate and the growth characteristics of the lambs should be improved together. These desired improvements can be achieved with crossbreeding and pure breeding. Genetic improvement through pure breeding takes a long time. Therefore, crossbreeding is often preferred, because of reaching high genetic improvements in a shorter period (2).

The objective of this study was to evaluate and compare the fertility traits of B, A, and BAF_1 ewe genotypes, and the growth traits and survival rate of B, A, BAF_1 and BAB_1 lambs.

Materials and Methods

This study was approved by the Ankara University Animal Experiments Local Ethics Committee (53184147-50.04.04/38558). Data was obtained from 1347 ewes and 645 lambs raised on the Gözlü State Farm (38° 29' N and 32° 27' E, 1020 m of altitude), which belongs to TİGEM, in Konya province in the central Anatolia region of Turkey. Steppe climate conditions prevail in the region. This study was carried out between August 2014 and March 2017. The number of ewes and lambs using in this study by year and subclasses of genotypes are shown in Table 1.

Two successive lambing and mating seasons were taken into consideration. While natural insemination was used for mating groups of B×B, A×A (firstly, hand mating, then flock mating/pasture mating) and B×BAF_1 (pen mating), artificial insemination was applied in the B×A (firstly, artificial insemination, then flock mating/pasture mating) group due to the difficulty in mating thin-tailed B rams with fat-tailed A ewes. All lambs were raised in similar management conditions in both years. Lambing occurred between March and April. After lambing, every ewe was kept with its lamb or lambs in a pen (1.20×1.50 m) on deep straw bedding for 24 hours. After that, the lambs were kept with their dams for two weeks in groups of similar age in straw-bedded pens. Then these groups were combined to form larger groups. Lambs were weaned around the 90^{th} day of age.

Individual lamb records contained the information of birth date, birth type, ear tag number, sex, ear tag numbers of dam and sire. Lamb birth weight data was taken within 8-16 hours after lambing. Lambs were allowed to suckle their dams freely every night during the suckling period. In the daytime, lambs were kept indoors, had free access to good-quality hay and commercial lamb creep feed (2800 kcal/kg ME and 18% CP). When the milking of the ewes started, which is about 30 days after lambing, 300 g/day lamb grower feed (2500 kcal/kg ME and 16% CP) began to be given to each lamb. The lambs were grazed in the pasture with their mothers after the 30^{th} day of age. When the lambs reached at average of 6 months of age, 300 g/day feedlot feed (2750 kcal/kg ME and 12% CP) per lamb began to give. All sheep had free access to potable water and natural mineral block licks. 10 days after lambing, the ewes were let out daily in the pasture, save for in winter period (from October to March). During winter period, they were fed with roughage (straw etc.) and concentrated feed (300g/ewe/day). The ewes were given about 700 g/ewe/day wheat in the last one-third of pregnancy and during the lactation period. The ewes were also grazed on wheat stubble from July to September. Flushing feeding was started 15-20 days before the mating period in September, and continued during the first 30 days of the mating period. The lambing period was started in February.

The lambs were weighed individually at birth and every 30 days until weaning. After weaning, the lambs were weighed every 60 days. The lambing rate (the number of ewes lambing/the number of ewes exposed to rams*100), lamb production (the number of lambs born alive / the number of ewes exposed to rams *100) and litter size (the number of lambs born alive/the number of ewes lambing) of B, A and BAF_1 genotypes were calculated. The lamb survival rate (the number of lambs born alive/the number of lambs at the day investigation*100) at the 1^{st}, 3^{rd}, and 6^{th} months was calculated based on live lambs born.

Table 1. The number of animals by year and subclasses of genotypes.

Genotype	2014 - 2015		2015 - 2016		Marginal totals		Total
	Ewe	Lamb	Ewe	Lamb	Ewe	Lamb	
B	111	113	70	91	181	204	385
A	831	84	278	74	1109	158	1267
BAF_1	19	128	38	86	57	214	271
BAB_1	-	19	-	50	-	69	69
Total	961	344	386	301	1347	645	1992

B: Bafra, A: Akkaraman, BAF_1: Bafra × Akkaraman F_1, BAB_1: Bafra × Akkaraman B_1.

