



Reproductive and Growth Characteristics During The First Age of Kıvırcık, Sakız and Gökçeada Indigenous Sheep Breeds

Tamer Sezenler^{1*}, Ertan Köycü², Yalçın Yaman¹, Ayhan Ceyhan³
Mustafa Küçükkebaşı¹, Mehmet Akif Yüksel¹

^{1*}Bandırma Sheep Research Station, 10200 Bandırma/Balıkesir, Turkey

²Namik Kemal University, Agriculture Faculty, Department of Animal Science, 59100 Tekirdağ, Turkey.

³Nigde University, The Vocational School of Bor, 51700 Bor/Nigde, Turkey

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* Corresponding Author:

E-mail: tsezenler@hotmail.com

ABSTRACT

This study was conducted to determine first age reproduction characteristics of indigenous Kıvırcık, Sakız and Gökçeada sheep breeds and growth performances of ewe lambs which have been kept in Bandırma Sheep Research Station (BSRS). The data of reproduction characteristics of ewes and growth characteristics of lambs were collected on 15 Kıvırcık, 8 Sakız and 10 Gökçeada ewes, and on 16 Kıvırcık, 12 Sakız and 11 Gökçeada lambs, respectively. After the lambs completed their fifth month ages, estrus detection was carried out with a teaser ram twice a day with 12 hour intervals. For the Kıvırcık, Sakız and Gökçeada lambs, the first oestrus weights were 37.93, 33.35 and 29.75 kg; first oestrus ages were 315, 320 and 337 days; oestrus durations were 30.99, 25.85 and 20.28 hours and the duration of the oestrus cycles were 16.59, 19.91 and 17.76 days, respectively. The birth weights of Kıvırcık, Sakız and Gökçeada lambs were found to be 3.64, 3.91, 3.28 kg; the weaning weight (WW), 31.01, 25.44 and 23.67 kg, the six month live weight (SMLW), 32.87, 26.95 and 24.15 kg, the yearling live weight (YLW), 39.01, 30.95 and 30.27 kg and the average daily weight gain (ADWG), 0.271 0.257 and 0.202 kg, respectively.

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ÖZET

Bu çalışma, Bandırma Koyunculuk Araştırma İstasyon'unda yetiştirilen Kıvırcık, Sakız ve Gökçeada yerli koyun ırklarımızın ilk yaş üreme özellikleri ve büyüme performansını belirlemek amacıyla yapılmıştır. Araştırmada ilk yaş üreme özellikleri için 15 baş Kıvırcık, 8 baş Sakız ve 10 baş Gökçeada dişi kuzu, büyüme özellikleri için ise 16 baş Kıvırcık, 12 baş Sakız ve 11 baş Gökçeada dişi kuzunun verileri kullanılmıştır. Kızgınlık tespitleri kuzuların beşinci ayını doldurması ile beraber arama koçları ile on iki saat arayla günde iki kez yapılmıştır. Kıvırcık, Sakız ve Gökçeada kuzularında ilk kızgınlık canlı ağırlığı sırasıyla; 37,93; 33,35 ve 29,75 kg, ilk kızgınlık yaşı; 315, 320 ve 337 gün, kızgınlık süresi; 30,99; 25,85 ve 20,28 saat, kızgınlık siklusu; 16,59; 17,91 ve 17,76 gün bulunmuştur. Kıvırcık, Sakız ve Gökçeada dişi kuzuların doğum ağırlığı sırasıyla; 3,64; 3,90; 3,28 kg, sütten kesim ağırlığı; 31,01; 25,44 ve 23,67 kg, altıncı ay canlı ağırlığı; 32,87; 26,95 ve 24,15 kg, bir yaş canlı ağırlığı; 39,01; 30,95 ve 30,27 kg ve günlük canlı ağırlık artışı; 0,271; 0,257 ve 0,202 kg bulunmuştur.

* Sorumlu Yazar:

E-mail: tsezenler@hotmail.com

Introduction

It is clear that sheep is one of the most important species widely distributed all over the world, having different production traits (meat, milk and wool) and high capacity of adaptation which allows it to survive in a great variety of environments from cold mountainous regions, arid zones to semi-deserts area. Simply defined, ewe reproduction is giving birth to offspring. The survival of lambs largely depends on their ability to reproduce its own lambs. Sheep reproduction consists of the chain of gamete production, fertilization, gestation, reproductive behaviour and lambing. Therefore, reproduction is vital and complex process in sheep, as being in all other living organisms.

