

Hacer TÜFEKÇİ^{1*} , Hilal TOZLU ÇELİK² , Basak ÖZTEN³ 

¹ Yozgat Bozok University, Faculty of Agriculture, Animal Science Department, Yozgat, 66100, Türkiye

² Ordu University, Ulubey Vocational School, Department of Food Processing, Ordu, 52000, Türkiye

³ Yozgat Bozok University, Graduate Education Institute, Yozgat, 66100, Türkiye

Fertility and Lamb Growth Characteristics in Akkaraman Sheep: The Case of Çorum

ABSTRACT

Objective: This study aimed to determine the reproductive efficiency and lamb growth characteristics of Akkaraman sheep in Çorum province under breeder conditions.

Material and Methods: The animal material of the study consisted of 2214 Akkaraman sheep and 2508 Akkaraman lambs from three different farms located in the center of Çorum province. The study was conducted between 2019 and 2022. In the study, the reproductive characteristics of Akkaraman sheep and birth, weaning weights, and survival of lambs were determined.

Results: By the time they were 75 days old, the average weight of the lambs was 19.58 kg, compared to 4.15 kg at birth. Weaning and birth weights varied by sex, year, farm, and kind of birth ($P<0.001$). There were 94.1% of lambing rate, 79.5% of single birth rate, and 20.5% of twinning birth rate, respectively. The litter size at birth was 1.20, the female lamb ratio was 52.1%, and the male lamb ratio was 47.9%. The survival rate of lambs on the 75th-day varied according to sex, type of birth, years, and farms, and the average survival rate of lambs was 94%.

Conclusion: In summary, the results obtained concerning the growth characteristics and reproductive efficiency of Akkaraman sheep in the province of Çorum are consistent with those documented in the literature.

Keywords: Akkaraman sheep, growth characteristics, fertility, survivability

Akkaraman Koyununda Döl Verimi ve Kuzu Büyüme Özellikleri: Çorum Örneği

Öz

Amaç: Bu çalışma, Çorum ilindeki Akkaraman koyunlarının yetiştirici koşullarında döl verimi ve kuzu büyüme özelliklerinin belirlenmesini amaçlamıştır.

Materyal ve Method: Çalışmanın hayvan materyalini Çorum ili merkezinde bulunan üç farklı işletmeye ait 2214 baş Akkaraman koyunu ve 2508 baş Akkaraman kuzusu oluşturmuştur. Çalışma 2019-2022 yılları arasında gerçekleştirilmiştir. Çalışmada Akkaraman koyunlarında döl verimi özellikleri ile kuzularda doğum, süten kesim canlı ağırlıkları ve yaşama gücü belirlenmiştir.

Bulgular: Doğumda 4,15 kg olan kuzuların ortalama ağırlığı, 75 günlük olduklarında 19,58 kg olarak belirlenmiştir. Süten kesim ve doğum ağırlıkları cinsiyet, yıl, işletme ve doğum tipine göre farklılık göstermiştir ($P<0.001$). Kuzulama oranı %94,1, tek doğum oranı %79,5 ve ikiz doğum oranı %20,5 olarak bulunmuştur. Doğumda yavru sayısı 1,20, dişi kuzu oranı %52,1, erkek kuzu oranı ise %47,9 olarak bulunmuştur. Kuzuların 75. günde yaşama gücü cinsiyete, doğum tipine, yıllara ve işletmeye göre değişiklik gösterirken, kuzuların ortalama yaşama gücü oranı %94 olarak bulunmuştur.

Sonuç: Özetle, Çorum ilindeki Akkaraman koyunlarının büyüme özellikleri ve döl verimlerine ilişkin elde edilen sonuçlar literatürde yer alan sonuçlarla tutarlıdır.

Anahtar Kelimeler: Akkaraman koyunu, büyüme özellikleri, döl verimi, yaşama gücü



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INTRODUCTION

Sheep breeding is important in the world in terms of food production, livelihood, rural development and rural sociology, and utilization of poor pasture and fallow areas (Sakar, 2024). Sheep breeding has an important place in the world and in Türkiye since sheep meet most of their nutritional needs from pasture, have good adaptability and low cost (Baş-Ekici et al., 2024). Turkey is one of the largest sheep producers in the world, and its sheep production system is heavily dependent on domestic breeds (Aydin et al., 2024). With the biggest population of indigenous sheep, the fat-tailed Akkaraman breed of sheep is found throughout Central Anatolia (Kizilaslan et al., 2024a). The traits of the Akkaraman breed include its resistance to diseases and parasites, its capacity to survive and procreate in unfavorable environments, and its ability to feed on insufficient nutrients (Özmen et al., 2020; Kizilaslan et al., 2022a; Arzik et al., 2023).

