



Determination of Some Growth Traits in Morkaraman Lambs

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ABSTRACT

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In this study, it was aimed to determine the growth traits of Morkaraman lambs raised in breeder conditions born in 2018-2019 in Erzurum province. This study was conducted to determine the growth traits such as birth weight (BW), live weight at the beginning of the grazing period (LWBG), live weight at the grazing period (LWGP), live weight at the end of the grazing period (LWEGP), daily live weight gain from the birth to the beginning of the grazing period (DLWGBGP), daily live weight gains during the grazing period (DLWG) and daily live weight gain from the birth to the end of the grazing period (DLWGE) of 1032 Morkaraman lambs. It was, also, planned to reveal the differences between these performance characteristics. The effects of some environmental factors such as sex, lambing type, year, and ewe age on these traits were examined. The means of BW, LWBG, LWGP, LWEGP, DLWGBGP, DLWG and DLWGE of the lambs were found as 3,67kg, 24,82 kg, 13,76 kg, 38,25 kg, 226,16 g, 141,77 g, and 192,94 g, respectively. According to the statistical analysis results; not only the effect of years, sex, lambing type and ewe age on LWEGP were determined to be significant ($P<0,01$). To conclude, the local and pasture conditions in Erzurum province. Some growth performances of Morkaraman lambs were determined. Based on performance values such as live weight and daily live weight gains, the lambs can reach the desired slaughter weight up to the end of the grazing period.

Morkaraman Kuzularında Bazı Büyüme Özelliklerinin Belirlenmesi

MAKALE BİLGİSİ

ÖZ

Araştırma Makalesi

Muhammet Selçuk Şahin'in tez çalışmasından özetlenmiştir.

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Anahtar Kelimeler

Morkaraman
Büyüme gelişme
Canlı ağırlık
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Kuzu

Bu çalışmada, Erzurum ilinde yetiştirici şartlarında 2018 ve 2019 yıllarında doğan 1032 baş Morkaraman kuzuların doğum ağırlığı, meralanma başlangıcı canlı ağırlığı, meralanma dönemi canlı ağırlığı ve meralanma sonu canlı ağırlığı ile doğum meralanma başı arası günlük canlı ağırlık artışı, mera dönemi günlük canlı ağırlık artışı ve doğum meralanma sonu arası günlük canlı ağırlık artışı gibi büyüme ve gelişme özelliklerinin belirlenmesi ve ayrıca bu performans özellikleri arasındaki farklılıkları ortaya konulması amaçlanmıştır. Söz konusu parametreler üzerine cinsiyet, doğum tipi, yıl ve ana yaşı gibi kesikli çevre faktörlerinin etkisi incelenmiştir. Kuzuların doğum ağırlığı, meralanma başı, meralanma dönemi ve meralanma sonu canlı ağırlıklarına, doğum meralanma başı arası, mera dönemi ve doğum meralanma sonu arası günlük canlı ağırlık artışlarına ait genel ortalamalar ve standart hataları ile sırasıyla 3,67 kg, 24,82 kg, 13,76 kg, 38,25 kg, 226,16 g, 141,77 g, 141,77 g and 192,94 g olarak

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belirlenmiştir. İstatistik analiz sonuçlarına göre; mera sonu canlı ağırlığa yılların cinsiyetin, doğum tipinin ve ana yaşının etkisi önemli bulunmuştur ($P<0,01$). Sonuç olarak; Erzurum İli mera şartlarında Morkaraman kuzuların büyüme ve gelişme performansları belirlenmiştir. İlin mevcut yetiştirici ve mera şartlarında canlı ağırlık ve günlük canlı ağırlık gibi performans değerleri esas alındığında kuzuların mera sonunda istenen kesim canlı ağırlığa ulaşabileceği sonucuna varılmıştır.

Introduction

The livestock sector, which is included in agricultural activities, has great importance for all countries of the world, regardless of their level of development. Produced animal foods are important in terms of balanced and healthy nutrition for the population, raw material supply for the industry, and export revenues (Semerci and Çelik, 2016).

Different products come to the fore in different countries on a sectoral basis in sheep and goat farming in the world. In addition to the genetic structure of the studied breed, the geographical structure, climatic conditions, pasture, feed sources, effect of sheep breeds, the region of rearing, close markets of countries, the mount domestic consumption, product demand in such countries and regions have intensified. The main factor in determining the rearing direction of sheep breeding is the desire to benefit more from the products and to maximize the quality.

Turkey's natural and socio-economic conditions, agricultural structure, and traditions enable sheep breeding to be carried out widely in Türkiye and to constitute an important ground for livestock activities (Işık, 2010). The ability of agriculture to meet its own needs and the increase in population created a market for meat, milk, and wool in Türkiye, which led to significant changes in the structure of sheep breeding. Although wool production was in the first place in sheep breeding before, studies are being carried out to increase the meat yield in sheep breeding with the increase in the need for red meat (Mis and Öztürk, 2018).

