Improvement of reproductive and growth characteristics of local hair goats raised in extensive system in Kahramanmaraş province

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Abstract

This study aims to ensure the profitability of the enterprise and the sustainability of production by increasing the number of populations with high breeding value in Hair goat farms producing under extensive conditions. For this purpose, the reproductive criteria for the goats were determined and data on growth performance and survival rate of the kids were recorded on an annual basis. The current study was started in 2018 with 5175 female goats and 257 male goats with the voluntary participation of 26 breeders of hair goats in Dulkadiroğlu district of Kahramanmaraş province and was conducted over five years. The morphological characteristics of the hair goat breed and the birth and weaning weights of the kids were taken into account when selecting the breeding stock to be included in the herd each year. Approximately 10% of the male kids and 50% of the female kids with the best growth and breeding characteristics were selected for breeding. At the end of the study, the birth rate was found to be between 49.77 and 63.75%, the twinning rate was between 18.33 and 25.98%, prolificacy was between 58.90 and 80.08% and the litter size was between 1.18 and 1.26. The birth weight of the kids was found to be between 2.97 kg and 3.11 kg, the weaning weight were between 11.30 kg and 14.96 kg, the daily body weight gain to weaning age were between 92.54 and 131.64 g and the survival rate was between 91.89% and 95.68%. Based on these results, it was found that the differences in the growth traits of the kids according to year were significant ($P<0.001$). It was also found that the growth performance of male and single-born kids were significantly higher than those of female and twin-born kids depending on sex and birth type ($P<0.001$). As a result, it was found that keeping records based on some performance values in production with local genetic resources grown in an extensive system and keeping offspring with high breeding value in the herd based on these records helps to increase production performance due to the improvement of genetic structure.

Keywords: Hair goat, Breeding, Reproductive criteria, Growth performance, Survival rate

INTRODUCTION

Goats, bred in a very wide world geography, have been an important source of food and consumption throughout human history. As land and climatic conditions become difficult, goats are becoming one of the most important sources of income for the poor, and their breeding is practiced in traditional production methods and under extensive conditions (Gökdal et al., 2013). When considering the goat population in Türkiye over the last 20 years, it can be seen that the goat population, which was around 7 million animals in 2001, showed a declining trend between 2001 and 2010, but increased again between 2010 and 2024, reaching around 10.5 million animals today (TÜİK, 2024). In Türkiye, animal production is not sufficient to meet the food needs of the constantly growing human population. This situation is also reflected in the recent rise in meat prices. It is necessary to maximize the use of all types of livestock that are a source of human nutrition. Among these resources, Hair goat

breeding has an important place in livestock production with a share of about 96% of the Turkish goat population, which is active in almost all regions of Türkiye. The most important factors for the spread of Hair goats throughout Türkiye include adaptability to all kinds of climatic and terrain conditions in Anatolia, ability to be raised under inadequate care and feeding conditions, strong physique, resistance to diseases and resistance to heat and cold (Koluman et al., 2024). It is also a very valuable breed when it comes to converting plant products and/or waste into valuable animal foods. It is grown almost inexpensively on heaths, shrubs, forest pastures, stubble and fallow grasses in villages and hamlets in and near forests at high altitudes. However, since Hair goat breeding in Türkiye is mainly practiced in rural areas and under an extensive production model, the yield of the goats remains low (Koluman et al., 2024). The value of Hair goats in the national dimension is important and there is a need for studies to improve their yield characteristics. Therefore, the number of studies on increasing the meat and milk yield of herds reared under extensive conditions in Turkey has increased in recent years. In this context, the present breeding study conducted in the province of Kahramanmaraş for hair goats, which are reared under extensive conditions in rural areas and represent an important genetic resource for Turkey, is important. The Mediterranean region, where Kahramanmaraş province is located, is the most important goat breeding region of Türkiye due to its mountainous landscape and climatic characteristics, and the proportion of Hair goats in the goat population is about 27-28% (Ertuğrul et al., 2000; Koluman et al., 2024).