The reproductive traits of sheep and the number of lambs obtained have a direct impact on the profitability and productivity of farms (Kizilaslan et al., 2024b). A lot of characteristics that affect sheep farming's potential to be sustainable economically have complicated and quantitative backgrounds (Vatankhah et al., 2008; Kizilaslan et al., 2022b). There are various approaches to defining the productivity life of animals in sheep breeding. Studies have shown that the average and total number of weaned lambs, as well as the total weight of weaned lambs per sheep, are important parameters of productivity and the main source of income in sheep farming (Duguma et al., 2002; Ekiz et al., 2005; Vatankhah, 2016; Jafaroghli et al., 2019). Due to their economic worth, which includes their ability to efficiently transform low-quality feed into high-quality meat, milk, and wool, small ruminant production has expanded by roughly one-third globally over the past ten years. Sheep farms have also experienced a period of growth worldwide (Kuba et al., 2015; FAO, 2023). Sheep are preferred in terms of being more abstinent, more resistant to adverse environmental conditions, able to meet their nutritional needs from nutrients with low cost and quality and can be raised in lower cost farms compared to other species that are cultivated for economic purposes (Köseman et al., 2022). The number of sheep in Türkiye increased from 23,089,691 heads in 2010 to 44,678,888 heads in 2022 (TÜİK, 2024). Many studies have been carried out within the scope of domestic sheep breeding projects in Türkiye (Oğrak, 2020; Çetin et al., 2021; Kutlu et al., 2022; Ünal et al., 2022; Aksoy et al., 2023; Noyan and Ceyhan, 2023; Şirin, 2023; Ünal and Dellal, 2023). It can be said that these studies have contributed to the development of the breed, an increase in yield and number, as well as many positive results in sheep breeding in Türkiye. In Çorum province, where the Akkaraman breed is widely practiced, the sheep population was 110.843 heads in 2010 and increased to 228.672 heads in 2022 (TÜİK, 2024). Çorum province is located in the Black Sea region, ranks 3rd in the Black Sea region (2.261.719 sheep) in terms of sheep existence (226.890 sheep), and has 10.3% of the sheep existence in the region (Kandemir and Taşkın, 2022). According to these figures, Çorum province has a large sheep breeding industry. Sheep raising is one of the animal breeding industries in rural areas that provides income. It is crucial to do research for the enhancement and sustainability of sheep breeding in the province of Çorum. This study was carried out to determine the reproductive efficiency of Akkaraman sheep breed and some growth characteristics of lambs under breeder conditions in Çorum province.

MATERIAL and METHODS

Animal Material

The data of a total of 2214 Akkaraman sheep and 2508 Akkaraman lambs between 2019-2022 were evaluated in three different farms in Çorum province. Farms with similar care and feeding conditions were selected for the study. The data of lambs born to sheep of similar age (2-4 years) and live weight (average 45-50 kg) were evaluated. Each farm in the study has an average of 170-200 sheep.

Study Area

Located in the interior of the Central Black Sea region, Çorum is situated between 34 degrees 5 minutes east longitude and 39 degrees 54 minutes north latitude. It is surrounded by Amasya in the east, Yozgat in the south, Çankırı in the west, Sinop in the north, Samsun in the northeast, and Kırıkkale in the southwest. Its surface area is 12820 km² and its height above sea level is 801 meters. Çorum is located on the transition from the Black Sea climate to the Central Anatolian climate. In general, summers are hot and dry, and winters are cold and rainy. The hottest months in Çorum, which has a short spring and a long autumn, are July–August, and the coldest months are January–February. The climate becomes harsher from north to south (Anonymous, 2024).



Method

The research was conducted in 2019-2020-2021-2022 and all animals suitable for the study in the farms were included in the study. No intervention was made to the care and feeding conditions in the farms. In the farms, sheep were generally fed in the barn in winter and in the pasture in early spring and autumn. In pasture feeding, animals go out to pasture between March and April and are kept in pasture until November. Pastures are generally of poor or medium quality. During the summer period, hay and wheat straw were stored at an appropriate cost and amount for pen feeding during the winter and barley and concentrate feed were used as feed materials in addition to roughage. The amount of feed was roughly determined and distributed to the feeders and the mixing process was carried out in the feeders. In general, wheat straw (500–1000 kg), barley crumbs (300–400 g), and concentrate feed (200–300 g) were fed. Rams were given an additional feeding (750–850 g of concentrate feed containing 2700 kcal/kg metabolic energy and 16% crude protein) before ram siring, while sheep were grazed only on pasture. Ram mating was carried out between September 15 and October 15 by the free mating method. Lambing took place between February and March. The birth weights, date of birth, birth type, and sex of the lambs were recorded within the first 24 hours.