Considering the number of sheep, Akkaraman breed comes the first, followed by Morkaraman, Dağlıç, Kıvırcık, Merino, Karayaka, and Awassi breeds, respectively. Sheep breeding has become one of the most important branches of animal agriculture in the Northeast Anatolia Region, where Erzurum, Kars, Ağrı, and Muş provinces are located. Morkaraman sheep, which completely adapt to the conditions of the region, are the most reared sheep breed. Live weight, slaughter weight, and meat yield in Morkaraman breed vary according to age, sex, condition, fertility, and general condition of flock (Kayalık, 2009).

The province of Erzurum provides the necessary conditions for sheep and goat breeding due to its climate and ecological structure (altitude, slope of the land, temperature, humidity, etc.), and existing pasture-pasture areas. At the same time, the richness of the vegetation and water resources, the deep-rooted history of sheep breeding and the socio-economic status of the breeders in the province support the breeding of sheep and goats. (Kopuzlu et al., 2016). According to the statistics for 2020, Türkiye has 42,126,781 heads of sheep. According to the data for the same year, the total number of sheep in Erzurum province is 799,154 heads, and 361,453 heads are pure Morkaraman (45.2%), 408,551 heads are crossbred Morkaraman (51.1%), and the rest are other breeds (3.7%). Considering the total number of sheep in the

province, it is understood that it constitutes 18.1% and 1.9%, respectively, of the Northeast Anatolia Region (4,413,059 heads) and Türkiye (TUIK, 2020).

Morkaraman sheep is a race reared in the Eastern Anatolia Region. The breeding purpose of this race is primarily meat, also milk and wool. It has a strong and large body. The neck is long and legs are long. The head is long compared to the body. On the head profile there is a slight concavity between the forehead and nose. The nose of rams is convex. Body color changes among red, maron and violet. Rams usually have big and spiral horns. But, Ewes are either weakly horned. It is well adapted to the cold and long winter conditions. It utilizes poor pastures at high altitude. Birth weight, mature body weight, Daily live weight gain and breeding age and litter size averages obtained in studies conducted with this breed was determined as 3,9 kg, 50-90 kg, 192 g, 18 months and 1, respectively (Anonim, 2011).

The demand for lamb meat in Turkey is increasing every year. For this reason, breeders tended to produce more lamb meat according to market demand. Thus, the breeders make an effort to market the lambs at the end of the grazing period by making sufficient use of the pasture after birth instead of fattening the lambs in winter. With the increase in the market value of lamb meat in Turkey, it becomes important for the lambs to reach a live weight at the end of the grazing period in line with the market demand.

This study was conducted to determine the effects of environmental factors such as sex, birth type, year, and maternal age on growth traits such as birth weight, live weight at the beginning of the grazing period, live weight at the grazing period, live weight at the end of the grazing period, and daily live weight gains the beginning and end of grazing period in the Morkaraman lambs reared under the breeder conditions in Erzurum province. It was determined whether the lambs are ready to slaughter at the end of the grazing period.

Material and Method

The animal materials were 1032 Morkaraman lambs born from Morkaraman ewes under breeder conditions at 4 different enterprises in the city center of Erzurum in 2018-2019. Births took place in January-April in 2018-2019. In the first 24 hours following the birth of all lambs, their birth weights were determined by using a digital scale with a precision of 10 g, LWBGP one day before the pasture and LWEGP one day before the return from the pasture were determined by using a scale with a precision of 100 g. As enterprise records, data such as ear tag number, sex of lambs, lambing type, birth date, maternal age, the date of going to the pasture, the date of return from the pasture, and birth weights, live weight at the beginning of grazing period, and live weights at the end of grazing period were recorded. After the lambs were kept with their mothers together for 5 days, following the birth, they were kept with their mothers in the lamb pens from 18.30 in the evening to 05.00 in the morning within the enterprise until they went out to the pasture for 3 months. The same animal care and feeding program were applied to the lambs at 4 different enterprises under winter barn conditions. At these enterprises, the lambs were grazed with their mothers for 3 months until the end of the grazing period. The average time from birth to the end of the grazing period was determined as 182 days.

Statistical analyses

This study focused on BW, LWBGP, LWGP, LWE GP, DLWGBBGP, DLWG GP and DLWGEGP among growth traits. Sex, birth type, year, and ewe age were examined as environmental factors affecting the growth traits analyzed in the study. The General Linear Model (GLM) procedure of the SPSS 20.0 package program was used in the analysis of the data obtained as a result of the study, and Duncan's multiple comparison test was applied to compare the groups found to be important as a result of the analysis. The analysis of the obtained data was performed according to the following mathematical model;

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d_l + ab_{ij} + ab_{ik} + ad_{il} + bc_{jk} + db_{ij} + dc_{lk} + e_{ijklm} \quad (1)$$

