



Performance of Kivircik Sheep under Three Lambing Systems in Two Years

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ABSTRACT

This study was carried out to investigate reproductive traits of Kivircik ewes under three lambing systems in two years and their lambs' survival and growth performances. A total of 200 Kivircik ewes and 15 Kivircik rams were used. Ewes were subjected to a system of lambing every 8 months. Ewes were mated in August (summer), April (spring) and December (winter), respectively. Ewes were synchronized using FIS (intravaginal flourogestone sponges) for 14 days. Additionally, 600 IU eCG (equine chorionic gonadotropin) was administered intramuscularly at sponges withdrawal. Rams remained with the ewes for 3-day from the start of estrus. Estrus rate, lambing rate and litter size were 96.00, 87.50% and 1.70 lamb/doe; 92.35, 85.20 and 1.50 lamb/doe; 78.92, 58.38 and 1.43 lamb/doe for summer, spring and winter seasons, respectively. Survival rates at weaning, birth and weaning weights of lambs were 86.44%, 3.11kg and 17.85kg; 72.80%, 3.24kg and 16.38kg; 66.88%, 3.38kg and 18.97kg for summer, spring and winter, respectively. The effect of mating season on estrus rate was not significant ($P>0.05$). The effect of mating season on lambing rate and litter size was significant ($P<0.01$). The effects of mating season and birth type on survival rate at weaning were significant ($P<0.05$). Effect of mating season on body weights at birth and weaning was significant ($P<0.01$). The findings of the current study that the reproductivity of Kivircik ewes (in three lambing in two years) synchronized with combination of eCG and FIS tended to improve. Lambing rate and litter size were the highest in the first mating season and the lowest in the third mating season. Lambing rate in the second mating season was similar to that in the first mating season. Survival of lambs at weaning was the highest in the first lambing season and the lowest in the third lambing season. Weaning weight was the highest in the third lambing season and the lowest in the second lambing season. These results also indicate that three lambing system in two years could be utilized in Kivircik sheep.

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Authors' Contribution

MA was in charge of organizing and supervising the course of the study. OY, BC and AFD were responsible for supervision and writing the manuscript.

Key words

Kivircik sheep, Accelerated lambing, Lamb productivity, Growth performance

INTRODUCTION

Sheep and goats are major contributors to global livestock production in essentially all agro-ecological regions. In many parts of the world, sheep and goats are produced under extensive, arid or semi-arid conditions, with little or no supplemental feeding (Notter, 2012).

Sheep breeding have played an important role in the production characteristics of sheep breeds in Turkish agricultural economy and rural society. Although the sheep population in Turkey is high, the production performance of the sheep breeds is inadequate (Ceyhan *et al.*, 2010). The sheep breeds in Turkey are believed to be seasonal breeders and seasonal reproduction in sheep without hormonal treatments is dependent on the breed. The normal breeding season of sheep in this research area is mostly restricted from July to August (Summer).

The effect of seasonal climatic changes on the reproductive activity of ewes results in a seasonality of reproduction in sheep (Vasques *et al.*, 2006). The seasonal reproductive pattern of ruminants imposes specific challenges to production systems (Montes-Quiroza *et al.*, 2018). Accelerated lambing systems in which ewes may lamb more than once per year, improvement in ewe productivity can also be attained by increasing frequency of lambing (Vanimisetti and Notter, 2012). However, many factors can influence the reproductive performance of ewes in an accelerated lambing system. These include breed and age of ewe, lactation, photoperiod and level of feeding (Sheehan and Quirke, 1984). Application of accelerated lambing systems requires a high management level and is hardly applicable at commercial farm levels under normal management. However, under intensive sheep production systems it is likely that extra inputs will result in additional output (Rawlings *et al.*, 1987). Three lambing in two years an opposed to the normal single season production system, is designed to increase the number of lambs produced per ewe per year as a more

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economical alternative for the producer to market an even supply of lambs over the year (Sormunen-Cristian and Suvela, 1999). Various hormones are administered to increase fertility and to obtain lambs of ewes twice in one year or three times in two years. Estrus synchronization results in an increase of offspring per year, as it reduces the lambing interval and can be used regardless of the season in the small ruminants. Estrus synchronization of ewes can be achieved by cycle with exogenous progesterone or its analogues to either extend the cycle or reducing the duration on the luteal phase of the estrus cycle (Wei *et al.*, 2016). The most used protocol is based on intravaginal sponges impregnated with medroxyprogesterone acetate (MAP) and fluoroprogesterone acetate (FGA) during 12 or 14 days, followed by the administration of equine chorionic gonadotropin (eCG) at device withdrawal (Gardón *et al.*, 2015).