Lambs were left with their mothers for 2-3 days after birth. Then they were separated from their mothers and suckled 3 times a day in the first month, 2 times a day in the second month and 1 time a day in the third month. The lambs were given dry grass and approximately 150-200 g of concentrate feed per lamb from the second week onwards. Lambs were grazed on pasture during the weaning period when they were separated from their mothers, after weaning (75th-day) lambs were grazed on pasture and no additional feeding was given. The animal materials used in the study were vaccinated against internal and external parasites as well as foot and mouth, smallpox, enterotoxaemia and brucella vaccines.

During the study, number of sheep giving twin births, number of lambs born female, number of lambs born male, total number of lambs born, lambing rate, single birth rate, twinning birth rate, and litter size at birth were recorded to determine the reproductive characteristics of sheep. In addition, birth and weaning weight data were taken to determine the growth characteristics of lambs. Data on reproductive traits were calculated according to the methods reported by Kaymakçı (2006). The live weights of lambs at birth and weaning were determined by weighing them with a precision scale of to 50 g.

Data Analyses

In the evaluation of the data, the Kolmogorov-Smirnov test was applied for the normality test and it was determined that the traits were compatible with a normal distribution ($P>0.05$). According to the results of Levene's test, the variances were homogeneous ($P>0.05$). Year of birth, type of birth, sex, and farm were included in the model as effective factors on live weight, and the Duncan multiple comparison test was applied in groups with more than two differences (SPSS, 2016). The effects of the factors on the growth performance of lambs were calculated using the following mathematical model.

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

Y_{ij} : Live weight of lamb

μ : Expected mean

a_i : Impact of farm

b_j : Effect of birth year

c_k : Effect of birth type

d_l : Effect of sex

e_{ijkl} : Error

RESULTS and DISCUSSION

Data on the fertility of Akkaraman sheep are given in Table 1. According to the data obtained from 2019 to 2022, it is seen that the number of sheep breed, number of sheep lambing, the number of lambs born female, the number of lambs born male, and the total number of lambs born are similar. The lambing and twinning birth



rate have increased in recent years. The average lambing in 2019-2022 was 94.0%, with single birth rate of 79.5%, twinning birth rate of 20.5%, litter size of 1.20, a female lamb birth rate of 52.1%, and a male lamb birth rate of 47.9%. It was observed that the parameters analyzed in the study were similar in terms of years. Akçapınar et al. (2000) aimed to develop mother and father lines suitable for lamb production by using different breeds in their study. As a result of the study, it was reported that the birth rate, which is important in terms of fertility, was found to be 93.63%, 86.32% and 80.77% in Akkaraman sheep crossed with Akkaraman, Sakız and Kıvrıkcık rams according to the average of the first and second years, respectively. The (Akkaraman x Akkaraman) birth rate data obtained in this study are similar to the results of our study. In a study conducted in Yozgat province, the lambing rate of Akkaraman sheep was 95.8%, the twin birth rate was 21.8%, and litter size was 1.22 (Tüfekci, 2023). In a study conducted on Akkaraman sheep in Tokat province, the lambing rate was reported at 85%, and litter size at birth was 1.05 (Şirin, 2023). In Akkaraman sheep reared in Çaldıran, Van, birth, single birth, twin birth, and litter size were determined as 89.88%, 96.25%, 3.75%, and 1.03, respectively (Türkmen and Çak, 2021). In the study conducted in Sivas province, the average birth rate of Akkaraman sheep was 92.7%; the differences between years were statistically significant, and the differences between districts were found to be insignificant. While the average twin birth rate in Sivas province was 22%, the differences between years, districts, and mating season (five months between August and December) were significant, and litter size was 1.22. It was also reported that while the general average of weaned lamb rate or weaning period survival rate, which is one of the measures of reproductive efficiency, was 91.3%, the differences between years, districts, and lamb birth time (five months between January and May) were statistically significant (Oğrak, 2020). The findings of this study were similar to those reported by Tüfekci (2023) and Oğrak (2020), but different from those reported by Şirin (2023) and Türkmen and Çak (2021). Aktaş et al. (2015) stated in their study that better reproductive performance and higher profitability can be achieved by increasing the prepartum weight of sheep through improved feeding strategies, and emphasized the importance of this situation especially for sheep raised under poor nutritional conditions and sheep that will give birth for the first time.