μ = mean

a_i = Effect of sex i (i: 1, 2; male, female)

b_j = Effect of lambing type j (j: 1, 2; single, twin)

c_k = Effect of year k (k: 1, 2; 2018, 2019);

d_l = Effect of ewe age l (l: 2, 3, 4, 5, 6 \geq)

ab_{ij} = Effect of i. Sex j. Birth type (ij:4; female single, female twin, male single, male twin)

ab_{ik} = Effect of i. sex k. years (ik:4; female 2018, female 2019, male 2018, male 2019)

ad_{il} = Effect of i. sex l. ewe age (ik:10; female 2, male 2, female 3, male 3, female 4, male 4, female 5, male 5, female 6 \geq , male 6 \geq)

bc_{jk} = Effect of j. Lambing type k. years (ik:4; twin 2018, twin 2019, single 2018, single 2019)

db_{ij} = Effect of l. ewe age j. lambing type (ik:10; 2 twin, 2 single, 3 twin, 3 single, 4 twin, 4 single, 5 twin, 5 single, 6 \geq twin, 6 \geq single)

dc_{lk} = Effect of l. ewe age j. years (ik:10; 2 2018, 2 2019, 3 2018, 3 2019, 4 2018, 4 2019, 5 2018, 5 2019, 6 \geq 2018, 6 \geq 2019)

e_{ijklm} = Random error

Results

Birth weight

Examining Table 1, the average BW was determined as 3.67 \pm 0.03 kg. When the effect of sex on BW was examined, birth weight was revealed to be 3.51 \pm 0.04 kg in females and 3.76 \pm 0.04 kg in males, and as expected, higher in males. When these values were analyzed, it was found that males showed an increase of 0.25 kg compared to females, and the effect of sex was significant in favor of males (P<0.05).

When the effect of birth type on BW was examined, the average BW of lambs was determined as 3.87 \pm 0.04 kg in singles and 3.45 \pm 0.05 kg in twins. Single lambs had a higher live weight than twins, and the weight difference between them was very significant (P<0.01).

When birth weights were examined by years, they were obtained as 3.79 \pm 0.04 and 3.54 \pm 0.05 kg in lambs in 2018 and 2019, respectively. Considering this average value, a decrease of 0.25 kg was observed in 2019, and this difference between years was determined

to be statistically very significant ($P < 0.01$). It is thought that the high average birth weight in the first year of the study may have resulted from the more accurate selection of breeding sheep in that year at the enterprise, the nutritional value of the feed used, and the effects of the grazing period.

The age of the ewe, one of the environmental factors whose effects were measured in the study, was considered as 2, 3, 4, 5, 6 \geq . The average birth weights of lambs born to mothers of this age were determined as 3.52 ± 0.11 , 3.59 ± 0.05 , 3.64 ± 0.06 , 3.71 ± 0.06 , and 3.85 ± 0.07 kg, respectively. The differences between the obtained averages were found to be very significant ($P < 0.01$). When the values were examined in terms of ewe age, the highest BW was obtained in the lambs born to 6 \leq years old ewes, while lambs born to ewes aged 4 and 5 years had values close to each other, and the lowest value was obtained in the lambs born to 2-year-old ewes. According to these results, an increase was observed in the BW of the lambs born as the ewe age increased, and the difference between the BW according to the ewe age groups was 0.33 kg (Table 1).

For the interaction effect on birth weight, only the sex x year interaction was found to be significant ($P < 0.05$), while the other interaction effects were determined to be insignificant.

Live weight at the beginning of the grazing period

The average LWBGP of the lambs is 24.82 ± 0.27 kg. According to the sex of lambs, the average live weight at the beginning of the grazing period was calculated as 26.25 ± 0.38 kg in males and 23.39 ± 0.38 kg in females. The difference between the LWBGP of the sex (2.86 kg) was very significant ($P < 0.01$).

When LWBGP was examined by years, it was determined as 25.31 ± 0.37 kg and 24.27 ± 0.39 kg on average in the lambs born in 2018 and 2019. According to this result, it was revealed that there was a decrease of up to 1.22 kg in the values of this trait in the 2nd year compared to the 1st year. It is thought that this live weight decrease may have originated from the variability of the feeding conditions of the breeders until the pasture period. The difference in the average LWBGP between the years was determined as very significant ($P < 0.01$).

When the average LWBGP were evaluated according to single and twin lambing, they were determined as 37.12 ± 0.48 kg in twin lambs and 39.27 ± 0.38 kg in single lambs. The effect of lambing type on LWBGP was found to be very significant ($P < 0.01$).

As a result of the study, the average LWBGP in lambs born to ewes aged 2, 3, 4, 5 and ≤ 6 years was determined as 21.51 ± 0.94 kg, 22.79 ± 0.44 kg, 25.06 ± 0.51 kg, 27.38 ± 0.53 kg, and 26.53 ± 0.63 kg in the same order. Upon examining these values, it was understood that lambs born to 5-year-old ewes had the highest (27.38 ± 0.53 years, there is a continuous increase in the average DLWGPP and a decrease at the age of 6 years. It can be stated that the reason for the increase in weights of this period depending on the ewe age may be due to the increase in the amount of milk given by their mothers every year depending on the age and the increase in the birth weight of lambs.

