

Growth, survival rate, and some reproductive characteristics of Hair goat under breeder conditions in Kahramanmaraş Province

İrfan GÜNGÖR^{1*}, Kürşat ALKOYAK¹, Sezer ÖZ¹, Seyrani KONCAGÜL²

¹General Directorate of Agricultural Research and Policies, Ankara, Turkey

²Department of Animal Science, Faculty of Agriculture, Ankara University, Ankara, Turkey

Received: 16.04.2021 • Accepted/Published Online: 25.10.2021 • Final Version: 13.12.2021

Abstract: This study was carried out to determine the growth characteristics and survival rate until weaning, some reproductive characteristics of Hair goat, and the factors affecting these characteristics under farmer conditions in Kahramanmaraş province. In the study, a total of 19386 birth weight (BW) records of kids in 49 different flocks in 14 villages for 5 years (2014–2018), and a total of 18017 weaning weight (WW) records were used from the National Genetic Improvement Project of Sheep and Goat in Turkey (NGIPSG). The average BW, WW, and daily live weight gain (DWG) of the kids were determined as 3.17 ± 0.013 , 15.81 ± 0.045 kg and 139.78 ± 0.502 g, respectively. Among the environmental factors examined on these characteristics, the effect of dam's age, year and season of birth, type of birth, and sex were found to be statistically significant ($p < 0.01$). While the average survival rate of the kids at weaning was 92.94% and ranged between 90.99% and 95.14% depending on the years the effects of dam's age ($p < 0.01$), year of birth ($p < 0.01$), season of birth ($p < 0.05$), sex ($p < 0.01$) and type of birth ($p < 0.01$) on survival rate were found to be significant. In the study, litter size and twin birth rate were found to be 1.10 and 9.9%, respectively. These results showed that the Hair goat was adapted to the region, and its breeding was carried out in a sustainable manner in the region.

Key words: Hair goat, growth, environmental factors, reproductive characteristics, survival rate

1. Introduction

Goats raised in a wide geography of the world have been an important food source throughout the human history [1]. In developing countries, with the effect of suitable climate and other environmental factors, goats are very valuable source of income especially for poor families in rural areas.

The number of goats in Turkey showed a sharp decrease before the year 2010, and, in the following years, its breeding plan was included in “National Genetic Improvement Project of Sheep and Goat (NGIPSG) Project in Turkey” by the Ministry of Agriculture and Forestry. As a result, with more than 10 million goats as of 2020, Turkey is ranked the first among the European and Mediterranean countries and the twenty-third in the World.¹ The Hair goat is a contented breed that is resistant to the harsh climate of Anatolia, can use weak pastures, and is raised in mountain

villages in the forest and on the edge of the forest. It is a dual-purpose goat breed, which is mainly raised for meat and milk, and it is the most numerous goat breed in our country [2]². The main indigenous goat breeds raised in Turkey are Angora, Honamlı, Kilis, and Hair goats, which constitute the majority (97%) of the goat population³. In addition, low-yielding sheep and goats in our country are raised under wide conditions by breeders because they adapt well to harsh conditions [3]. It contributes to the Hair goat breeder and the economy with meat, milk, and hair yield, albeit a little [4].

Growth and survival rates of kids are important determinants of productivity in goat breeding [5]. Birth weight (BW) is an important factor for the growth and development of goats, reaching a certain weight at a certain age and for postnatal kid losses [6, 7]. In some studies conducted in our country, it was found that the

¹ FAOSTAT (2020). Food and Agricultural Organization of the United Nations [online]. Website <http://www.fao.org/faostat/en/#data/QA>. [accessed 25 January 2021].

² General Directorate of Agricultural Research and Policies (GDAR). Domestic Animal Genetic Resources in Turkey. Ankara, Turkey: GDAR; 2009. <https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/Katalog%20T%C3%BCrk%C3%A7e.pdf> [accessed 25 January 2021].

³ TURKSTAT (2021). Turkish Statistical Institute Statistics. [online]. Website <http://www.turkstat.gov.tr/Start.do> [Accessed 01 Feb, 2021].