Table 1. Fertility characteristics of Akkaraman sheep

Çizelge 1. Akkaraman Koyunlarında döl verim özellikleri

	2019	2020	2021	2022	Overall
Number of sheep bred	585	524	551	554	2214
Number of sheep lambing	548	492	519	523	2082
Number of single-born sheep	433	395	424	404	1656
Number of twin-born sheep	115	97	95	119	426
Number of lambs born female	353	311	314	329	1307
Number of lambs born male	310	278	300	313	1201
Total number of lambs born	663	589	614	642	2508
Lambing rate %	93.7	93.9	94.2	94.4	94.0
Single birth rate %	79.1	80.3	81.7	77.3	79.5
Twinning lamb rate %	20.9	19.7	18.3	22.7	20.5
Litter size	1.21	1.20	1.18	1.23	1.20
Female lamb birth rate %	53.2	52.8	51.1	51.2	52.1
Male lamb birth rate %	46.8	47.2	48.9	48.8	47.9

In the study, the effects of farm, year, type of birth and sex on birth and weaning live weight were analyzed and the results are given in Table 2. It was determined that the birth weight and weaning weight (75 th-day weight) of lambs differed significantly between farms ($P<0.001$). The birth and weaning weight (3.83 kg, 19.03 kg) of lambs in the first farm were lower than the second (4.30 kg, 19.70 kg) and third (4.32 kg, 20.02 kg) farms. Lamb birth and weaning weight were significantly different between years only for lambs born in 2020 compared to other years ($P<0.001$). The effect of birth type and sex on birth and weaning weight was significant ($P<0.001$). Birth and weaning weight of females were lower than male lambs. The birth and weaning weight of singletons were higher than twins (Figure 1).



Table 2. The effect of farm, year, type of birth, and sex on birth and weaning weight in Akkaraman sheep

Çizelge 2. Akkaraman koyunlarında işletme, yıl, doğum tipi, cinsiyetin doğum ve süttten kesim ağırlığına etkisi

Factors	n	Birth weight (kg) $\bar{x} \pm SX$	n	Weaning weight (kg) $\bar{x} \pm SX$
Overall	2508	4.15±0.045	2362	19.58±0.10
Farm				
1	993	3.83±0.07 ^b	948	19.03±0.03 ^a
2	791	4.30±0.72 ^a	742	19.70±0.12 ^a
3	724	4.32±0.56 ^a	672	20.02±0.21 ^b
p		<0.001		<0.001
Year				
2019	660	4.21±0.26 ^a	627	20.11±0.17 ^b
2020	597	4.03±0.47 ^b	559	19.13±0.09 ^a
2021	624	4.14±0.08 ^a	587	19.44±0.16 ^a
2022	627	4.23±0.01 ^a	589	19.73±0.02 ^a
p		<0.001		<0.001
Birth type				
Single	1656	4.28±0.81	1614	20.08±0.14
Twin	852	3.61±0.89	748	18.71±0.32
p		<0.001		<0.001
Sex				
Female	1307	3.87±0.38	1224	19.51±0.18
Male	1201	4.37±0.64	1138	20.25±0.32
p		<0.001		<0.001

a,b: Values in the same column with different letters indicate statistical differences.

When Figure 2 is analyzed, it is seen that the average survival rate of lambs is 94%, male lambs have a higher survival rate than female lambs, and singletons have a higher survival rate than twins on the 75th-day. It is seen that the survival power of lambs born in the third farm is lower than that of the other farms. When the years are analyzed, it is seen that the 75th-day survival of lambs born in 2020 is lower than the other years. This situation may be due to the deficiencies in care and feeding due to the COVID-19 pandemic in 2020.

In the study, it was determined that lamb mortality was generally caused by inadequate care-feeding at birth and in the first week following birth and the adverse effects of a cold climate.

Lamb deaths caused by bacterial diarrhea towards the end of the neonatal period have also occurred, although to a lesser extent. The environment has a significant effect on the survival of newborns. Lambs are very sensitive to cold and a significant part of the mortality in the early postnatal period occurs due to this (Aydoğdu, 2016). It is known that lambs with slightly lower birth weights may be at greater risk during this period. Low temperatures, failures in colostrum intake and multiple births may result in unfavorable conditions, particularly for low-birth-weight lambs (Daş and Savaş, 2002). It is reported that the risk of death due to hypothermia in lambs with a low birth weight is approximately two times higher than in lambs with a high live weight (Nash et al., 1996). The results of the study are consistent with the literature reports.