For the interaction effect on birth weight, only the lambing type x year interaction was found to be significant ($P < 0.01$), while the other interaction effects were determined to be insignificant. When Table 2 is examined, in terms of the LWBGP, among twin-born lambs was 3.44 kg in those born in 2019 compared to those born in 2018. Among single-born lambs, those born in 2018 weighed 5.02 kg more than those born in 2019.

Live weight during the grazing period

In the population in which the study was carried out, lambs were grazed on the pastures of the enterprises for an average of 86 days. During this period, the general average live weight in lambs that evaluated the grazing period was determined as 13.76 ± 0.22 kg.

Table 1. Least squares means and standard errors for birth weight, live weight at the beginning of grazing period, live weight during the grazing period and live weight at the end of the grazing period of Morkaraman lambs (g)

Tablo 1. Morkaraman ırkı kuzuların doğum ağırlığı, meralanma başı, meralanma dönemi ve meralanma sonu canlı ağırlığına ait ortalamalar ve standart hataları (kg)

Factors		N	$\bar{X} \pm S\bar{x}$
Birth Weight			
General Average		1032	$3,67 \pm 0,03$
Years			**
	2018	514	$3,79 \pm 0,04$
	2019	518	$3,54 \pm 0,05$
Sex			*
	Female	507	$3,51 \pm 0,04$
	Male	525	$3,76 \pm 0,04$
Lambing Type			**
	Twin	274	$3,45 \pm 0,05$
	Single	758	$3,87 \pm 0,04$
Ewe Age			**
	2	66	$3,52 \pm 0,11^c$
	3	264	$3,59 \pm 0,05^{bc}$
	4	259	$3,64 \pm 0,06^{ab}$
	5	236	$3,71 \pm 0,06^{ab}$
	$6 \geq$	207	$3,85 \pm 0,07^a$
Years X Sex			*
	2018	Female	$3,78 \pm 0,06$
		Male	$3,80 \pm 0,06$
	2019	Female	$3,36 \pm 0,06$
		Male	$3,71 \pm 0,06$
Live Weight at The Beginning of Grazing Period			
General Average		1031	$24,82 \pm 0,27$
Years			*
	2018	514	$25,31 \pm 0,37$
	2019	517	$24,27 \pm 0,39$
Sex			**
	Female	507	$23,39 \pm 0,38$
	Male	524	$26,25 \pm 0,38$
Lambing Type			**
	Twin	275	$23,92 \pm 0,43$
	Single	756	$25,62 \pm 0,33$
Ewe Age			**
	2	66	$21,51 \pm 0,94^c$
	3	264	$22,79 \pm 0,44^c$
	4	259	$25,06 \pm 0,51^{bc}$
	5	235	$27,38 \pm 0,53^b$
	$6 \geq$	207	$26,53 \pm 0,63^a$
Lambing Type X Years			**
	Twin	2018	$22,39 \pm 0,60$
		2019	$25,83 \pm 0,61$
	Single	2018	$28,23 \pm 0,43$
		2019	$23,02 \pm 0,51$
Live Weight at The Grazing Period			
General Average		1024	$13,76 \pm 0,22$
Years			**
	2018	504	$11,07 \pm 0,30$
	2019	520	$16,75 \pm 0,32$

Continue of Table 1
Tablo 1'in devamı

Sex			NS
	Female	507	13,49±0,31
	Male	524	14,03±0,31
Lambing Type			NS
	Twin	273	13,35±0,35
	Single	751	14,13±0,28
Ewe Age			NS
	2	65	15,98±1,10
	3	261	14,40±0,37
	4	258	13,24±0,44
	5	235	11,90±0,45
	6≥	205	12,61±0,53
Lambing Type X Years			**
	Tiwin	2018	11,77±0,49
		2019	15,33±0,50
	Single	2018	10,36±0,36
		2019	17,89±0,43
Ewe Age X Lambing Type			**
	2	Tiwin	11,43±1,14
		Single	15,97±1,02
	3	Tiwin	13,44±0,56
		Single	13,53±0,44
	4	Tiwin	14,66±0,73
		Single	13,95±0,40
	5	Tiwin	11,47±0,76
		Single	14,25±0,41
	6≥	Tiwin	14,82±0,84
		Single	12,96±0,61
Ewe Age X Years			*
	2	2018	11,25±0,75
		2019	20,88±1,78
	3	2018	10,53±0,48
		2019	16,44±0,53
	4	2018	12,41±0,52
		2019	16,19±0,65
	5	2018	10,70±0,63
		2019	15,02±0,60
	6≥	2018	10,45±0,90
		2019	17,29±0,51
Live Weight at The End of The Grazing Period			
General Average		1024	38,25±0,30
Years			**
	2018	509	36,14±0,41
	2019	515	40,60±0,45
Sex			**
	Female	504	36,56±0,43
	Male	520	39,95±0,43
Lambing Type			**
	Twin	273	37,12±0,48
	Single	751	39,27±0,38
Ewe Age			**
	2	65	35,22±1,07 ^c
	3	261	36,14±0,49 ^c
	4	258	39,02±0,57 ^b
	5	235	40,18±0,60 ^a
	6≥	205	39,95±0,711 ^a
Lambing X Years			**
	Tiwin	2018	34,05±0,67
		2019	40,95±0,68
	Single	2018	38,23±0,49
		2019	40,32±0,59

NS: İnsignificant; *: P<0,05 (Significant); **: P<0,01 (Very significant); a-c Differant in the same columns.