* Correspondence: igungor@ankara.edu.tr

BW of Hair goat kids varied between 2.46–3.52 kg for males and 1.92–3.55 kg for females, and weaning weight (WW) (90 days) ranged from 12.41–18.50 kg for males and 11.68–16.59 kg for females [4, 8–12]. Average daily live weight gain (DWG) ranges from 104.57–166.8 g in males and 100.46–151.4 g in females [4, 9, 11]. In studies on Hair goats, survival rates up to weaning (90th day) vary between 78.61–95.44% [8–10, 13, 14]. In some studies on Hair goats, litter size ranged from 0.79 to 1.09, while the twin birth rate ranged from 2.09 to 9.21% [12, 13–15]. However, in another study, litter size was found to be 1.16 and 1.26 in 2-3- and 4-5-year-old goats, respectively, and the twin rate was 45% and 58.3 [16].

This study was carried out to determine growth characteristics, survival rates, and some reproductive characteristics with the data obtained for the first time at this size of Hair goats raised under farmer conditions for 5 years (2014–2018) in Kahramanmaraş. Thanks to the large number of data used, reliable information about the characteristics of Hair goats in the region will be presented.

2. Materials and methods

This study was carried out in Kahramanmaraş Province (37° 50' 22" N and 36° 31' 30" E) by the the Ministry of Agriculture and Forestry (MoAF), General Directorate of Agricultural Research and Policies (TAGEM). The data of the study consisted of 19386 birth weight (BW) records and 18017 weaning weight (WW) records taken on the 90th day after the birth of the kids born in 49 flocks in 14 villages of Onikişubat district between the years 2014 and 2018. The data of the study conducted by Koncağül and Güngör [17], in the same study area, were also included in this study.

Flocks of Hair goats were grazed from early morning until evening in the open fields in or around the forests, in bushes such as Kermes oak (*Quercus coccifera*), the Aleppo oak (*Quercus infectoria*), Blackthorn (*Paliurus spina-christi* Miller), and in pastures dominated by Astragalus plants. Goats are taken to pasture between April and October, and no additional feeding is supplied during this period. However, in the winter, in addition to the pasture, approximately 0.5–1 kg / head of concentrate feed and 1–2 kg / head of hay were given per day. Feeds such as wheat, barley, and cotton seed were added to the concentrate feeds separately or mixed together depending on the season and economic conditions. Goats were mated free between 15th of August and 15th of October, which is the mating season in the region. All kids born in the farms are identified with ear tags and weighed with a digital scale (sensitive up to 10 g with a capacity of 50 kg) within 24 h after birth. Meanwhile, the birth registration information of the kids was taken and recorded (date of birth, ear tag number of the dam, birth type and sex).

Kids sucked dams in the morning and evening for an average of 90 days after birth, and WWs were measured with a digital cage scale sensitive up to 100 g with a capacity of 300 kg. The live weights of weaned kids were adjusted for 90-day age using the formula below [18]:

$$\text{Adjusted weight} = \frac{(\text{actual weight} - \text{birth weight})}{\text{actual age in days}} \times 90 + \text{birth weight}$$

The parameters determined for the breeding characteristics of goats are as follows:

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

Single birth rate (%) = (Number of goats with single kid / Number of kidding does) × 100

Twinning rate (%) = (Number of goats with twin kids / Number of kidding does) × 100

Survival rate (%) = (Number of kids live at weaning / Number of kids born) × 100

The statistical model used to analyze the BW of kids was;

$$Y_{ijklmnp} = \mu + a_i + b_j + c_k + d_l + f_m + g_n + h_p + e_{ijklmnp}$$

where;

$Y_{ijklmnp}$ = BW in i^{th} dam's age, j^{th} village, k^{th} flock-village, l^{th} year, m^{th} season, n^{th} sex, and p^{th} birth type of r^{th} kid.

μ = population mean,

a_i = the effect of dam's age ($i = 2 - 7 \leq$)

b_j = the effect of village ($j = 14$ different villages),

c_k = the effect of flock (village) ($k = 49$ flocks. Flock was nested in the village),

d_l = the effect of the year ($k = 2014-2018$),

f_m = the effect of season ($l =$ winter, spring)

g_n = the effect of sex ($m =$ female, male),

h_p = the effect of birth type ($n =$ single, twin)

$e_{ijklmnp}$ = random error

For WW and ADWG, the statistical model was as follows:

$$Y_{ijklmnp} = \mu + a_i + b_j + c_k + d_l + f_m + g_n + h_p + b_1 X_{ijklmnp} + e_{ijklmnp}$$

$\mu, a_i, b_j, c_k, d_l, f_m, g_n, h_p$ ve $e_{ijklmnp}$ are the same as in the model above,

b_1 = partial regression coefficient of WW and daily weight gain on BW

$X_{ijklmnp}$ = Birth weight

The effect of environmental factors was determined using the GML procedure, and the statistical significance between the subgroup means was checked by Tukey multiple comparison test. Due to the insufficient data in the subgroups, it was assumed that there was no two-way or three-way interaction between the analyzed factors. The survival rates were compared with the chi-square (χ^2) test. Minitab (18v) package program were used for the analyses [19]. The effect of the village and the flock (village) was found to be significant ($p < 0.01$) on the weight traits examined in the study, and, since their number of levels

is very high (14 villages, 49 flocks), the results will not be presented.