1	Wither height
2	Chest depth
3	Body length
4	Chest girth
5	The widest circumference of tail
6	Cannon bone circumference

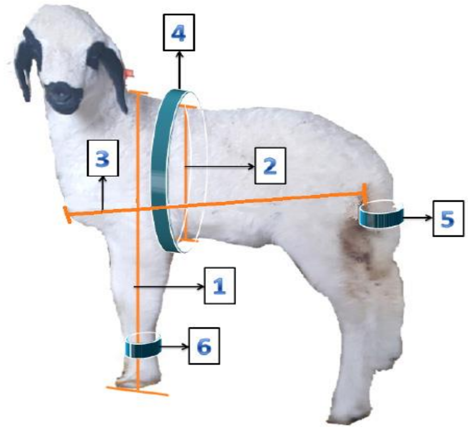

Figure 1. Body measurements.

The body measurement of lambs where measurements were taken was showed in Figure 1. The withers height, body length, cannon bone circumference, tail circumference, chest depth and girth measurements of the lambs were taken every 2 months in the lambs from one month old to 6 months old. The body measurements of the 90th and 180th days, and the body weights of the 30th, 60th, 90th, and 180th days of the lambs were calculated by using the interpolation method.

In this study, the statistical tests were done using SPSS package software (6). The effects of genotype, age of dam, year, sex of lambs and birth type on the live weight and body measurements, as well as the statistical significance among the means were analyzed by using the Least Squares Means Method and Duncan's Multiple Test. The lamb production and litter size traits were tested by the Kruskal-Wallis test and, the lambing rate of ewes and survival rate of the lambs was tested by the chi-square test.

Results

Meteorological data: The data (temperature and rainfall) was received from the Gözlü State Farm. Total rainfall, minimum and maximum temperatures of the first season (September 2014/August 2015) were 469.5 mm, -18.4 and 38.0 °C, respectively. The same traits at the second season (September 2015/August 2016) were 257.6 mm, -16.6 and 36.6 °C, respectively.

Reproductive traits: The means of the two years' results (2014-2015 and 2015-2016) for the reproductive traits of B×B, A×A, B×A and B×BAF$_1$ mating groups and their statistical results were presented according to the dam age in Table 2.

Table 2. Some reproductive traits of ewes.

Mating groups^{x}	Age	Ewe exposed to rams	Lambing rate, %	Lamb production, %	Litter size
B×B	1.5	39	66.67^{b}	117.95^{b}	1.77
	2.5	41	65. 85^{b}	102.44^{ab}	1.56
	3.5	78	52.56^{b}	84.62^{ab}	1.61
	4.5+	23	26.09^{a}	56.52^{a}	2.17
			**	*	—
	Total	181	55.25^{A}	92.27	1.67^{B}
A×A	1.5	98	68.37	71.43^{a}	1.04^{a}
	2.5	260	71.15	86.54^{ab}	1.22^{b}
	3.5	115	75.65	106.09^{b}	1.40^{c}
	4.5+	123	63.41	91.87^{ab}	1.45^{c}
			—	**	***
	Total	596	69.97^{B}	88.93	1.27^{A}
B×A	1.5	100	50.00^{a}	52.00^{a}	1.04^{a}
	2.5	244	73.36^{b}	90.98^{b}	1.24^{b}
	3.5	61	73.77^{b}	111.48^{b}	1.51^{c}
	4.5+	108	65.74^{b}	99.07^{b}	1.51^{c}
			***	***	***
	Total	513	67.25^{B}	87.54	1.30^{A}
B×BAF$_1$	1.5	36	69.44	130.56	1.88
	2.5	21	57.14	109.52	1.92
			—	—	—
	Total	57	64.91^{B}	122.81	1.89^{B}
P		1347	**	—	***

B: Bafra, A: Akkaraman, BAF$_1$: Bafra × Akkaraman F$_1$, — P> 0.05; ** P< 0.01; *** P< 0.001

$^{a, b, c}$ The different superscripts of age groups for each genotype within a column differ significantly (P<0.05). $^{A, B}$ The different superscripts for genotypes within a column differ significantly (P<0.05).