The aim of this study was to increase the yield by creating an elite herd with high breeding value through selection from the existing Hair goats raised by the farmer and to increase the profitability of the enterprise accordingly.

MATERIALS AND METHODS

Publication authorization for this study was obtained from the Directorate-General for Agricultural Research and Policy byletter dated 24.05.2024 and numbered 14390928. The current study on Hair goats was started in 2018 in the province of Kahramanmaraş in the Eastern Mediterranean with 5175 animals of female goats and 257 male animals of breeding goats and continued for five years. For this purpose, 26 Hair goat breeders registered in the database of Sheep and Goat Breeders Association and breeding in extensive production system were voluntarily selected to represent Dulkadiroğlu district of Kahramanmaraş province. Accordingly, the present study was conducted in 10 neighborhoods of Dulkadiroğlu district (latitude: 37.5833; longitude: 36.9333) of Kahramanmaraş province (Figure 1). The region where the study was conducted reflects the climatic conditions of the Mediterranean region with hot and dry climate conditions in summer and mild and rainy climate conditions in winter.
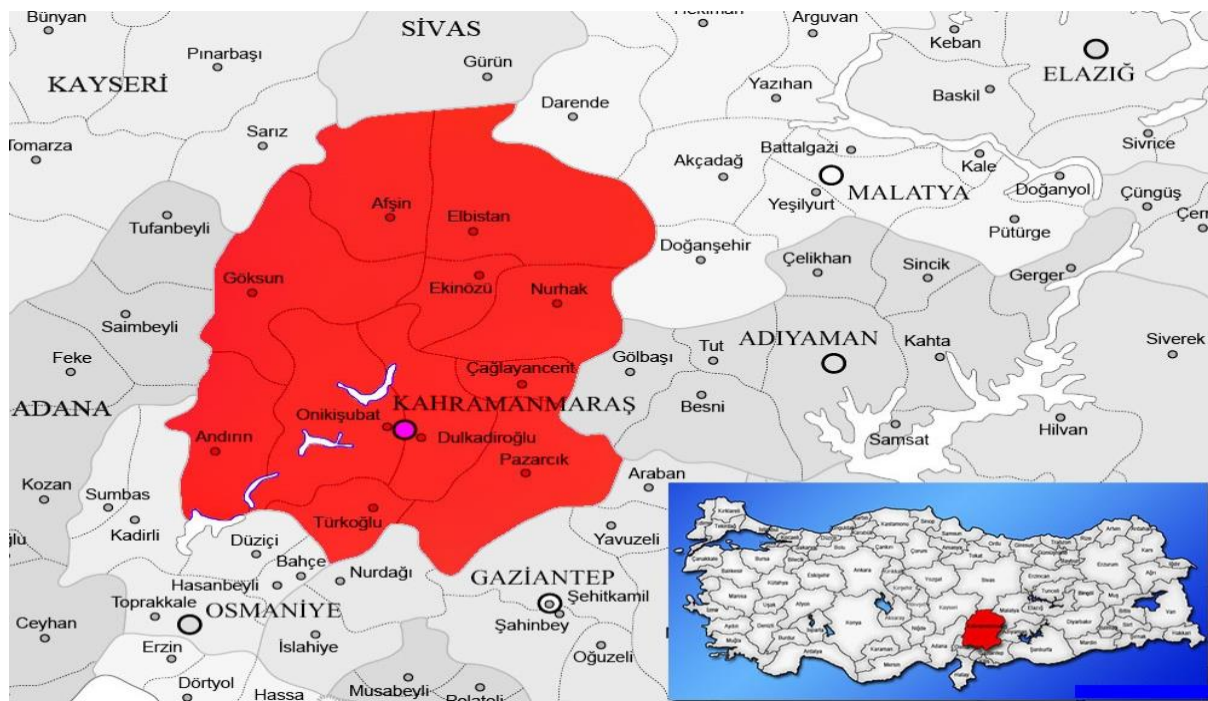

Figure 1. Map image of Kahramanmaraş Dulkadiroğlu district

Table 1 shows the number of neighborhoods and animals identified for the study in the Dulkadiroğlu district. In the production herds on the farms, the mating process was conducted by free mating, resulting in a ratio of one male for every 25 females. The female members of the herd remained in the population until they were no longer

fertile, while the males were replaced every two years when the first offspring of their sons reached sexual maturity. Surplus male offspring and bucks that had spent two years in the herd were sold that year.