3. Results

Descriptive statistics of BW, WW, and DWG are given in Table 1. The least squares means and their standard errors are given in Table 2. BW, WW, and DWG of kids were found to be 3.17 ± 0.013 , 15.81 ± 0.045 kg, and 139.78 ± 0.502 g, respectively. The effects of all the factors on the live weight of kids were found to be significant ($p < 0.01$).

The survival rate of kids up to weaning was found to be 92.94% (Table 3), and the effects of dam's age, year of birth, season of birth, sex, and type of birth were found to be significant among the factors examined ($p < 0.05$). Some of the breeding characteristics of Hair goats are presented in Table 4. Litter size, single birth, and twin birth rate were found as 1.10, 90.1, and 9.9%, respectively.

4. Discussion

In this study, the BW of kids was determined as 3.17 ± 0.013 kg. This value was found to be higher than the values reported by Tekin and Ögeç [4] (3.02 kg), Oral Toplu and Altınel [8] (2.19 kg), Şengonca et al. [13] (2.63 kg), Erten and Yılmaz [9] (3.01 kg), Şimşek et al. [20] Saanen x Hair goat hybrid (F1) (2.18 kg), G1 hybrid (2.82 kg) and Akbaş and Saatçı [2] (3.04 kg), and similar to the value reported by Yılmaz et al. [10] (3.14 kg). However, it was lower than the values by Tekin and Arlı [11] (3.48 kg), Akbaş and Saatçı [2] in Honamlı x Hair goat hybrid (F1) (3.58 kg), Karadağ [21] in Saanen x Hair goat hybrid (3.309 kg) and also lower than the values reported as 3.59 and 3.72 kg by Tozlu [22] for BW of Saanen x Hair goat hybrid (F1) and Hair goat kids. In this study, the lowest BW was obtained from 2-year-old dams (3.07 ± 0.017 kg) and the highest BW from 5 (3.21 ± 0.06 kg) and 6-year-old dams (3.21 ± 0.017 kg).

In addition, it was observed that BW increased regularly from 2 to 5 years age of dam. This result can be explained by the increase in reproductive performance as the maturity age of the Hair goats increases. Consistent with the results of this study, Tekin and Arlı [11] and Yılmaz et al. [10] reported on a study that the BW of the

kids increased with the increase of the dam's age. In this study, the highest BW (3.25 ± 0.016 kg) was obtained in 2015. Differences in BW values between years may have resulted from the climate conditions in the region during the year and the changes in the maintenance - feeding conditions in the flocks.

WW and DWG were increased from 15.57 kg and 137.13 g in 2014 to 17.65 kg and 160.18 g in 2018, respectively, as expected in a genetic improvement program (Table 2). However, there was a small but significant decrease in BW; a possible reason should be the negative genetic correlation between BW and the other traits (WW and DWG). In addition, one other possible explanation should be that the selection was for increased WW; criteria in selection index was increase in WW but having BW unchanged. Thus, constraining BW in the selection index may cause the BW to decrease a little bit.

In the study, it was observed that kids born in winter (3.22 ± 0.012 kg) have higher BW than those born in spring (3.12 ± 0.016 kg). This situation can be attributed to the fact that Hair goats are fed better indoors in winter conditions. In the study, BW was found to be 3.30 ± 0.013 kg for male kids and 3.04 ± 0.013 kg for female kids. These values were higher than those reported by Tekin and Ögeç [4] as 3.07 kg in males and 2.96 kg in females. On the other hand, BW calculated in this study were lower than the values of 3.40 kg in males and 3.55 kg in females found by Tekin and Arlı [11], and 3.52 kg in male kids and 3.13 kg female kids by Elmaz et al. [12]. In this study, BW was determined as 3.33 ± 0.012 kg and 3.01 ± 0.015 kg in single and twin born kids, respectively, so it was determined that single kids were heavier than twin kids. In accordance with the results of this study, Elmaz et al. [12] reported that single kids were heavier, and BW of single and twin kids were 3.44 kg and 3.21 kg, respectively. In addition, many studies have been carried out on Hair goats that support the result of this research [4, 8, 9, 11, 20].