^{x} Sires are listed first.

Gestation length: The least square means for the gestation length were shown in Table 3. The gestation length was affected by genotype (P<0.001), age of dam (P<0.001) and type of birth (P<0.01); but the year of the birth had no significant effect on the gestation length (P>0.05).

Survival rate of lambs: The chi square analysis for the survival rates of the lambs were presented in Table 4. The age of the dam, the year and the type of birth did not significantly affect on the survival rates of lambs (P>0.05). The survival rate, however, was significantly affected by the sex of the lamb at the 1st (P<0.05) and 6th (P<0.001) months also by the genotype of the lamb at the 3rd (P<0.05) month.

Table 3. The least square means (±SE) of the gestation length (day).

Item	n	Mean± SE
Genotype		***
B	117	150.28 ± 0.21^b
A	388	148.97 ± 0.20^a
BAF_1	276	149.11 ± 0.21^a
Age of dam		***
1.5	128	148.79 ± 0.24^a
2.5	338	149.24 ± 0.18^a
3.5	169	149.77 ± 0.22^b
4.5+	146	150.00 ± 0.21^b
Year		─
2015	555	149.48 ± 0.17
2016	226	149.42 ± 0.19
Type of birth		**
Single	438	150.07 ± 0.14^a
Twin	313	149.52 ± 0.14^a
Triplet+	30	148.76 ± 0.44^b
Total	781	149.45 ± 0.15

B: Bafra, A: Akkaraman, BAF_1: Bafra × Akkaraman F_1, BAB_1: Bafra × Akkaraman B_1, ─ P> 0.05; ** P< 0.01; *** P< 0.001
[a, b] The different superscripts within a column in a subgroup symbolize the difference significantly (P<0.05).

Table 4. Survival rate of lambs at 1st, 3rd and 6th month of age.

Item	Live birth	Survival rate (%)		
		1 month	3 month	6 month
Genotype		─	*	─
B	188	96.81	89.89^a	80.32
A	156	95.51	94.23^b	79.49
BAF_1	214	94.86	88.79^a	78.04
BAB_1	61	98.36	98.36^c	86.89
Age of dam at birth		─	─	─
2	163	93.87	89.57	76.07
3	241	98.34	93.78	83.40
4	118	94.92	88.14	78.81
5+	97	94.85	92.78	79.38
Year		─	─	─
2015	332	95.78	89.46	78.31
2016	287	96.17	93.73	81.88
Sex		*	─	***
Male	309	94.17	89.97	74.11
Female	310	97.74	92.90	85.81
Type of birth		─	─	─
Single	286	95.80	90.21	79.72
Twin	276	96.01	92.75	80.43
Triplet+	57	96.49	91.23	78.95
Total	619	95.96	91.44	79.97

B: Bafra, A: Akkaraman, BAF_1: Bafra × Akkaraman F_1, BAB_1: Bafra × Akkaraman B_1, ─ P> 0.05; * P< 0.05; *** P< 0.001
[a, b, c] The different superscripts within a column in a subgroup symbolize the difference significantly (P<0.05).

Growth traits of lambs: The least square means of lamb weights at birth and as well as the 90th, 180th and 360th days were shown in Table 5. The age-live weight graph of the lambs based on genotype was given in Figure 2. Genotype, age of dam, year, sex and birth type had mostly highly significant effect (P<0.001; P<0.01) on lamb live weight but age of dam at 180th day (P>0.05)

Body measurement of lambs: The least square means for lamb body measurements were presented in Table 6. The genotype had a significant effect on wither height at 90th and 180th days (P<0.001), chest girth at 90th and 180th days (P<0.001), chest depth at 90th and 180th days (P<0.001), cannon bone circumference at 90th and 180th days (P<0.001), body length at 90th day (P<0.01) and 180th day (P<0.05), and the widest circumference of tail at 90th and 180th days (P<0.001).