Reproduction or insemination can be defined as the chain of inter-related biological events ranging from the creation of the reproduction cell to mating, gestation, birth and lactation and to reproduction again. The first condition for the production of elements necessary for life of plants and animals is to reproduce or fertilize. For the ewe lamb, sexual maturity or puberty is the development of the egg and desire to mate or display oestrus. The first time when ewe lambs display oestrus is called sexual maturity. The sexual maturity age of ewe lambs varies depending on the breed, live weight, feeding, birth date, year, and birth type. In general ewe lambs reach sexual maturity when they reach 40-60% of their mature age weight. This is possible for breeds that develop early and have long mating seasons to display oestrus during their first age. This is called sexual maturity or early development feature. Sexual maturity can be measured in terms of the percentage of the ewes that reach sexual maturity during their first age, percentage of ewes fertilized or the average age when oestrus is observed (Kaymakçı, 1994).

Growth performance of young animals kept for breeding is the period when they are not fruitful and are costly. Shorter this period, lower the costs for the establishment and higher the profitability of the establishments as a result of increased efficiency from the animals (Akçapınar and Özbeyaz, 1999). Thus, reproduction is a crucial process for livestock breeding. If animals fail to reproduce they can even face the threat of extinction. It can be said that reproduction allows more effective animal improvement activities and selection (Kaymakçı, 1984).

Kıvırcık, Sakız and Gökçeada sheep breeds have low percentage of total sheep population in Turkey. However, each breed has its unique reproductive efficiency qualities. Kıvırcık is known for its meat quality, Sakız is for its high litter size and Gökçeada is for its high milk yield and survival rate. Although the contribution of these breeds to animal production is limited, they can be used during the cross-breeding studies in the future particularly due to their high milk yield and litter size (Ertuğrul et al., 2000).

This study was conducted to determine the first age reproduction characteristics of indigenous Kıvırcık, Sakız and Gökçeada sheep breeds and growth performances of lambs which have been kept in the Bandırma Sheep Research Station.

Materials and Methods

Location of Study

This study was conducted in Balıkesir provinces in Turkey. The sheep flocks were kept in Balıkesir province at Bandırma Sheep Research Station farm, located in the Marmara region of the country at longitude of 40° 21 E, the latitude of 27° 52 N, and at altitude of 65m. The mean relative humidity ranges from 20% to 88% and the maximum and the minimum ambient temperature ranges from -14 to 42.4°C. The annual rainfall in this area varies from 500 to 900 mm with an erratic distribution throughout the year (TSMS, 2012).

Animals Material

The data of reproduction characteristics were collected on 15 Kıvırcık, 8 Sakız and 10 Gökçeada ewes aged from 3 to 6 years old. In growth characteristics, the animal materials comprised 16 Kıvırcık, 12 Sakız and 11 Gökçeada lambs.

Methods

This study was carried out in the Bandırma Sheep Research Station (BSRS) in Turkey. Ewes were mated by hand mating method and it generally started between 15th of June and 15th of August at BSRS. Lambing was lasted from November 15th and January 15th. The lambs were weaned starting from the beginning of April. Following the weaning, the ewe lambs from these three breeds were selected based on their ages and placed in a separate section. During the study, oestrus behaviour was determined by using the teaser rams described as the best method by Gökçen (1990) and starting from the beginning of June, four teaser rams were released among the ewes twice a day (at 9:00 am and 09:00 pm) and kept with the ewes for an hour every day during the research period. The reproductive organs of the rams were cleaned using special clothing before teasing to prevent unwanted pregnancies. In order to prevent the teaser ram from wasting time with ewes showing oestrus, they were immediately separated from the flock and placed in a separate section and the teaser rams were allowed to continue teasing. After the search was over, animals showing oestrus were brought back into the flock.

First Age Reproductive Characteristics: First age reproductive characteristics were calculated according to the method described by Kaymakçı (1984).

First oestrus age: It is the age when ewe lambs first display oestrus during their first year.

First oestrus weight: It is the live weight at the time when ewe lambs show first oestrus behavior.

Oestrus period: (number of) consecutive oestrus behaviour x 12 hours.

Oestrus Cycle: Period between the start of the first oestrus until the start of the second.