In this study, the effect of dam's age, year of birth, sex, season, and type of birth on BW was found to be significant ($p < 0.01$). It was observed that the effect of dam's age on BW is significant and also consistent with the results of previous studies [4, 9, 11, 12, 20] on Hair goats; it is also

Table 1. Descriptive statistics of growth traits to weaning age (90 days) in Hair goats.

Parameters	Number of records	Mean (\bar{x})	Standard error Mean	Minimum	Maximum	Coefficient of variation (%)
BW (kg)	19386	3.23	0.005	1.00	4.98	21.7
WW 90th day (kg)	18017	16.37	0.028	8.09	34.54	23.0
DWG (g)	18017	146.00	0.305	42.86	347.66	28.1

BW: Birth weight, WW: Weaning weight, DWG: Daily live weight gain.

Table 2. Least squares means and standard errors of BW, WW, and DWG in Hair goats based on dam's age, birth year, season, sex, and birth type.

Factors	BW (kg)		WW 90th day (kg)		DWG (g)	
	n	($\bar{x} \pm S\bar{x}$)	n	($\bar{x} \pm S\bar{x}$)	n	($\bar{x} \pm S\bar{x}$)
Dam's age (year)		*		*		*
2	2597	3.07 ± 0.017 ^c	2449	15.10 ± 0.094 ^c	2449	131.92 ± 1.040 ^c
3	4470	3.14 ± 0.015 ^b	4179	15.66 ± 0.083 ^b	4179	138.11 ± 0.916 ^b
4	3391	3.19 ± 0.015 ^a	3158	16.00 ± 0.084 ^a	3158	141.86 ± 0.937 ^a
5	3128	3.21 ± 0.016 ^a	2881	15.95 ± 0.087 ^a	2881	141.37 ± 0.967 ^a
6	2571	3.21 ± 0.017 ^a	2376	16.12 ± 0.094 ^a	2376	143.20 ± 1.040 ^a
7 ≤	3229	3.18 ± 0.016 ^a	2974	16.03 ± 0.089 ^a	2974	142.20 ± 0.984 ^a
Birth year		*		*		*
2014	4296	3.18 ± 0.016 ^b	3909	15.57 ± 0.089 ^b	3909	137.13 ± 0.989 ^b
2015	4798	3.25 ± 0.016 ^a	4450	14.84 ± 0.085 ^c	4450	129.00 ± 0.942 ^c
2016	3820	3.20 ± 0.016 ^b	3610	15.59 ± 0.087 ^b	3610	137.32 ± 0.963 ^b
2017	3923	3.10 ± 0.016 ^c	3623	15.40 ± 0.090 ^b	3623	135.25 ± 0.995 ^b
2018	2549	3.11 ± 0.016 ^c	2425	17.65 ± 0.085 ^a	2425	160.18 ± 0.940 ^a
Birth season		*		*		*
Winter	16786	3.22 ± 0.012 ^a	15574	15.55 ± 0.067 ^b	15574	136.89 ± 0.739 ^b
Spring	2600	3.12 ± 0.016 ^b	2443	16.07 ± 0.088 ^a	2443	142.66 ± 0.979 ^a
Sex		*		*		*
Female	9607	3.04 ± 0.013 ^b	8988	14.96 ± 0.073 ^b	8988	130.34 ± 0.812 ^b
Male	9779	3.30 ± 0.013 ^a	9029	16.66 ± 0.073 ^a	9029	149.21 ± 0.806 ^a
Birth type		*		*		*
Single	15902	3.33 ± 0.012 ^a	14674	16.33 ± 0.068 ^a	14674	145.53 ± 0.759 ^a
Twin	3484	3.01 ± 0.015 ^b	3343	15.29 ± 0.083 ^b	3343	134.02 ± 0.924 ^b
Regression				1.1489 ± 0.045*		1.655 ± 0.502*
Overall average	19386	3.17 ± 0.013	18017	15.81 ± 0.045	18017	139.78 ± 0.502

*: $p < 0.01$ a, b, c: Differences among means with different letters in the same column within factors are significant ($p < 0.01$)

Regression: Partial regression of WW and daily weight gain on BW.