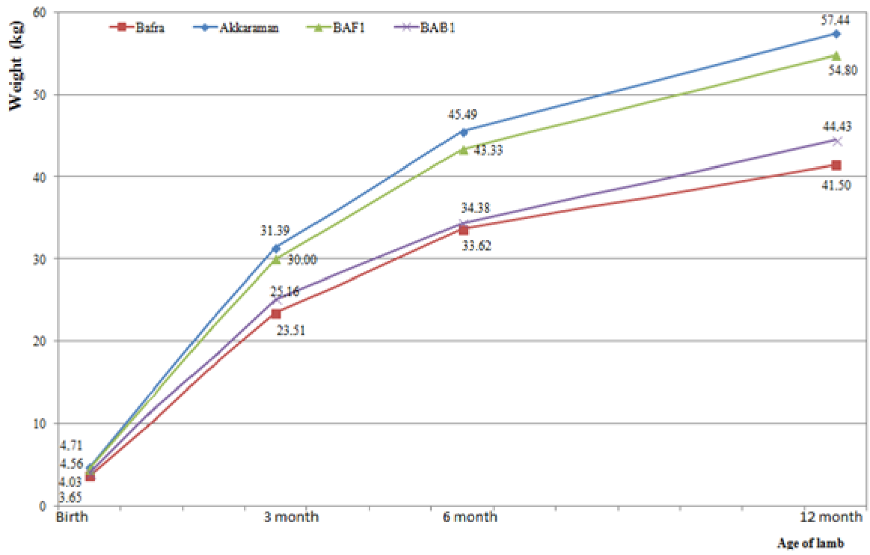

Figure 2. The age-live weight graph of the lambs based on genotypes.

Table 5. Least square means (±SE) for live weights (kg) of lambs.

Item	n	Birth	n	90th day	n	180th day	n	360th day
Genotype		***		***		***		***
B	188	3.65±0.05^{a}	169	23.51±0.30^{a}	151	33.62±0.38^{a}	140	41.50±0.52^{a}
A	156	4.71±0.07^{c}	147	31.39±0.37^{d}	124	45.49±0.49^{c}	97	57.44±0.71^{d}
BAF$_1$	214	4.56±0.06^{c}	190	30.00±0.35^{c}	167	43.33±0.45^{b}	144	54.80±0.62^{c}
BAB$_1$	61	4.03±0.10^{b}	60	25.16±0.53^{b}	53	34.98±0.68^{a}	47	44.43±0.96^{b}
Age of dam		***		***		–		***
2	163	3.91±0.06^{a}	146	26.19±0.35^{a}	124	38.54±0.46	103	47.93±0.65^{a}
3	241	4.28±0.05^{b}	226	27.16±0.30^{b}	201	38.70±0.38	180	48.58±0.54^{b}
4	118	4.33±0.07^{b}	104	27.98±0.41^{c}	93	39.99±0.53	79	51.25±0.77^{c}
5+	97	4.44±0.08^{bc}	90	28.73±0.42^{d}	77	39.19±0.54	66	50.41±0.78^{c}
Year		**		***		***		***
2015	332	4.16±0.05	297	25.75±0.28	260	36.00±0.36	215	45.16±0.51
2016	287	4.32±0.05	269	29.28±0.28	235	42.22±0.36	213	53.93±0.52
Sex		***		***		***		***
Male	309	4.39±0.05	278	29.50±0.27	229	42.62±0.35	201	50.05±0.49
Female	310	4.09±0.05	288	25.53±0.27	266	35.59±0.34	227	45.03±0.48
Birth type		***		***		***		**
Single	286	4.75±0.05^{c}	258	29.81±0.30^{c}	228	40.79±0.38^{c}	186	51.21±0.55^{c}
Twin	276	4.15±0.04^{b}	256	26.82±0.24^{b}	222	38.68±0.31^{b}	194	49.08±0.45^{b}
Triplet+	57	3.82±0.10^{a}	52	25.92±0.54^{a}	45	37.85±0.70^{a}	48	48.34±0.92^{a}
Total	619	4.24±0.04	566	27.51±0.22	495	39.11±0.28	428	49.54±0.39

B: Bafra, A: Akkaraman, BAF$_1$: Bafra × Akkaraman F$_1$, BAB$_1$: Bafra × Akkaraman B$_1$, – P> 0.05; ** P< 0.01; *** P< 0.001
$^{a, b, c, d}$ The different superscripts within a column in a subgroup symbolize the difference significantly (P<0.05).