Table 1. Number of neighborhoods and animals identified for the study in the Dulkadiroğlu district

District	Neighborhoods	Number of breeder	Number of does	Number of bucks
Dulkadiroğlu	Budaklı	10	2190	109
Dulkadiroğlu	Başdervişli	2	260	13
Dulkadiroğlu	Hacıeyüpoğlu	1	330	17
Dulkadiroğlu	Bahçeli	2	475	23
Dulkadiroğlu	Eyüpsultan	2	380	19
Dulkadiroğlu	Bulanık	2	400	20
Dulkadiroğlu	Kuzucak	4	650	32
Dulkadiroğlu	Dereköy	1	140	7
Dulkadiroğlu	Dereli	1	130	6
Dulkadiroğlu	Elmalar	1	220	11
Total		26	5175	257

While the male breeding animals were exchanged among the farmers, the remaining male kids were fattened and sold. The goats were mated according to the breeding plan determined by the breeders. However, the bucks were only brought together with the does during the planned mating season, which lasted from August to September. In this way, the reproductive capacity of the bucks could be optimally utilized. After recording some reproductive criteria after birth in all herds between 2018-2022 on the farms, performance data such as birth weight, mortality rate and weaning weight were measured. After the colostrum consumption of the born kids was ensured, the birth weight was recorded by the breeders using a digital scale. While the birth records were taken, the sex, birth type and birth dates of the kids were also recorded. The weaning weights of the kids were made when they were 135 days old on average. The 135th day live weights of all kids were calculated individually using the interpolation method, based on the daily body weight gain they gained between birth and the second weighing. The daily body weight gain was found by dividing the total weight gain between the two weighings by the age on the weighing day. The survival rate of the kids was calculated by dividing the number of kids who survived to weaning age by the number of kids born alive. Breeding animals were selected according to the needs of the farm, taking into account descriptive traits such as morphological traits and some performance data of the kids. In accordance with the above criteria, approximately 10 percent of the males and 50 percent of the females with the most optimal growth and reproductive traits were selected as core herds. In addition, to investigate the reproductive criteria, the following formulas were used to calculate kidding rate (%), twinning rate (%), litter size and prolificacy (%).

Birth rate = (Number of does kidding/Number of mated does) x100

Twinning rate = (Number of twin births/Number of does kidding) x 100

Litter size = Number of born kids/Number of does kidding

Prolificacy = (Number of born kids/Number of mated does) x 100

On all farms, the animals were fed around 500-600 g of concentrated feed and around 1000-1100 g of low-quality roughage per animal per day for three months during the winter months. In the other seasons, the animals were fed on pasture for nine months. The study data were analyzed using the SPSS package program (SPSS, 2021) and the mean values of two groups were compared using the t-test. A one-way ANOVA test was used to compare the means of more than two groups. The mathematical model of the one-way ANOVA is as follows. A comparison of the differences between the groups was conducted using the Duncan test. Data were summarized as mean and standard error. All tests were performed with a statistical significance level of 0.05.

$$Y_{ij} = \mu + \alpha_i + e_{ij} \quad i = 1, 2, \ldots, t \quad j = 1, 2, \ldots, r$$

Where μ is the mean effect, αi is the ith year effect, t is number of treatment, r is the number of replications, eij is the error term (Montgomery, 2001).

RESULTS AND DISCUSSION
Reproductive Characteristics in the Hair Goats

The results on the reproductive traits of Hair goats are presented in Table 2 according to the years in which the data were collected. The results on reproductive traits showed a birth rate of 49.77 to 63.75%, a twinning rate of 18.33 to 25.98%, prolificacy of 58.90 to 80.08% and a litter size of 1.18 to 1.26%. When examining the reproductive perfomance of goats, an improvement was recorded in all subsequent years compared to the first year of the study.