BW: Birth weight, **WW:** Weaning weight, **DWG:** Daily live weight gain.

inconsistent with the findings of the study conducted by Akbaş and Saatçı [2], and the effect of year of birth was found to be significant ($p < 0.05$) and consistent with most studies [4, 8, 11–13]. The effect of the season was significant ($p < 0.05$) and consistent with the results of the study by Mioč et al. [23] but inconsistent with the results of Afzal et al. [24], and the effect of sex was significant ($p < 0.05$) and consistent with the results of some studies [2, 4, 8, 11, 12] but inconsistent with the results of some other studies [9, 13, 20]. It was also observed that the effect of birth type was significant ($p < 0.05$) and consistent with the results of some studies [2, 4, 8, 12, 20] but inconsistent with the

results of Erten and Yılmaz [9]. The difference between the results of this study and the results of the previous studies may be due to the different care and feeding of the Hair goats in the regions where the research was carried out.

The other growth characteristics examined in the study was WW and determined as 15.81 ± 0.045 kg. This value was higher than the values reported by Şengonca et al. [13] (12.12 kg), Erten and Yılmaz [9] (12.32 kg), Saanen x Hair goat hybrid (F1) (14.07 kg), Yılmaz et al. [10] (12.06) and Akbaş and Saatçı [2] (12.95 kg) and similar to the values reported by Simsek et al. [20], Saanen x Hair goat hybrid (G1) (15.62 kg) but lower than the values reported

Table 3. Survival rates of kids up to weaning age (90 days).

FACTOR	Number of born kids	Number of kids alive in weaning	Survival rates %
Dam's age (year)			**
2	2597	2449	94.30 ^a
3	4470	4179	93.49 ^{ab}
4	3391	3158	93.13 ^{abc}
5	3128	2881	92.10 ^c
6	2571	2376	92.42 ^{bc}
7 ≤	3229	2974	92.10 ^c
Birth year			**
2014	4296	3909	90.99 ^c
2015	4798	4450	92.75 ^b
2016	3820	3610	94.50 ^a
2017	3923	3623	92.35 ^b
2018	2549	2425	95.14 ^a
Birth season			*
Winter	16786	15574	92.78 ^b
Spring	2600	2443	93.96 ^a
Gender			**
Female	9607	8988	93.56 ^a
Male	9779	9029	92.33 ^b
Birth type			**
Single	15902	14674	92.28 ^b
Twin	3484	3343	95.95 ^a
Overall average	19386	18017	92.94

* : $p < 0.05$ ** : $p < 0.01$ a, b, c: Differences between means with different letters in the same column are significant ($p < 0.05$).

by Akbaş and Saatçı [2] Honamlı x Hair goat hybrid (F1) (16.60 kg), Akdağ et al. [25] and Saanen x Hair goat hybrid (18,29 kg). In this study, the lowest WW was obtained from 2-year-old dams (15.10 ± 0.094 kg), and the highest WW was obtained from 6-year-old dams (16.12 ± 0.094 kg). In general, it was observed in the study that, as the dam's age increased, the WW of the kids also increased. In accordance with this study, some studies reported that the WW of the kids increased with the increase of dam's age [10, 12, 20].

In the study, the highest WW (17.65 ± 0.085 kg) was obtained in 2018, and the lowest WW (14.84 ± 0.085 kg) was obtained in 2015. The differences in the WW value between years may have resulted from the climatic conditions in the region and the changes in the shelter conditions during the years. In addition, the fact that the highest WW increase in 2018 may be due to the experience of the breeders in care and feeding as the years progress.

In this study, it was observed that the kids weaned in the spring (16.07 ± 0.088 kg) had more WW than the kids weaned (15.55 ± 0.067 kg) in the winter. This situation can be attributed to the better feeding of goats as a result of the improvement of pasture conditions in the spring. In the study, WW was found to be 16.66 ± 0.073 kg and 14.96 ± 0.073 kg in male and female kids, respectively. These values were found higher than those in males (12.41 kg) and females (12.23 kg) reported by Erten and Yılmaz [9] and than those in males (13.70 kg) and females (12.46 kg) by Oral Toplu and Altınel [8]. On the other hand, WW in this study was lower than the values found in males (18.50 kg) and females (16.59 kg) in the study by Elmaz et al. [12]. In this study, WW of single and twin kids was determined as 16.33 ± 0.068 kg and 15.29 ± 0.083 , respectively, and it was observed that single kids had higher WW than twins. Consistent with the results of this study, Oral Toplu and Altınel [8] reported the WW as 13.51 kg for single born

Table 4. Some breeding characteristics of Hair goats.