Growth traits: Within 12 hours after the birth of the lambs were weighed and ear tags. Their ear numbers, birth dates, birth types, and sex were recorded in the birth registration book. The birth weight (BW), weaning weight (WW), six month live weight (SMLW), yearling live

weight (YLW) and first oestrus live weights (FELW) were measured using electronic scale sensitive to 100 grams. Daily weight gain (DWG) until weaning (90 day) was calculated by deducting the birth weight from the weaning live weight and dividing the difference by the age at weaning.

Statistical Analyses

The general linear model (GLM) was used to analyse the effect of breed, age of dam and the birth type on reproduction and growth characteristics. Significant differences among the means were compared by Duncan-test. The statistical model is as follows:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$$

where y_{ijkl} is the trait of interest, μ is overall mean, a_i is the effect of breed ($i = \text{Kıvrıcık, Sakız, Gökçeada}$), b_j is the effect of age of dam ($j = \leq 3, 4-5 \geq 6$), c_k is the effect of birth type ($k = \text{single, twin}$) and e_{ijkl} is the random error term. The statistical analyses were carried out in SPSS (1999) 10.0. The results obtained were presented as least squares mean and standard error.

Results and Discussion

In the literature, publications are very limited on reproductive traits for native Turkish sheep breeds. Most studies have been published in different country and different sheep breeds, therefore the results of reproductive traits in this study have been discussed relative to findings for other sheep breeds.

Reproductive Traits

The first oestrus live weight and ages of the Kıvrıcık, Sakız and Gökçeada sheep breeds are shown in Table 1. Average first oestrus live weights for these breeds were found to be 37.93, 33.35 and 29.75 kg, respectively. The highest first oestrus live weight was observed in Kıvrıcık breed and this was followed by Sakız and Gökçeada sheep breeds. The first oestrus live weight was the highest among the lambs of the ewes aged 4-5 years old, this was followed by the lambs of the ewes aged ≥ 6 and ≤ 3 . The first oestrus live weights of the single born ewes were found to be higher than those of the twins born ewe.

The first oestrus age for the Kıvrıcık, Sakız and Gökçeada breeds were found to be 315.13, 320.35 and 337.37 days, respectively, and the breeds that showed oestrus earlier displayed the same order as well. When the lambs were ranked according to first oestrus age based on

the dam age, ewes aged ≤ 3 years old displayed the earliest oestrus behavior and it was followed by the sheep aged 4-5 and ≥ 6 years old. The first oestrus age of the single born lambs was found to be smaller than those of the twins born lambs.

The effect of breed as a factor influencing the oestrus live weight of the lambs was found to be statistically significant ($P < 0.01$), but the effect of dam age and birth type were found to be insignificant. Similarly, the effect of breed, dam age and birth type on the first oestrus age was found to be insignificant.

In this study, the first oestrus live weights of Kıvrıcık, Sakız and Gökçeada sheep (37.93, 33.35 and 29.75 kg) were found to be lower than the reports by Dyrmondsson (1978) 39.00 kg, Urrutia et al. (1994) 42.60 kg, Saeid and Leroy (1997) 44.10 kg, Sezenler et al. (2009) 45.30 and 47.30 kg and Urrutia et al. (1998) 45.00 kg and higher than the findings reported by Boshoff et al. (1975) 24.80, 24.40 and 31.70 kg, Gonzales et al. (1980) 20.90 kg, Suleiman (1981) 20.60, 21.80 and 17.50 kg, Johnson et al. (1988) 19.10, 20.60, 23.40 and 20.80 kg, Velazquez et al. (1995) 28.90, 24.00, 26.50 and 27.70 kg and Mukasa et al. (1995) 16.90 kg for the different sheep breeds. Moreover, our results are in general agreement with the finding by Keane (1974) 33.00 kg, Kaymakçı (1984) 33.50, 32.00, 36.50 and 34.90 kg, Souza et al. (1995) 37.90 kg.