Table 2. Reproductive characteristics of Hair goats by year

Reproductive characteristics	Years				
	2018	2019	2020	2021	2022
Number of mated does	4800	4805	4795	5175	5175
Number of given birth does	2389	3011	3048	3201	3299
Number of twin births	438	610	792	752	796
Number of born kids	2827	3621	3840	3953	4095
Birth rate (%)	49.77	62.66	63.57	61.86	63.75
Twinning rate (%)	18.33	20.26	25.98	23.49	24.13
Prolificacy (%)	58.90	75.36	80.08	76.39	79.13
Litter size	1.18	1.20	1.26	1.23	1.24

In some studies on Hair goats, the birth rate was reported as 79.00% by Şengonca et al. (2003), 82.93% by Tozlu (2006), 90.00% by Şimşek et al. (2006), 80.00% by Erişir and Gürdoğan (2004) and 85.89% by Erten and Yılmaz (2013). On the other hand, Prolificacy was reported as 100.00% by Çam et al. (2003), 79.00% by Şengonca et al. (2003), 116.00% by Erişir and Gürdoğan (2004), 103.00% by Tozlu (2006), 118.00% by Şimşek et al. (2006), 96.27% by Oral and Altınel (2006) and 101.28% by Erten and Yılmaz (2013). In the present study, the birth rate and prolificacy were found to be low compared to the literature. This result shows that goats on the farms not become pregnant at a significant rate as a result of mating. It is thought that this situation is due to the fact that farms operating in the extensive system in rural areas do not apply the selection and elimination practices that should be carried out each year in about 20-22%. In the following years of the study, however, by eliminating animals that had lost their reproductive and selecting offspring from dam goat with high breeding value for the herd, improvement in the birth rate and prolificacy was achieved. The twin birth rate was reported as 32.56% by Erişir and Gürdoğan (2004), 17.65% by Tozlu (2006) and 17.91% by Erten and Yılmaz (2013). The results of the current study in terms of twin birth rate are largely consistent with the literature, although an increase was observed in all other years compared to the beginning of the study. Litter size was reported as 1.43 by Özcan (1977), 1.17 by Tozlu (2006), 1.41 by Şimşek et al. (2006) and 1.18 by Erten and Yılmaz (2013). In the current study, the litter size was found to be within the literature limits, lower than the results of Özcan (1977) and Şimşek et al. (2006) but higher than the results of the studies conducted by Tozlu (2006) and Erten and Yılmaz (2013). Although it is assumed that the reproductive performance of these goats reared in the extensive system is lower than that in the intensive farms, it has been shown that the reproductive performance of the Hair goats reared in farmer condition will increase with the effect of the breeding program carried out.

Growth characteristics and survival rate of hair goat kids by year

Birth weight, weaning weight, daily body weight gain to weaning and survival rates were recorded for five years in relation to growth characteristics of female and male kids (Table 3). Accordingly, the birth weights of the kids ranged from 2.97 kg to 3.11 kg, weaning weights ranged from 11.30 kg to 14.96 kg, daily body weight gain ranged from 92.54 to 131.64 g and survival rate to weaning ranged from 91.89 to 95.68%. The observed differences in the growth-related performance values of the Hair goat kids were significant depending on the year (P<0.001).

Table 3. Growth characteristics of Hair goat kids

Years	Birth weight (kg)	Weaning weight (kg)	Daily body weight gain (g)	Survival rate (%)
2018	2.97±0.01[a]	11.30±0.09[a]	92.54±0.96[a]	91.89
2019	2.99±0.01[a]	12.14±0.08[b]	101.68±0.86[b]	95.36
2020	3.03±0.01[b]	14.86±0.07[d]	131.50±0.83[d]	95.68
2021	3.10±0.01[c]	13.11±0.8[c]	111.18±0.86[c]	94.46
2022	3.11±0.01[c]	14.96±0.5[d]	131.64±0.51[d]	94.11
P value	P<0.001	P<0.001	P<0.001	-