Reproductive characteristics	Years					General
	2014	2015	2016	2017	2018	
Number of kidding does	3920	4373	3430	3610	2309	17642
Number of born kids	4296	4798	3820	3923	2549	19386
Litter Size	1.10	1.10	1.11	1.09	1.10	1.10
Number of goats with single kid	3544	3948	3040	3296	2074	15902
Number of goats with twin kids	376	425	390	314	235	1740
Single birth rate %	90.4	90.3	88.6	91.3	89.8	90.1
Twinning rate %	9.6	9.7	11.4	8.7	10.2	9.9

goats and 12.65 kg for twins. Many studies have been carried out on Hair goats, which support the result of this research [9, 10, 12, 20].

In this study, the effect of the dam's age, year and season of birth, sex, and type of birth on the WW was found to be statistically significant ($p < 0.01$). The effect of dam's age on WW was significant and consistent with the results of many studies [2, 8, 9, 12] but inconsistent with the results of the study by Şimşek et al. [20]; the effect of the year of birth was significant and consistent with the studies [8, 12]; the effect of the season was significant but inconsistent with the result of the study by Mioč et al. [23]; the effect of sex was significant and consistent with the results of many studies [2, 8, 12, 13] but inconsistent with some other studies [9, 20]; the effect of birth type was significant and consistent with the results of some studies [2, 13] but inconsistent with the results of many studies [8, 9, 12, 20].

One other growth characteristics examined in the study was the DWG until weaning and found as 139.78 ± 0.502 g. This value was higher than the values reported in the studies by Şimşek et al. [20] Saanen x Hair goat hybrid (F1) (131 g) and Erten and Yılmaz [9], similar to the value reported by Şimşek et al. [20] Saanen x Hair goat hybrid (G1) (141 g), and lower than the value reported by Tekin and Ögeç [4] (143 g) and Tekin and Arlı [11] (159.1 g). In this study, the lowest DWG was obtained from the kids of 2-year-old dams (131.92 ± 1.040 g), and the highest DWG was obtained from the kids of 6-year-old dams (143.20 ± 1.040 g). In the study, the highest DWG (160.18 ± 0.940 g) was obtained in 2018. This result can be explained by the care given by the breeders to goat and feeding, with the effect of education and experience as the years progressed. In the study, it was observed that kids weaned in spring (142.66 ± 0.979 g) had more DWG than kids weaned in winter (136.89 ± 0.739 g). This situation may be the result of better feeding of goats since climate and improved pasture conditions in spring. In the study, male kids (149.21 ± 0.806 g) were found to have higher DWG than female

kids (130.34 ± 0.812 g). These results are higher than the values reported by Erten and Yılmaz [9] in males (104.57 g) and females (100.46 g), higher than the value in males (139.00 g), and similar to the value in females (133.00 g) reported by Şimşek et al. [20]. On the other hand, this value was found to be lower than the values in males (166.80 g) and females (151.40 g) in the study conducted by Tekin and Arlı [11]. In this study, DWG until weaning was determined as 145.53 ± 0.759 g and 134.02 ± 0.924 g in single and twin born kids, respectively, and it was found that single kids had more DWG than twins. Many studies have been conducted on Hair goats supporting the results of this study that singleton kids have more DWG than twins [4, 9, 11, 20].

In this study, the effects of dam's age, year and season of birth, sex, and type of birth on DWG until weaning were found to be significant ($p < 0.01$). The fact that the effect of dam's age on DWG was significant and consistent with the results of many studies [4, 9, 11] but inconsistent with the results of the study by Şimşek et al. [20]; the effect of year of birth was significant and consistent with the performed studies [4, 11]; the effect of the season was significant and inconsistent with the results of the study by Mioč et al. [23], and the effect of sex and type of birth was significant was consistent with the results of some studies [4, 11] but inconsistent with the results of some other studies [9, 20].

In this study, the highest survival rates of kids until weaning were found as 94.30% for those born from 2-year-old dams, 95.14% for those born in 2018, 93.96% for those born in the spring season, 93.56% for females, and 95.95% for twins. Average survival rate was determined as 92.94%. For the same weaning period in Hair goat kids, this rate was found higher than the results reported by Şengonca et al. [13] (78.61% Hair goat, 91.64% Saanen x Hair), Erten and Yılmaz [9] (89.87%), Yılmaz et al. [10] (90.24%), Atay et al. [14] (80.65%), Şimşek et al. [20] (86.20% F1, 81.25% G1 Saanen x Hair); and lower than the results of Oral Toplu and Altinel [8] (95.44%). The effect of all the factors

examined in this study on the survival rate was found to be significant ($p < 0.05$, $p < 0.01$). The effect of dam's age on survival rate was significant and consistent with the study by Erten and Yılmaz [9]; the effect of year of birth was significant and consistent with the results of some studies [4, 12, 13], and the effect of sex and type of birth was found to be significant but inconsistent with some studies [9, 13].