The results of this study for the first oestrus age of Kıvrıcık, Sakız and Gökçeada sheep (315.13, 320.35 and 337.37 day) are similar to those obtained by Velazquez et al. (1995) 311.30, 302.80, 261.30 and 329.00 days and were found to be higher than the reports by Keane (1974) 254 day, Boshoff (1975) 170, 163 and 224 days, Cedillo et al. (1977) 205 days, Dyrmondsson, (1978) 212.8 days, Cumlivski, (1979) 184, 185, 213, 210 and 270 days, Cumlivski (1980) 217.5 days, Gonzales et al. (1980) 286.2 days, Berger and Ginisty (1980) 250 days, Suleiman (1981) 194.9, 217 and 205.3 days, Boshoff (1984) 116 days, Kaymakçı (1984) 225.5, 217, 304.5, 301.2 and 289.8 days, Urrutia et al. (1994) 202.1 days, Polskaya et al. (1988) 240 and 270 days, Johnson et al. (1988) 283, 294, 310 and 266 days, Sousa et al. (1995) 281.8 days, Mukasa et al. (1995) 300 days, Saeid and Leroy (1997) 244.7 days, Bathei (1996) 212 days. On the other hand, they were found to be lower than Mehta et al. (1995) 18 months and Gaillard (1979) 351.4 days in different sheep breeds.

Table 1. Least square means and standard errors of sheep breeds first oestrus live weight and age of ewe lambs

Sources of Variation		First oestrus live weight (kg), Mean \pm SE	First oestrus age (day), Mean \pm SE
Breeds	n	**	NS
Kıvrıcık	15	37.93 \pm 1.022a	315.13 \pm 8.483
Sakız	8	33.35 \pm 1.518b	320.35 \pm 12.601
Gökçeada	10	29.75 \pm 1.263b	337.37 \pm 10.485
Age of Dame		N.S.	N.S.
≤ 3	12	32.46 \pm 1.152	323.48 \pm 9.564
4-5	13	35.63 \pm 1.475	323.88 \pm 12.247
≥ 6	8	32.93 \pm 1.331	325.48 \pm 11.051
Birth Type		NS	NS
Single	14	34.17 \pm 1.270	323.97 \pm 10.546
Twin	19	33.18 \pm 0.966	324.59 \pm 8.024
Mean	33	33.68 \pm 0.720	324.28 \pm 5.979

** : $P < 0.01$, * : $P < 0.05$, NS: Not Significant . a,b,c: Means followed by the same letter in the same column are not significantly different at $P < 0.05$.

The lengths of oestrus and oestrus cycles are given Table 2. The oestrus lengths were determined as 30.99, 25.85 and 20.28 hours for the Kıvrıkcık, Sakız and Gökçeada breeds, respectively. The longest oestrus length was found to be in the lambs of ewes aged ≤ 3 and this was followed by the lambs of ewes aged ≥ 6 and 4-5 years old. Single born lambs had longer oestrus length compared to twin born. The differences among the breeds in terms of oestrus length are significant ($P < 0.01$), however, the effect of the dam age and birth type was insignificant ($P > 0.05$)

The oestrus cycle lengths for Kıvrıkcık, Sakız and Gökçeada sheep breeds were 16.59, 17.91 and 17.76 days, respectively. The longest oestrus cycle (18.03 days) was seen in the lambs of ewes aged 4-5 years old, and it was followed by the lambs of ewes aged ≥ 6 and ≤ 3 years old. In terms of oestrus cycle length, single born lambs showed longer oestrus cycle compared to twin born lambs. In terms of oestrus cycle length, the effect of breed and birth type ($P < 0.01$) and also the effect of dam age were found to be significant ($P < 0.05$).

The oestrus length for the lambs of Kıvrıkcık, Sakız and Gökçeada sheep breeds were lower than the reports by Boshoff (1975) 36, 40.4 and 34.8 hours, Berger and Ginisty (1980) 36 hours, Boshoff (1984) 30, 36 hours, Aboul et al. (1984) 47, 37.7 and 37.5 hours, Toteda et al. (1987) 37.5, 37.7 and 47 hours, Mehta et al. (1995) 36 hours and Bathei (1996) 32.8 hours, and were found to be higher than those reported by Gaillard (1979) 18.4 hours and Sezenler et al. (2009) 19.4 and 21.2 hours. Also, they are similar to findings by Castillo et al. (1977) 29.7, 31.2 and 25.8 hours, Cumlivski (1979) 26, 27, 26, 26 and 28 hours, Cumlivski (1980) 26 hours, Gonzales et al. (1980) 26.7 hours and Kaymakçı (1984) 29.5, 34.8, 32, 28.6, 27.5 and 27.8 hours.