Table 6. The least square means (±SE) for the measurements of lamb body (cm).

Item	n	90th day	n	180th day	n	90th day	n	180th day
		Wither height				Chest girth		
Genotype		***		***		***		***
B	76	56.79±0.45^{a}	64	64.01±0.42^{a}	78	63.05±0.73^{a}	66	75.18±0.57^{a}
A	75	61.75±0.54^{b}	62	70.85±0.51^{c}	75	71.88±0.89^{b}	64	84.32±0.70^{b}
BAF_1	71	60.98±0.59^{b}	61	68.99±0.55^{b}	71	60.89±0.96^{a}	61	84.04±0.77^{b}
BAB_1	59	61.73±0.62^{b}	54	64.63±0.58^{a}	59	61.92±1.02^{a}	54	76.48±0.80^{a}
Total	281	60.31±0.30	241	67.12±0.27	283	64.18±0.48	245	80.01±0.38
		Chest depth				Cannon bone circumference		
		***		***		***		***
B	78	22.14± 0.17^{a}	67	25.58±0.19^{a}	77	6.60±0.04^{a}	60	7.07±0.05^{a}
A	75	24.35± 0.21^{b}	62	27.92±0.24^{b}	75	7.20±0.05^{c}	64	7.77±0.06^{b}
BAF_1	71	23.89± 0.23^{b}	62	27.81±0.26^{b}	71	7.02±0.05^{c}	60	7.66±0.06^{b}
BAB_1	59	22.36± 0.24^{a}	54	25.85±0.27^{a}	59	6.86±0.06^{b}	43	7.29±0.07^{a}
Total	283	23.19± 0.11	245	26.79±0.13	282	6.92±0.03	227	7.45±0.03
		Body length				The widest circumference of tail		
		**		*		***		***
B	78	55.76± 0.32^{a}	62	63.58±0.38^{a}	77	16.63±0.50^{a}	66	18.39±0.61^{a}
A	75	55.18± 0.39^{a}	62	64.41±0.46^{a}	74	40.45±0.62^{c}	64	44.86±0.76^{d}
BAF_1	71	56.91± 0.42^{b}	61	65.35±0.49^{b}	67	28.33±0.67^{b}	61	31.79±0.82^{c}
BAB_1	59	57.43± 0.45^{b}	52	64.09±0.52^{a}	59	18.33±0.70^{a}	53	21.05±0.86^{b}
Total	283	56.07± 0.21	237	63.36±0.25	277	25.93±0.33	244	29.30±0.41

B: Bafra, A: Akkaraman, BAF_1: Bafra × Akkaraman F_1, BAB_1: Bafra × Akkaraman B_1, ─ $P>0.05$; * $P<0.05$; ** $P<0.01$; *** $P<0.001$
$^{a, b, c, d}$ The different superscripts within a column in a subgroup symbolize the difference significantly ($P<0.05$).

Discussion and Conclusion

The profitability of farm, and the continuation and increase of herd size and more effective selection of breeding stock in the animal husbandry depend on reproductive performance of herd. Thereby, the improving of this increases the efficiency of sheep production. Prolific sheep breeds have more than one oocyte per ovulation, but this trait has a low heritability value. Therefore, crossbreeding can be used, and crossbreed F_1 ewes coming from the prolific × native breeds usually have better reproductive performance than pure native breed ewes (19, 20, 23). In this study BAF_1 dams had a higher litter size than A dams ($P<0.001$) and similar to B dams. BAF_1 dams had the highest lamb production in this study even though the differences among the groups were not significant. Although statistical significance ($P<0.001$) is obtained for only A genotype, the litter size of 4.5+ years old dams was higher that of 3.5 years old A, B and BAF_1 dams, 3.5 years old dams was higher that of 2.5 years old A, B and BAF_1 dams, and 2.5 years old dams was higher that of 1.5 years old A and BAF_1 dams in the A genotype. This result confirms that the reproductive performances of the dams increase from young ages to intermediate ages (3, 10, 16, 18).