In some studies, the birth weight of Hair goat kids was reported as 3.89 kg by Darcan (2000), 2.60 kg by Öztürk (2000), 3.80 kg by Daş and Savaş (2002), 2.70 kg by Çam et al. (2003), 2.63 kg by Şengonca et al (2003), 2.99 kg by Şimşek (2005), 3.31 kg by Karadağ (2006), 3.72 kg by Tozlu (2006), 2.58 kg by Oral and Altınel (2006), 2.18 kg by Şimşek et al. (2006), 3.12 kg by Atay et al. (2010), 3.01 kg by Erten and Yılmaz (2013), 2.75 kg by Gökdal et al. (2013), 3.70 kg by Çelik and Olfaz (2018) and 3.11 kg by Alşahan and Öztürk (2019). The results of this study are within the scope of the literature results and are similar to the results of the studies of Alşahan and Öztürk (2019) and Atay et al (2010). In addition, it was found to be lower than the results of the studies of Darcan (2000), Daş and Savaş (2002), Karadağ (2006), Çelik and Olfaz (2018) and Tozlu (2006) and higher than the results of other studies. The weaning weights of three-month-old kids were reported as 11.84 kg by Cengiz et al (1995), 18.00 kg by Darcan (2000), 13.70 kg by Çam et al (2003), 17.77 kg by Şimşek (2005), 13.58 kg by Oral and Altınel (2006), 16.0 kg by Tozlu (2006), 16.05 kg by Şimşek and Bayraktar (2007), 17.02 kg by Erduran and

Yaman (2012) and 12.32 kg by Erten and Yılmaz (2013). In this study, weaning weights of kids were lower than the results of the studies by Darcan (2000), Şimşek (2005), Tozlu (2006), Şimşek and Bayraktar (2007) and Erduran and Yaman (2012), but similar to the results of other studies. The survival rate of Hair goat kids to weaning reported 93.34% by Eser (1998), 78.16% by Odabaşıoğlu and Altın (1992), 78.61% by Şengonca et al (2003), 93.3% by Çam et al (2003), 82% by Şimşek (2005), 88.11% by Tozlu (2006), 95.44% by Oral and Altınel (2006), 90.62% by Şimşek and Bayraktar (2007), 80.00% by Erduran and Yaman (2012), 89.87% by Erten and Yılmaz (2013), 89.27% by Tekin and Arlı (2019), 94.91% by Elmaz et al. (2020), 95.7% by Ceyhan et al. (2022) and 93.48% by Alkkonyak and Güngör (2022). In the present study, the survival rate was higher than in Odabaşıoğlu and Altın (1992), Şengonca et al. (2003), Şimşek (2005), Tozlu (2006), Erduran and Yaman (2012), Erten and Yılmaz (2013), Tekin and Arlı (2019), but it was similar to the results of other researchers. The growth performance and survival rates of the kids generally improved in the later years compared to the year in which the study began. This situation can be explained by the fact that the offspring of breeding animals with high reproductive are kept in the herd by the breeders. However, it should be noted that this method does not directly reflect the relationship between the genetic predisposition of the parents to growth and performance traits and the likelihood of their occurrence in the offspring.

Growth characteristics and survival rate of hair goat kids according to dam age, sex and birth type

The growth characteristics of Hair goat kids depending on dam age, the sex and type of birth of the kids are shown in Table 4 as an average of all years. Depending on the dam age, the birth weights of the kids varied between 2.94 kg and 3.07 kg, the weaning weight between 12.23 kg and 14.67 kg, the daily body weight gain until weaning between 102.44 and 130.30 g and the survival rate between 88.38% and 96.93%. The birth weight, weaning weight and daily body weight gain to weaning depending on sex were 3.12 kg; 13.98 kg and 120.71 g in male kids and 2.94 kg; 12.42 kg and 105.30 g in female kids, respectively. The birth weight, weaning weight, daily body weight gain to weaning depending on birth type were 3.14 kg; 13.35 kg and 113.51in single kids and 2.66 kg; 12.77 kg and 112.52 g in twinning kids, respectively.