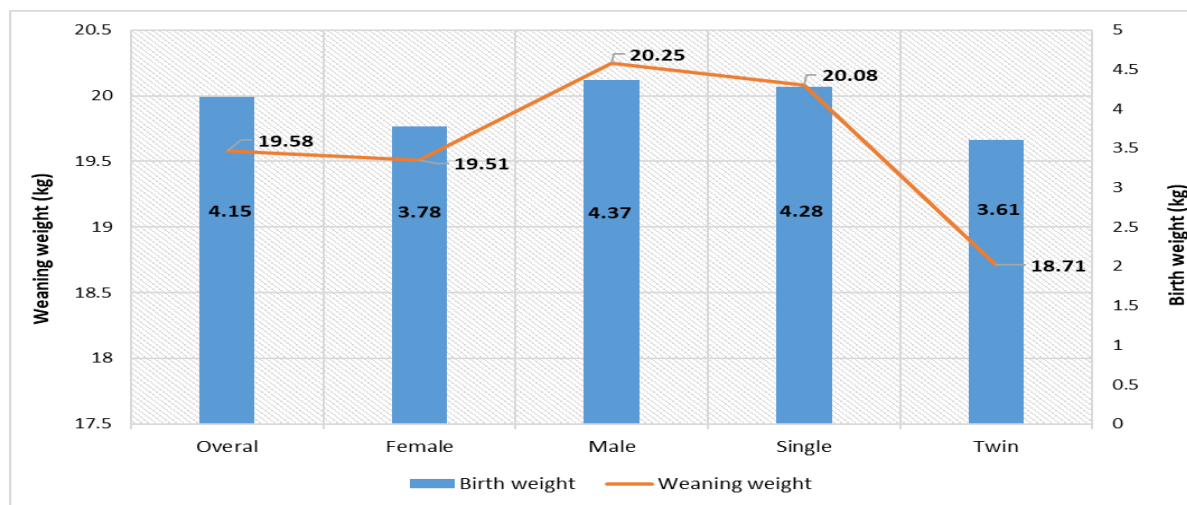


Figure 1. Live weights of lambs at birth and weaning

Şekil 1. Kuzuların doğum ve süttten kesimdeki canlı ağırlıkları

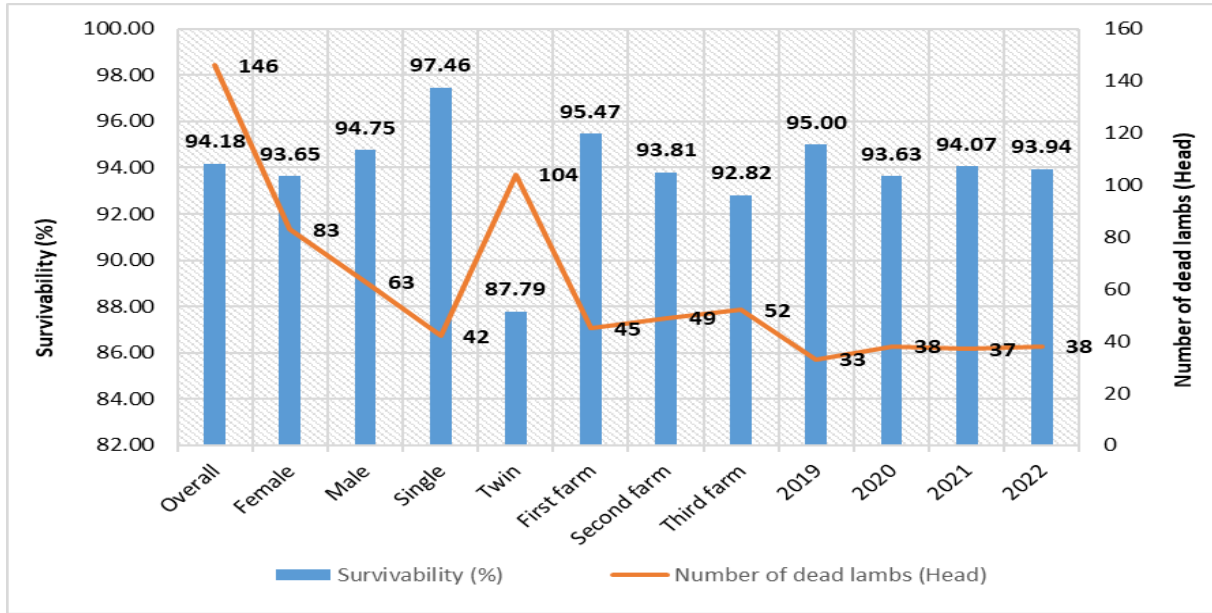


Figure 2. 75th-day survivability rate of lambs

Şekil 2. Kuzulara ait 75. gün yaşama gücü

In a study conducted in Yozgat province, the birth weight of Akkaraman lambs was 3.71 kg, the 60th-day live weight was 15.54 kg, and survival was 97.6% (Tüfekci, 2023). The birth weight (4.15 kg) and 75th day live weight (19.58 kg) of Akkaraman lambs were higher than the values reported by Tüfekci (2023), while the 75th-day survival (94%) values of the same study were similar to the results of the study. In the study conducted in Akkaraman sheep in Tokat province, the average birth weight of lambs was 4.14 kg, the average weaning weight (90th day) was 30.85 kg, and the survival rate of lambs was 93%. The survival rate of lambs was determined to be 93%. In the same study, it was reported that average birth and weaning weights differed according to year, dam age, type of birth, and sex ($P < 0.01$) (Şirin, 2023). The birth, 60th, and 90th day live weight values of Akkaraman lambs raised in Çaldıran, Van were 4.29, 14.44, and 19.69 kg, respectively. In the same study, the 60th and 90th-day survival values of Akkaraman lambs were reported as 96.38 and 95.92, respectively (Türkmen and Çak, 2021). In a study conducted under semi-intensive conditions in Niğde province, the average birth and 90th day live weight of Akkaraman lambs were determined to be 4.07 kg and 24.18 kg, respectively. According to reports, there were notable differences in the birth weights and 90-day live weights of lambs depending on the year, age of the dam, flock, manner of birth, and sex (Noyan and Ceyhan, 2021). Similar results were found for lamb birth weight and survival as reported by Şirin (2023). The differences between the literature reports and study results may be due to feeding and breeding practices.

Akçapınar et al. (2000) reported the birth weight of Akkaraman lambs as 4.83 kg and found the effect of sex and type of birth to be significant. The data obtained in the study were lower than the lamb birth weight reported by Akçapınar et al. (2000). In the study conducted by Yağcı et al. (2018) in Şavak Akkaraman lambs under breeder conditions, the average birth weight of 3.43 kg calculated from a total of 28374 records taken