The gestation length of the A and BAF_1 lambs was significantly ($P<0.001$) shorter than B lambs. The gestation length of the 1.5- and 2.5-years old dams was significantly ($P<0.001$) shorter than 3.5 and 4.5+ year's old dams. The gestation length of the triplet+ birth lambs was significantly ($P<0.01$) shorter than single and twin birth lambs. The fact that the significant effect of parity and type of birth on the gestation length was similar to Dwyer (11) research results. Genotype had a significant effect on the gestation length in accordance with Unal et al. (20) and Dwyer (11) results.

The survival rate of the lambs is a main factor for the profitability of sheep breeding, especially before the weaning date. Many genetic and environmental factors affect the survival rate, such as the genotype, the sex of the lambs, the age of the dam, the type of birth, the behavior of maternal-offspring, the birth weight, etc. The survival rate of the lambs is lowest for the first two days after lambing, especially in the case of high and low birth weights, and this develops day by day up to the weaning date (2, 9, 15, 20). BAF_1 dams had the highest litter size ($P<0.001$), and their lambs (BAB_1) had the highest survival rates (90th day $P<0.05$) in this research. The fact that the survival rate of BAB_1 lambs and the litter size of BAF_1 dams were higher than other genotypes can be evaluated as an advantage of crossbreeding.

The survival rates of the lambs were not significantly affected by the year, age of dam and type of birth, and these findings are in agreement with the results of some other studies (5, 20, 23). The fact that the male lambs have a lower survival rate than the female lambs during 1st and 6th months in this research was in accordance with the findings of the previous study (3). It may be due to the female lambs maintain a closer proximity to their dams than male lambs (13).

A lot of environmental (year, age of dam, type of birth, season, dam's milk yield and composition etc.), genetic and epigenetic factors (sex, genotype and some major genes etc.) are supposed to affect the growth of lambs. In this research, the growth performances of the lambs were affected by genotype, age of dam, year, sex and type of birth, and these results were in accordance with a great deal of previously published literatures (1, 17, 20). While the growth performance of the BAF_1 lambs was found to be partially similar to A lambs, the BAB_1 lambs were found to be partially similar to B lambs. The fact that both BAF_1 and BAB_1 lambs had better growth performance (except 180^{th} day) than B lambs in steppe conditions could be evaluated as an advantage for mutton production.

Body measurements are important indicators of body development (14). A lambs had higher wither height at the 180^{th} ($P< 0.001$) days and higher chest girth at the 90^{th} ($P< 0.001$) days and this result was in agreement with live weights in these ages. In addition, that A lambs at the 90^{th} and 180^{th} days had higher the widest circumference of tail ($P< 0.001$) than the other genotypes, the carcasses of thin-tailed sheep usually have a higher price than those of fat-tailed sheep in Turkey because consumers prefer to buy thin-tailed sheep meat rather than fat-tailed sheep meat, according to the TİGEM data. The widest circumference of tail is one of the important determinants of tail weight. Accordingly, the fact that the widest tail circumferences of BAF_1 and BAB_1 genotypes were lower than those of the A genotype can be evaluated as a positive development of crossbreeding.

In conclusion the results showed that the reproductive traits of BAF_1 were higher than A. It can be said generally that crossbred lambs (BAF_1 and BAB_1) had similar survival rates with A and B or better survival rates than A and B lambs. The growth characteristics of BAF_1 lambs were partially similar to the A lambs. To sum up, the fact that BAF_1 ewes have a higher reproductive performance than the A breed, and BAF_1 lambs have partially similar growth performance with the A lambs can be evaluated as an important factor for mutton production.

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Ethical Statement

This study was approved by the Ankara University Animal Experiments Local Ethics Committee (53184147-50.04.04/38558).

Conflict of Interest

The authors are declared that there is no conflict of interest.

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