The average values of this trait in Morkaraman lambs were found 11.07 ± 0.30 kg for 2018 and 16.75 ± 0.32 kg for 2019, according to years; 14.03 ± 0.31 kg for males and 13.49 ± 0.31 kg for females according to the sex of lamb; 13.35 ± 0.35 kg for twins and 14.13 ± 0.28 kg for singles, according to lambing type; 14.46 ± 0.78 kg for 2 age, 13.49 ± 0.36 kg for 3, 14.30 ± 0.42 kg for 4, 12.86 ± 0.43 kg for 5 and 13.87 ± 0.52 kg for $6 \leq$, according to ewe age, respectively. Female lambs with low birth weight and LWBGP have gained less live weight during the at the grazing period compared to male lambs during the grazing period. In this period, male lambs gained an average of 0.59 kg more live weight than females.

The difference between the means determined for this feature was found to be insignificant. Among the factors affecting this trait, the effect of the year was found to be significant ($P < 0.01$). While the effect of the sex x years and ewe age x years was found to be significant ($P < 0.05$), and the effect of the lambing type x years and ewe age x lambing type was found to be significant ($P < 0.01$).

Live Weight at the end of the grazing period

The least-squares average value of the live weights of Morkaraman lambs at LWEGP is 38.25 ± 0.30 kg. The effects of sex, lambing type, year, ewe age, and lambing type x year on LWEGP were found statistically significant ($P < 0.01$).

According to the sex of lambs, the average LWEGP was detected to be 39.95 ± 0.43 kg in males and 36.56 ± 0.43 kg in females. When these averages were considered, it was determined that the difference of 3.41 kg between the sexes was statistically very significant ($P < 0.01$). When the average LWEGP were evaluated according to single and twin birth type, they were revealed as 37.12 ± 0.48 kg in twin lambs and 39.27 ± 0.38 kg in single lambs. The effect of birth type on LWEGP was found to be very significant ($P < 0.01$). As a result of the study, the average live weight values at LWEGP were 35.22 ± 1.07 kg, 36.14 ± 0.49 kg, 39.02 ± 0.57 kg, 40.18 ± 0.60 kg, and 39.95 ± 0.71 kg in lambs born to mothers aged 2, 3, 4, 5, and $6 \leq$ years, respectively. Upon examining these values, it was determined that lambs of 5-year-old mothers had a higher average LWEGP compared to lambs born to mothers of other ages, and there was a weight difference of up to 4.96 kg between them and lambs of 2-year-old mothers, which had the smallest value.

According to the analysis of variance results, it was revealed that the difference between the average live weights at the end of the grazing period obtained from lambs of mothers of different ages was very significant ($P < 0.01$). Among the interactions whose effects on LWEGP only the effect of birth type x year interaction was significant ($P < 0.01$), and the effect of all other interactions was insignificant.

Daily live weight gain from the birth to the beginning of the grazing period

As seen in Table 2, the average DLWGBBGP in the studied lambs was 226.16 ± 3.17 g. Considering the sex, the average of DLWGBBGP was determined as 235.69 ± 4.51 g in male lambs and 216.63 ± 4.45 g in female lambs. According to the lambing type, the average value of this trait was obtained as 220.64 ± 5.05 g in twins and 231.13 ± 3.94 g in singletons. When the effect of year on daily live weight gain in this period was examined, the average value was 214.94 ± 4.34 g in lambs born in 2018 and 238.63 ± 4.64 g in lambs born in 2019. For this trait,

the average difference between the years was found to be very significant ($P < 0.01$). As a result of the study, DLWGBBGP in lambs born to ewes aged 2, 3, 4, 5, and ≤ 6 years was 185.06 ± 11.02 g, 203.30 ± 5.17 g, 224.42 ± 6.04 g, 263.90 ± 6.30 g, and 243.85 ± 7.42 g in the same order. Upon examining these values (Table 2), it was observed that lambs of 5-year-old mothers had higher **DLWGBBGP** than the others.

As a result of the analysis of variance, it was revealed that, among the environmental conditions whose effects on DLWGBBGP were examined, sex, ewe age, lambing type x years interaction and ewe age x years interaksyonu had a very significant effect ($P < 0.01$), and the year, lambing type and sex x lambing type interaction had a significant effect ($P < 0.05$).

Daily live weight gain during grazing period

The mean of the least-squares and standard error values of DLWGGP obtained from Morkaraman lambs that went out to the pasture at an average age of 91 days were determined as 141.72 ± 2.57 g (Table 2).