Table 4. Growth characteristics and survival rate of Hair goat kids depending on dam age, sex and birth type

Dam age	Birth weight (kg)	Weaning weight (kg)	Daily body weight gain (g)	Survival rate (%)
1	2.94±0.03[a]	14.67±0.34[a]	130.30±3.81[a]	88.38
2	3.01±0.01[b]	13.01±0.07[cd]	111.09±0.76[cd]	93.38
3	3.06±0.01[b]	13.62±0.07[b]	117.39±0.81[b]	94.26
4	3.07±0.01[b]	13.25±0.07[c]	113.17±0.73[c]	94.12
5	3.02±0.01[b]	13.28±0.09[c]	113.92±0.99[c]	95.02
6	3.03±0.02[b]	12.86±0.11[d]	109.25±1.24[d]	95.15
7≤	3.01±0.02[b]	12.23±0.10[e]	102.44±1.09[e]	96.93
P value	P<0.001	P<0.001	P<0.001	-
Sex				
Male	3.12±0.01	13.98±0.04	120.71±0.49	94.65
Female	2.94±0.01	12.42±0.05	105.30±0.57	94.21
P value	P<0.001	P<0.001	P<0.001	-
Birth type				
Single	3.14±0.01	13.35±0.04	113.51±0.44	94.67
Twin	2.66±0.01	12.77±0.07	112.32±0.76	93.69
P value	P<0.001	P<0.001	0.176	-

The effect of dam age on growth performance of kids was significant (P<0.001). In addition, the growth-related performance data of the kids were found to be significantly influenced by birth type and sex (P<0.001). In a study conducted by Erten and Yilmaz (2013), the birth weight of kids born from dam 2, 3 and 4 years and older was 2.81, 3.12 and 3.10 kg; weaning weight (90-day live weight) was 11.65, 12.68 and 12.65 kg; daily body weight gain to weaning was 95.95, 105.71 and 105.88 g; survival rate was 82.75%, 100.00% and 88.00%, respectively. In the same study, the birth weights of the kids depending on single and twin births were 2.97 and 3.05 kg; weaning weights were 12.52 and 12.13 kg; daily body weight gain to weaning was 105.76 and 99.27 g; survival rates were 89.09 and 91.66%, respectively. The birth weights of the male and female kids were 2.99 and 3.03 kg; the weaning