under supervision in a 5-year period was found to be lower than the results of our study (4.15 kg). Kırdag (2019) found that the difference in time-dependent changes in terms of barn and outdoor temperature in live weight gain in Akkaraman female lambs was statistically significant ($P < 0.001$). Firdolaş (2022), in his study which aimed to compile the studies in which survival and growth and development characteristics of Akkaraman and Lalahan sheep were examined, reported that live weight and live weight gain are important criterion in almost every period to follow the growth and development of farm animals. In addition, in their study, it was reported that there was a wide variation in Akkaraman and Kıvırcık breeds due to reasons such as care and feeding and individual differences when the growth and development characteristics of lambs and fertility, which is the most important fertility parameter in sheep breeding, were considered.



CONCLUSION

As a result of the study, it was determined that the twinning birth rate, offspring development, and survival of Akkaraman sheep in Çorum province were high. It was observed that lambing rate and twinning rate increased in Akkaraman sheep according to years. In conclusion, the findings obtained in terms of reproductive efficiency and growth characteristics of Akkaraman sheep in Çorum province are similar to the literature reports. The current climatic conditions and geographical structure of Çorum province are suitable for sheep breeding. However, more studies should be conducted on Akkaraman sheep in Çorum for sustainable sheep breeding.

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Data availability: Data will be made available upon reasonable request.

Author contributions*: Conception and design of the study: HT, HTÇ, BÖ; sample collection: BÖ, HT, HTÇ; analysis and interpretation of data: HT, HTÇ, BÖ; statistical analysis: HT, HTÇ, BÖ; visualization: HTÇ, HT, BÖ; writing manuscript: HT, HTÇ, BÖ.

Competing interests.: There is no conflict of interest between the authors in this study

Ethical statement: All researchers declared it that "all animal procedures were conducted in accordance with EU Directive for animal experiments (European Union, 2010), ARRIVE guidelines (Kilkenny et al., 2010) and national regulation on the protection of experimental animals used for experimental "

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