The mean value of this trait was found to be 142.86 ± 3.645 g in male lambs and 140.58 ± 3.629 g in female lambs. Considering the birth type, the mean values of this trait were determined as 135.57 ± 4.06 g and 7.25 ± 3.24 g for single and twin-born lambs, respectively. Based on the mean values, the difference of 11.68 g was in favor of single lambs. Considering the years in the study, the mean values were determined as 110.14 ± 3.51 g for 2018 and 176.80 ± 3.78 g for 2019. The daily live weight gains of lambs born from mother ewes of 5 different ages (2, 3, 4, 5 and $6 \leq$) during their stay in the grazing period were 145.04 ± 9.06 , 142.67 ± 4.18 , 149.00 ± 4.86 , 123.74 ± 5.06 and 148.96 ± 6.04 g, in order of age.

As a result of the analysis of variance, the effect of years, ewe age, sex x years interaction and ewe age x lambing type on DLWGGP was found to be very significant ($P < 0.01$), and the effect of ewe age x years on DLWGGP was determined to be significant ($P < 0.05$).

Daily live weight gain from the birth to the end of the grazing period

The average age of lambs at the end of the grazing period is 182 days. During this period, the least-squares average of DLWGEGP was determined as 192.94 ± 1.69 g. Considering the sex, the average DLWGEGP was found to be 200.62 ± 2.39 g in male lambs and 185.25 ± 2.38 g in female lambs. In general, as expected, male lambs achieved higher live weight gain. The effect of sex on the average of these parameters was very significant ($P < 0.01$). Based on lambing type, the values obtained for this trait were 191.03 ± 2.67 g in twins and 194.65 ± 2.13 g in single. During DLWGEGP, the difference in daily live weight gain in two different lambing types in lambs of this breed was determined to be statistically insignificant. The average daily live weight gain from the birth to the end of the grazing period was 186.44 ± 2.30 g in lambs born in 2018 and 200.15 ± 2.48 g in lambs born in 2019. According to the analysis of variance applied, the difference between the year groups for DLWGEGP was found to be very significant ($P < 0.01$).

Ewe age is one of the discrete variables affecting live weight gain. As a result of the study, the average daily live weight gain of lambs born to ewes aged 2, 3, 4, 5, and ≤ 6 years at the end of the grazing period was 176.83 ± 5.95 g, 183.03 ± 2.74 g, 197.34 ± 3.19 g, 201.92 ± 3.32

g, and 201.54±3.96 g, respectively. When these results were examined, it was understood that lambs of 5-year-old ewes had a higher average DLWGEGP compared to the others (Table 2).

Table 2. Least squares means and standard errors for daily live weight gains from the birth to the beginning and the end of the grazing period, and daily live weight gains during the grazing period of Morkaraman lambs (g)

Tablo 2. Morkaraman ırkı kuzuların doğumdan mera başına, merasonu kadarki sürede ve mera döneminde günlük canlı ağırlık artışlarına ait en küçük kareler ortalamaları ve standart hataları (g)

Factors	N	$\bar{X} \pm S\bar{x}$
Daily Live Weight Gain from the Birth to The Beginning of The Grazing Period		
General Average	1031	226.16±3.17
Years		*
2018	513	214.94±4.34
2019	518	238.63±4.64
Sex		**
Female	507	216.63±4.45
Male	524	235.69±4.51
Lambing Type		*
Twin	274	220.64±5.05
Single	757	231.13±3.94
Ewe Age		**
2	66	145.04±9.06 ^b
3	264	142.67±4.18 ^b
4	259	149.00±4.86 ^a
5	235	123.74±5.06 ^c
6≥	207	148.96±6.04 ^a
Lambing Type X Sex		*
Twin	Female	218.75±7.49
	Male	222.54±6.78
Single	Female	214.73±5.10
	Male	247.52±6.01
Lambing Type X Years		**
Twin	2018	196.98±7.04
	2019	250.23±7.20
Single	2018	232.90±5.07
	2019	229.35±6.04
Ewe Age X Years		**
2	2018	188.76±10.89
	2019	177.66±24.89
3	2018	198.54±6.89
	2019	208.06±7.71
4	2018	227.85±7.50
	2019	220.10±9.47
5	2018	230.38±9.09
	2019	297.42±8.72
6	2018	229.17±12.85
	2019	258.53±7.43
Daily Live Weight Gain During The Grazing Period		
General Average	1031	141.77±2.57
Years		**
2018	513	110.14±3.51
2019	518	176.80±3.78
Sex		NS
Female	507	140.58±3.63
Male	524	142.86±3.65
Lambing Type		NS
Twin	274	135.58±4.06
Single	757	147.25±3.24