weights were 12.41 and 12.23 kg; the daily body weight gain until weaning was 104.57 and 100.46 g; the survival rate was 90.90 and 88.57, respectively. In a similar study by Ceyhan et al. (2020), the birth weight of kids born from 2, 3 and 4 years and older dam was 2.57, 2.47 and 2.53 kg; the weaning weight (90-day live weight) was 13.30, 13.57 and 13.87 kg, respectively. In the same study, the birth weights of kids depending on single and twin births were 2.71 and 2.33 kg; weaning weights were 13.76 and 13.60 kg, respectively. The researchers reported that the birth weights of male and female kids were 2.56 and 2.48 kg; weaning weights were 13.89 and 13.46 kg, respectively. Tozlu (2006) reported that the birth weights of kids born from 3, 4, 5, 6 and 7 years and older dam was 4.03, 3.68, 4.05, 3.68 and 3.40 kg; weaning weight (75-day live weight) was 15.88, 16.57, 17.11, 16.23 and 15.21 kg; daily body weight gain to weaning was 158.29, 169.40, 176.00, 165.20 and 157.88 g, respectively. In the same study, the birth weights of the kids in single and twin births was reported as 3.90 and 3.31 kg; weaning weights were 16.99 and 13.91 kg; daily body weight gain to weaning was 173.58 and 141.56 g, respectively. In addition, the birth weights of male and female kids was reported as 3.76 and 3.67 kg; weaning weights were 16.44 and 15.22 kg; daily body weight gain to weaning was 168.72 and 153.50 g, respectively. In a similar study by Tekin and Arlı (2019), the birth weight of kids born from 2, 3, 4, 5, 6 and 7 years and older dam was 3.30, 3.41, 3.51, 3.52, 3.55 and 3.57 kg; the weaning weight (120-day live weight) was 22.53, 22.51, 22.75, 22.63, 23.18 and 22.29 kg; the daily body weight gain to weaning was 158.20, 158.00, 159.90, 158.90, 163.50 and 156.10 g, respectively. The birth weight of the kids depending on single and twin births were stated 3.60 and 3.35 kg; the weaning weight was 22.86 and 22.43 kg; the daily body weight gain until weaning was 160.90 and 157.30 g, respectively. Researchers reported that birth weights of male and female kids to be 3.40 and 3.55 kg; weaning weights to be 23.57 and 21.72 kg; daily body weight gain to weaning to be 166.80 and 151.40, respectively. In another study by Elmaz et al. (2020), the birth weights of kids born from 2, 3, 4, 5 and 6 years and older dam was 3.14, 3.24, 3.56, 3.43 and 3.45 kg; the weaning weights (90-day live weight) was 17.29, 17.31, 17.58, 17.72 and 17.82 kg, respectively. In the same study, the birth weight of the kids was 3.44 and 3.21 kg depending on single and twin births; the weaning weight was 17.63 and 17.46 kg, respectively. In addition, the birth weights of the male and female kids were 3.52 and 3.13 kg; the weaning weights were 18.50 and 16.59 kg, respectively. In a similar study by Alkoyak and Güngör (2022), the birth weights of kids born from 2, 3, 4, 5, 6 and 7 years and older dam was 2.81, 2.75, 2.80, 2.81, 2.78 and 2.88 kg; weaning weight (90-day live weight) was 15.39, 15.32, 15.25, 15.77, 15.87 and 15.96 kg; daily body weight gain to weaning was 139.46, 138.70, 137.88, 143.73, 144.79 and 145.77g, respectively. The birth weights of kids in the same study was 2.85 and 2.76 kg, according to single and twin births; weaning weights was 15.73 and 15.45 kg; daily body weight gain to weaning was 143.28 and 140.17 g, respectively. The researchers reported that the birth weights of the male and female kids were 2.81 and 2.79 kg; weaning weights were 16.00 and 15.19 kg; the daily body weight gain to weaning was 46.22 and 137.22 g, respectively. In the present study, it was found that the performance values of kids depending on the dam age, birth type and sex were similar to the results reported by Erten and Yılmaz (2013) and Ceyhan et al. (2020), while they were lower than the results reported by other researchers. In addition, the survival rate of kids was found to increase with increasing dam age. This may be explained by the fact that older mothers tend to be more accepting and experienced in raising their kids. At the same time, depending on the sex and type of birth, the birth weight of male and single-born kids is higher than that of females and twins, which increases their survival rate and led to higher performance values.

CONCLUSION

Hair goats will be an indispensable gene source for the sustainability of livestock production if freshwater and feed resources are not sufficient in the near future due to climate change. Hair goats are of great value due to their status as an local gene source, which is common in almost all regions of Türkiye and is mainly bred in rural areas. They continue to be productive under all kinds of difficult conditions and probably adapt better than other gene sources to scenarios that are to be developed under the negative effects of changing climatic conditions. However, breeding of Hair goat in Türkiye is mostly carried out by small family farms under extensive conditions to meet the needs of the family. Therefore, it is obvious that the genotype of the Hair goat breeding under farmer conditions does not reflect its yield potential. For this reason, it is a well-known fact that the genotype of the Hair goat bred by the public cannot reflect its productivity potential and breeders suffer economic losses due to productivity losses in production. In this context, the projects initiated throughout Türkiye aimed to increase the reproductive traits of the local Hair goats breeding in extensive systems under farmers' conditions. Breeders with this study were first trained to keep records and taught how to make yield-oriented breeding selections based on the records. By training the breeders in this way, it has been determined that the reproductive criteria of the breeding animals and performance data such as birth weight, weaning weight, daily body weight gain and survival rate of the kids have improved compared to the first year of production. This study has shown that training farmers producing in extensive system supports the sustainable structure and profitability of production by minimizing possible misapplications during production.

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