The values obtained for oestrus cycles length were higher than the results obtained by Cumlivski (1979), Gaillard (1979), Cumlivski (1980), Sabrh et al. (1992), Mehta et al. (1995) and Narayanaswamy (1976). Also, our the results are similar to findings of Berger and Ginisty (1980) 17.4 days, Gonzales et al. (1980) 17.6 days, Osterberg (1981) 18 days, Boshoff (1984) 17-18 days, Abaul et al. (1984) 17.4 and 17.02 days, Kaymakçı (1984) 15.7, 16.5, 17, 17.2, 16.4 and 17.5 days, Aboul et

al. (1985) 17.8, 17.6 and 17.1 days, Elias (1985) 17.6 and 16.6 days, Toteda (1987) 17.8, 17.6 and 17.1 days, Mukasa et al. (1995) 17.9 days, Rosenmoller (1996) 17 days and Sezenler et al. (2009) 16.12 and 17.07 days. The differences between results related to reproduction traits in this study and those from other studies may be due mainly to genetic factor such as breed and some environmental factors such as feeding level of ewes and lambs, pre- and post-weaning growth characteristic of lambs, pastures quality and the management conditions of the ewes and lambs.

Growth Traits

The live weights of Kıvrıkcık, Sakız and Gökçeada ewe lambs in different period are present Table 3. The birth weights (BW) were 3.64, 3.91 and 3.28 kg, the weaning weights (WW) were 31.01, 25.44 and 23.67 kg, the sixth month live weights (SMLW) were 32.87, 26.95 and 24.15 kg, yearling weights (YLW) were 39.01, 30.95 and 30.27 kg, the average daily weight gains (ADWG) were 0.271, 0.257 and 0.202 kg in Kıvrıkcık, Sakız and Gökçeada lambs, respectively. The effect of breed on the BW, WW, SMLW, YLW and ADWG were found to be significant ($P < 0.05$, $P < 0.01$) while the significant effect of dam age was observed only on YLW. The effect of birth type was significant only on BW, but it was insignificant on the other weight traits.

BW values were found to be similar or slightly higher than those obtained by Özder et al. (1999, 2004) 3.51 and 3.32 kg, Esen and Ay (2004) 3.10 kg, Ceyhan et al. (2004, 2007, 2009b) 3.49, 3.62 and 2.98 kg, Akçapınar et al. (2005) 3.6 kg, and Cemal et al. (2005) 3.41 kg, but they were found to be lower than the values obtained by Sezenler et al. (2009) 4.08 kg, Esen and Yıldız (2000) 4.01 kg, Akçapınar et al. (2000) 4.68, 4.57 and 4.51 kg, Ceyhan et al. (2010) 4.20 kg, Daşkıran et al. (2010) 4.43 kg and Koncağül et al. (2013).

The WW in this study were found to be higher than those obtained by the Özder et al. (1999, 2004) 19.35 and 19.89 kg, Akçapınar et al. (2000, 2005) 21.179 and 18.7 kg, Esen and Yıldız (2000) 20.88 kg, Sezenler et al. (2009) 32.70 kg, Ceyhan et al. (2007) and Koncağül et al. (2013) 22.1 kg, and found to be similar to or lower than Ceyhan et al. (2010) 34.31 and 26.94 kg and Ceyhan et al. (2009b) 24.89 kg.

Table 2. Least square means and standard errors of sheep breeds length of oestrus cycle and oestrus duration

Source of Variance		Oestrus Duration (hour), Mean \pm SE	Oestrus Cycle (day), Mean \pm SE
Breeds	n	**	**
Kıvrıkcık	15	30.99 \pm 1.457a	16.59 \pm 0.213b
Sakız	8	25.85 \pm 2.149ab	17.91 \pm 0.314a
Gökçeada	10	20.28 \pm 1.570b	17.76 \pm 0.230a
Ages of Dam		NS	*
≤ 3	12	26.63 \pm 1.615	17.02 \pm 0.236b
4-5	13	25.41 \pm 1.842	18.03 \pm 0.269a
≥ 6	8	25.08 \pm 1.850	17.21 \pm 0.271b
Birth Type		NS	**
Single	14	26.63 \pm 1.699	18.00 \pm 0.249 a
Twin	19	24.79 \pm 1.307	16.83 \pm 0.191 b
Mean	33	25.71 \pm 0.950	17.42 \pm 0.139

** : $P < 0.01$, * : $P < 0.05$, NS: Not Significant . a,b,c: Means followed by the same letter in the same column are not significantly different at $P < 0.05$.