Ewe Age			**
	2	66	185,06±11,02 ^d
	3	264	203,30±5,17 ^c
	4	259	224,42±6,04 ^b
	5	236	263,90±6,30 ^a
	6≥	207	243,85±7,42 ^{ab}
Years X Sex			**
	2018	Female	116,74±4,81
		Male	103,55±5,11
	2019	Female	167,07±5,49
		Male	186,53±5,20
Ewe Age X Lambing Type			**
	2	Tiwin	98,94±13,24
		Single	168,09±11,86
	3	Tiwin	133,23±6,58
		Single	152,11±5,15
	4	Tiwin	147,59±8,54
		Single	150,40±4,63
	5	Tiwin	112,66±8,90
		Single	134,82±4,82
	6≥	Tiwin	167,10±9,75
		Single	130,82±7,12
Ewe Age X Years			*
	2	2018	109,35±8,75
		2019	216,42±20,79
	3	2018	103,10±5,58
		2019	182,24±6,21
	4	2018	122,84±6,03
		2019	175,16±7,61
	5	2018	99,12±7,30
		2019	148,36±7,01
	6≥	2018	116,31±10,49
		2019	181,61±5,98
Daily Live Weight Gain From The Birth to The End of The Grazing Period			
General Average		1032	192,94±1,69
Years			**
	2018	514	186,44±2,30
	2019	518	200,15±2,48
Sex			**
	Female	507	185,25±2,38
	Male	525	200,62±2,39
Lambing Type			NS
	Twin	274	191,03±2,67
	Single	758	194,65±2,13
Ewe Age			**
	2	66	176,826±5,95 ^b
	3	264	183,029±2,74 ^b
	4	259	197,337±3,19 ^a
	5	236	201,918±3,32 ^a
	6≥	207	201,542±3,96 ^a
Lambing Type X Sex			*
	Twin	Female	187,44±3,96
		Male	194,61±3,58
	Single	Female	183,28±2,79
		Male	206,03±3,21
Ewe Age X Years			*
	2	2018	172,20±5,75
		2019	186,08±13,65
	3	2018	172,47±3,67
		2019	193,59±4,08
	4	2018	199,51±3,96
		2019	195,16±4,10
	5	2018	197,37±4,80
		2019	206,47±4,60
	6≥	2018	190,65±6,89
		2019	212,43±3,93

NS: Insignificant; *: P<0,05 (Significant); **: P<0,01(Very significant); a-c Different in the same columns.

When the interaction effects of intermittent environmental factors on DLWGEGP were evaluated, it was determined that only the effect of sex x lambing type and ewe age x birth type was significant (P<0.05).

Discussion and Conclusion

When Table 1 is examined, among the studies conducted on Morkaraman breed with the general average BW, it was found to be lower than the values (4.69 kg, 4.26 kg, 4.19 kg, 4.10 kg, 4.19 kg, 3.97 kg, 4.74 kg, 4.19 kg, 3.71 kg, 3.81 kg, 3.80 kg, and 4.29 kg) reported by Macit (1994), Yaprak et al. (1996), Bilgin et al. (2004), Aksakal and Macit (2009), Kopuzlu and Sezgin (2017), Gözyuman (2018), Sezgin (2019), Yılmaz (2020), Cizmar *et al.* (2013), and Türkmen and Çak (2021), it was found to be higher from the values (2.91 kg, 3.37 and 3.46 kg, 3.50 kg, 3.38 kg and 3.17 kg) reported by Macit (2001), Kopuzlu et al. (2011) in elite and base flocks, Kopuzlu et al. (2014) and Bozgüllü (2019) and close to the values (3.73 kg and 3.71 kg) reported by Türkyılmaz (2014).

The average live weight of lambs at LWBGP is 24.82 ± 0.27 kg, and when this value is compared with the results obtained from other studies on the same breed, it was found to be higher than the values determined by Macit (1994), Yaprak et al. (1996), Aksakal and Macit (2009), Kopuzlu et al. (2011), Kopuzlu et al. (2014), Kopuzlu and Sezgin (2017), Sezgin (2019), Yavuz (2015) and Sezgin (2019) and it was lower than the results reported by Sezgin (2016) and Bozgüllü (2019). In the studies examined, as in this study, it was determined that the average live weight of the lambs born from these ewes increased with the increase in the age of the ewe.

Female lambs with low BW and LWBGP gained less live weight in the pasture compared to male lambs during their stay in the grazing period. Male lambs gained an average of 0.59 kg more live weight than females. The difference between the means determined for this trait was found to be insignificant. The results obtained for the sexes in this study were found to be lower than the values reported by Işık and Kaya (2011) for Tuj male and female lambs.

When the average LWEGP ($38,25 \pm 0,30$ kg) obtained in the studied 1024 heads of Morkaraman sheep is compared with other studies, it was determined to be higher than the values reported by Macit (1994) 28.26 ± 0.109 kg, Yaprak et al. (1996) 29.61 ± 1.22 kg, Aksakal and Macit (2009) 35.5 ± 0.72 kg, Koncagül et al. (2013), and Kopuzlu et al. (2014) 37.4 ± 0.09 kg and lower than the values reported by Kopuzlu et al. (2011) 41.26 ± 0.26 kg, Sezgin (2016) 39.63 kg, Kopuzlu and Sezgin (2017) 39.45 ± 0.719 kg, and Sezgin (2019) 41.59 ± 0.110 kg. When the lambing type was evaluated according to the years, it was determined that both single and twin lambs born in 2019 had higher live weight at the end of the grazing period than the lambs with the same birth type born in 2018. When the birth type and years were examined together in terms of this weighted average, it was determined that the difference between the averages of lambs born in two different years was 6.90 kg in twin-born and 2.09 kg in single-born.