The fertility traits of the Hair goats are given in Table 4. Litter size ranged from 1.09 to 1.11 with respect to the years, but it was found to be 1.10 on average. This value was higher than the results of Elmaz et al. [12] (1.05) and Oral Toplu and Altinel [15] (1.02), consistent with the results of Atay et al. [14] (1.09), and lower than the values found by Erişir and Erdoğan [16], which were 1.16 in 2–3 years old goats and 1.26 in 4–5 years old goats. On the other hand, the value found in this study was higher than the results found by Şengonca et al. [13] in Hair goats (0.79) but lower than the values found in Saanen x Hair goat hybrid (1.30). While the lowest twinning rate was 8.7% in 2017 and the highest was 11.4% in 2016, the average twinning rate was 9.9% with regards to the years. This rate is higher than the values reported by Oral Toplu and Altinel [15] (2.09%), consistent with the results of Atay et al. [14] (9.21%), and lower than the values found by Erişir and Erdoğan [16], which was 45% in 2–3 years old dams and 58.3% in 4–5 years old dams. In studies conducted on Hair goats, it is seen that reproductive characteristics are quite different. These differences may have resulted from the climate in the study regions, the condition of the pastures, the size of the flock, and the maintenance conditions.

References

1. Webb EC, Casey NH, Simela L. Goat meat quality. *Small Ruminant Research* 2005; 60 (1-2): 153-166. doi: 10.1016/j.smallrumres.2005.06.009
2. Akbaş AA, Saatçı M. Growth, slaughter, and carcass characteristics of Honamlı, Hair, and Honamlı × Hair (F1) male goat kids bred under extensive conditions. *Turkish Journal of Veterinary And Animal Sciences* 2016; 40 (4): 459-467. doi: 10.3906/vet-1511-5
3. Daşkıran İ, Bingöl M, Karaca S, Yılmaz A, Çetin AO et al. The effect of feeding system on fattening performance, slaughter, and carcass characteristics of Norduz male kids. *Tropical Animal Health and Production* 2010; 42 (7): 1459-1463. doi: 10.1007/s11250-010-9577-3
4. Tekin ME, Ögeç M. The Growth and Survival Ability of Hair Goat Kids Under the Breeder's Condition in Konya Region. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi* 2017; 57 (2): 93-98.
5. Lanari MR, Taddeo H, Domingo E, Centeno MP, Gallo L. Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). *Archiv für Tierzucht* 2003; 46 (4): 347-356.
6. Husain SS, Horst P, Islam ABMM. Effect of different factors on preweaning survivability of Black Bengal Kids. *Small Ruminant Research* 1995; 18 (1): 1-5.
7. Demirören E, Taşkın T, Alçiçek A, Koşum N. İnek sütü ile emiştirilen oğlaklarda gelişme. *Ege Üniversitesi Ziraat Fakültesi Dergisi* 1999; 36 (1-2-3): 89- 96.
8. Oral Toplu HD, Altinel A. Some production traits of indigenous Hair goats bred under extensive conditions in Turkey. 2nd communication: viability and growth performances of kids. *Archiv für Tierzucht* 2008; 51 (5): 507-514. doi:10.5194/aab-51- 507-2008

As a result, during the project, BW decreased, and the decrease was small but significant. This result may be attributable to the way the selection was applied for increased WW. In the selection index, the criteria were keeping BW unchanged but increasing WW; thus, the constrain applied for BW and negative genetic correlation between BW and WW might be because of this decrease in BW. On the other hand, WW together with DWG has been improved by about 13% and 17% from 2014 to 2018, respectively. Moreover, about 4.15% increase in the survival rate resulted in more weaned kids per doe, although the litter size relatively stays unchanged, It is thought that the productivity and the farm profitability would be increased even more if the genetic improvement program in the Hair goat flocks in Kahramanmaraş is continued by taking the environmental factors into account.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgments

This study was supported within the scope of "National Genetic Improvement Project of Hair Goat in Farmer Conditions Kahramanmaraş Province " carried out by the Ministry of Agriculture and Forestry (MoAF), General Directorate of Agricultural Research and Policies (TAGEM) (Project number: TAGEM/46KIL2012-01). We would like to thank TAGEM, Kahramanmaraş Sheep and Goat Breeders' Association, and the project's technical staff for their contributions to the study.