Table 3. Least squares means and standard errors of lamb growth performance

Source of Variance		BW, Mean \pm SE	WW, Mean \pm SE	SMLW, Mean \pm SE	YLW, Mean \pm SE	ADWG, Mean \pm SE
Breeds	n	*	**	**	**	**
Kıvrıkcık	16	3.64 \pm 0.127ab	31.01 \pm 0.815a	32.87 \pm 0.924a	39.01 \pm 1.147a	0.271 \pm 0.007a
Sakız	12	3.91 \pm 0.163a	25.44 \pm 1.039b	26.95 \pm 1.179b	30.95 \pm 1.463b	0.257 \pm 0.009b
Gökçeada	11	3.28 \pm 0.153b	23.67 \pm 0.978b	24.15 \pm 1.109b	30.27 \pm 1.376b	0.202 \pm 0.008c
Ages of Dam		NS	NS	NS	*	NS
≤ 3	14	3.39 \pm 0.146	26.56 \pm 0.933	27.71 \pm 1.058	32.91 \pm 1.313ab	0.239 \pm 0.008
4-5	11	3.78 \pm 0.169	27.03 \pm 1.079	28.92 \pm 1.224	34.16 \pm 1.519a	0.257 \pm 0.009
≥ 6	14	3.66 \pm 0.145	26.54 \pm 0.928	27.34 \pm 1.052	33.15 \pm 1.306b	0.234 \pm 0.008
Birth Type		*	NS	NS	NS	NS
Single	17	3.78 \pm 0.138	27.49 \pm 0.885	28.34 \pm 1.004	32.76 \pm 1.246	0.248 \pm 0.007
Twin	22	3.44 \pm 0.115	25.94 \pm 0.734	27.64 \pm 0.832	34.06 \pm 1.033	0.238 \pm 0.006
Mean	39	3.61 \pm 0.082	26.71 \pm 0.526	27.99 \pm 0.597	33.41 \pm 0.740	0.243 \pm 0.004

** : P<0.01, * : P<0.05, NS: Not Significant . a,b,c: Means followed by the same letter in the same column are not significantly different at P<0.05, BW: Birth Weight, WW: Weaning Weight, SMLW: Six Months Live Weight, YLW: Yearling Live Weight, ADWG: Average Daily Weight Gain

The SMLWs are close to the findings obtained by Akçapınar et al. (2005) 27.0 kg, while they are lower than those reported by Sezenler et al., (2009) 41.90 kg, Ceyhan et al., (2004, 2007, 2009a, 2010) 33.158, 34.31, 34.96 and 33.21 kg, Akçapınar et al., (2000) 33.92, 32.31 and 31.78 kg, Daşkiran et al. (2010) 42.36 kg and Koncağül et al. (2013) 36.1 kg. On the other hand, YLWs were found to be lower than those reported by Sezenler et al. (2009) 45.42 kg, Ceyhan et al. (2007, 2009a) 39.52 and 41.14 kg. The ADWGs until weaning were found to be similar to those determined by Ceyhan et al. (2009a, 2010) 269.3 g and 270.1, and higher than those reported by Ceyhan et al. (2007) 210 g, Esen and Yıldız (2000) 160 g, and Tekin et al. (2005) 200 g/day. The differences between findings related to lamb growth traits in this study and those from other studies may be due to genetic and environmental factors such as breed, the milk yield of ewes, the lamb growth methods employed in the enterprise (farm), the suckling period, the type of birth and the sex of the lamb.

Conclusion

Reproductive Traits

It was found that the lambs of each of the three breeds reached puberty lower in terms of first oestrus live weight than those indicated in the literature, and they reached the first oestrus age later. The evaluation of the lengths of oestrus and oestrus cycle revealed that they are close to those indicated in the literature. As known, the sexual maturity varies according to age, breed and the level of care and nutrition. The results obtained for the first oestrus reproductive characteristics of the Kıvrıkcık, Sakız and Gökçeada breeds may be due to the fact that the maturity weights of the local breeds are relatively lower than those of the breeds used for comparisons and that they have different care and nutritional conditions as well as due to breed, age and sex.

Growth Traits

The differences observed in the growth characteristics of ewe lambs may be due to genetic and environmental factors such as breed, age of dam, birth type, management and care and nutritional conditions.

As a result, it was demonstrated that the first oestrus of the Kıvrıkcık, Sakız and Gökçeada breeds occurred during the first age of lambs. There are differences among the breeds in terms of the first oestrus live weight and that dam age and birth type has no effect on the first oestrus age and live weight.

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