The average value (226.16 ± 3.17 g) determined for DLWGBBGP was lower than the value (249.81 ± 6.60 g) determined in the elite flock by Kopuzlu et al. (2011) researching with Morkaraman lambs, Kopuzlu et al. (2014), Sezgin (2016), Kopuzlu and Sezgin (2017), and Sezgin (2019) and higher than the value (203.38 ± 1.48 g; 210.97 ± 0.73 g) determined by Kopuzlu et al. (2011) in intermediate elite and base flocks. According to the results of the study performed by Yavuz (2015) with Akkaraman lambs, it was obtained to be higher (218.7 ± 2.3 g). Considering the sex x birth type interaction, when the values determined for DLWGBBGP were examined, it was found that both male and single-born lambs had a higher value than male and twin-born lambs, and female and twin-born lambs are a higher than twin and single-born lambs. For this feature, according to both lambing types, it was determined that the values obtained from male lambs were higher than the values obtained from female lambs. Considering the interaction of ewe age x years, Considering the mother age x years interaction, it was determined that DLWGBBGP was higher in lambs with 2, 4 and 5 ewe age in 2018 and 3 and $6 \geq$ ewe age in 2019. When the values of this trait were examined, the highest and lowest live weight gains between years were obtained from lambs born from the ewe age of 5 and 4 years, respectively.

In the studied flock, DLWGGP was 142.86 ± 3.645 g in males and 140.58 ± 3.629 g in females. While these values obtained according to sex were found to be higher than the values reported by Aksakal and Macit (2009) and Türkyılmaz (2014); found smaller than the value reported by Işık and Kaya (2011) for Tuj lambs, Kopuzlu et al (2016) and Sezgin (2019) for Morkaraman lambs. Based on the average values of this trait according to the lambing type, the difference of 11.68 g was in favor of single-born lambs. According to birth types, the values obtained for Morkaraman lambs were found to be higher than those determined by Aksakal and Macit (2009) for Awassi and Morkaraman lambs, and Türkyılmaz (2014) for Morkaraman and Romanov x Morkaraman crossbred lambs and were found to be lower than the values determined by Sezgin (2019) for Morkaraman and Akkaraman lambs and by Kopuzlu et al (2014) for same breed lambs. The difference of 66.66 g between the years for the daily live weight gain of the lambs during their stay in the pasture may be partly due to the changing pasture quality, operating conditions and shepherding activities. For this trait, when examining the mean values of lambs born between 2 and $6 \leq$ ewe age, it was determined that the lambs that made the least use of the pasture were the lambs born from ewes with the age of 5. Despite this, the lambs were determined as the lambs with the highest body weight per pasture, LWBGP and LWEGP, Daily live weight gains average at the beginning and end of the grazing period and according to the lambs of other ewe ages. When the findings of daily live weight gain in lambs during the grazing period are compared with other similar studies, the average value determined in the study was found to be higher than the values reported by Macit (1994)'s and Aksakal and Macit (2009)'s for lambs with 3-6 ewe age, and Türkyılmaz (2014)'s for lambs with 2-6 ewe age.

The average daily live weight gain (192.94 ± 1.69 g) obtained in Morkaraman lambs at the end of the grazing period was found to be lower than the values reported by Kopuzlu (2011) and Kopuzlu and Sezgin (2017) and higher than the value reported by Sezgin (2019). Considering the sex, the average DLWGGP was found to be 15.37 g higher in male lambs than in female lambs. When the studies on the subject were examined, it was determined that the live weight gain of male lambs in this period was higher in this study as well. In the study, the

values obtained for this live weight gain in both sex were found to be lower than the reports by Sezgin (2019). When DLWGEGP were examined, the average values were higher for female and twin-born lambs compared to female and single-born lambs (4.16 g), and male and single-born lambs compared to male and twin-born lambs (11, 42 g). According to the values determined for this feature, the average values of the lambs born in 2018 between the 2 and 5 years ewe age increased gradually and the decrease in the 6 years ewe age was determined. In 2019, it was observed that the average value of lambs born from 2 to 6 years ewe ages increased as the ewe age increased. When these values were examined, the highest average value was obtained in 2019 and 6 ≥ ewe aged lambs (212.43±3.925 g), and the lowest average value was obtained in 2018 and 2 ewe aged lambs (172.20±5,745 g).

In the current study, the traits addressed as the growth performances of Morkaraman lambs under the local conditions of Erzurum province were determined, and these performances were compared with studies carried out with various local breeds. Based on performance values such as live weight and daily live weight gain under the local and pasture conditions of the province, it was concluded that lambs could reach the desired slaughter live weight at the end of the grazing period.

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