9. Erten Ö, Yılmaz O. Investigation of survival rate and growth performances of Hair Goat Kids raised under extensive conditions. *Yüzüncü Yıl Üniversitesi Veteriner Fakültesi Dergisi* 2013; 24 (3): 109 – 112 (in Turkish with an abstract in English).
10. Yılmaz O, Küçük M, Bolacalı M, Çak B. Investigation of survival rate, growth performance and some body measurements of Saanen x Hair goat f1 crossbred and pure Hair goat kids raised in semi-intensive conditions. *Bulgarian Journal of Agricultural Science* 2013; 19 (4): 835-840.
11. Tekin ME, Arlı M. The growth and survival rate of Hair Goat Kids raised by public in Karaman region. *Journal of the Turkish Veterinary Medical Society* 2019; 90 (2): 152-157. doi: 10.33188/vetheder.539444
12. Elmaz Ö, Saatçı M, Ağaoglu ÖK, Akbaş AA, Metin MÖ et al. Reproductive performance and kid growth until weaning in Hair goat reared on-farm conditions in Turkey. *Turkish Journal of Veterinary and Animal Sciences* 2020; 44 (2): 370-376. doi: 10.3906/vet-1909-18
13. Şengonca M, Taşkın T, Koşum N. Simultaneous comparison of various production traits of Saanen × Hair crossbred and pure Hair goats. *Turkish Journal of Veterinary and Animal Sciences* 2003; 27 (6): 1319-1325 (in Turkish with an abstract in English).
14. Atay O, Gökdal Ö, Eren V. Reproductive characteristics and kid marketing weights of hair goat flocks in rural conditions in Turkey. *Cuban Journal of Agricultural Science* 2010; 44 (4): 353-358.
15. Oral Toplu HD, Altınel A. Some production traits of indigenous Hair goats bred under extensive conditions in Turkey. 1st communication: reproduction, milk yield and hair production traits of does. *Archiv für Tierzucht* 2008; 51 (5): 498-506.
16. Erişir Z, Gürdoğan F. The fertility and milk yield characteristics of Hair goats in extensive conditions. *Doğu Anadolu Bölgesi Araştırmaları* 2004; 109-112 (in Turkish with an abstract in English).
17. Koncagül S, Güngör İ. Birth and weaning weights of hairy goats raised in farmer conditions in Kahramanmaraş region. 2016. 12th International Conference on Goats, Antalya, Turkey
18. Mellado J, Marín V, Reyes-Carrillo JL, Mellado M, Gaytán L et al. Effects of non-genetic factors on preweaning growth traits in Dorper sheep managed intensively in central Mexico. *Ecosistemasy Recursos Agropecuarios* 2016; 3 (8): 229-235.
19. Minitab. Minitab statistical software version 18.1; 2017.
20. Şimşek ÜG, Bayraktar M, Gürses M. Investigation of growth and survivability characteristics in Saanen × Pure Hair goats crossbreeds F1 and B1. *Fırat Üniversitesi Sağlık Bilimleri Dergisi* 2007; 21 (1): 21-26 (in Turkish with an abstract in English).
21. Karadağ O. Saanen ve Saanen melezi (Saanen x Kıl) keçilerin büyüme özellikleri ve besi performanslarının karşılaştırılması. MSc, Trakya University, Edirne, Turkey, 2006.
22. Tozlu H. Amasya ili Kıl keçisi ıslah projesi kapsamında elde edilen Saanen x Kıl keçisi (F1) melezleri ile saf Kıl keçilerinin büyüme ve diğer yetiştiricilik özellikleri bakımından mukayesesi. MSc, Ondokuz Mayıs University, Samsun, Turkey, 2006.
23. Mioč B, Sušić V, Zvonko A, Prpić Z, Vnucec I et al. Study on birth weight and pre-weaning growth of Croatian multicolored goat kids n birth weight and pre-weaning growth of Croatian multicolored goat kids. *Veterinarski Arhiv* 2011; 339 (81): 339-347.
24. Afzal M, Javed K, Shafiq M. Environmental effects on birth weight in beetal goat kids. *Pakistan Veterinary Journal* 2004; 24 (2): 104-106.
25. Akdağ F, Pir H, Teke B. Comparison of growth traits in Saanen and Saanen X Hair crossbred (F1) kids. *Hayvansal Üretim* 2011; 52 (1): 33-38.