The Kivircik sheep, which is a native Turkish sheep breed with a long lean tail, constitutes 6.8% of the total sheep population in Turkey. Kivircik is known for its meat quality. The Kivircik breed is found in Turkey, Greece, and Bulgaria. In Greece, it is known as Thraki. It is mainly bred in the Thrace, Marmara and Aegean regions in Turkey (Cerit *et al.*, 2004).

This study was carried out to investigate reproductive traits of the Kivircik sheep breed under three lambing systems in two years and their lambs' survival and growth performances.

MATERIALS AND METHODS

The study was carried out in a private enterprise located in Gobel town of Susurluk district, Balikesir province in Marmara region, Turkey. Location of Gobel town is at longitude 40° 1' 10" N and latitude 28° 8' 44". In this area during 2007-2017, the average annual ambient temperature, relative humidity and rainfall were 15.3 °C, 79 % and 771.53 mm, respectively. Two hundred Kivircik ewes, aged 2-3 years, with an average body weight 55 ± 4.3 kg were used. Fifteen Kivircik rams, aged 3-5 years, with an average body weight 70 ± 6.8 kg were used. The Kivircik breed exhibit seasonal reproductive activity. The normal breeding season of the sheep in the research region is June-August (summer). In this study, Ewes were subjected to a system of lambing every 8 months. Ewes were mated in August (summer), April (spring) and December (winter), respectively. Ewes were synchronized using FIS [intravaginal flourogestone sponges (40 mg flourogestone acetate); Dogu Drug Company, Istanbul, Turkey] for 14 days. Additionally, 600 IU eCG (equine chorionic gonadotropin; Dogu Drug Company, Istanbul, Turkey) was administered intramuscularly at sponge's

withdrawal. During mating, estrus detection was performed daily by using teaser rams between 24th and 48th hours after injection of eCG. The rams remained with the ewes for 3-day from the start of estrus. Estrus rates, lambing rates, single-multiple lambing rates and litter size were recorded.

During the mating seasons, feeding programs were applied to the animals considering the vegetation of the pasture. Pasture consisted of meadow. In the first mating season (summer), ewes grazed on pasture in the first two months of pregnancy, and ewes were fed with concentrate feed (300 g per ewe per day) in addition to pasture during the other months of pregnancy. In the second mating season (spring), ewes grazed on pasture in the first four months of pregnancy, and ewes were fed with concentrate feed (300 g per ewe per day) in addition to pasture during the fifth month of pregnancy. In the third mating season (winter), ewes were housed indoors and fed with concentrate feed (500 g per ewe per day) and *ad libitum* alfalfa hay.

A total of 699 lambs obtained from the first, second and third mating seasons were used to determine of survival and growth performances. Within 24 h of birth, lambs were weighed, ear-tagged, dam, birth type and sex were recorded. Lamb mortality between birth and weaning was recorded. Lambs were weighed at biweekly interval till weaning (age at weaning=56 days). Lamb managements were similar for all seasons. Lambs remained with their dams for seven days after birth. Then, the lambs were separated from their dams and housed indoors until weaning, but the lambs were returned to their dams at night. After fifteen days of age, the lambs were offered alfalfa hay *ad libitum* and a lamb concentrate feed. The amount of concentrate feed was gradually increased and was 300 g for per lamb at weaning. Chemical compositions of diets used in the trial are given in Table I.

Estrus, lambing, multiple lambing rates of the ewes and survival rates of the lambs in different periods of growth were analyzed by chi-square test, and litter size was analyzed by kruskal wallis test. The effects of mating season, sex and birth type on the growth of the lambs were analyzed by analysis of variance (ANOVA), using general linear models (GLM) procedure of SAS (SAS, 1995).

Table I. Chemical compositions (%) of diets.

	Sheep's diet	Lambs' diet
Crude protein	18.00	16.00
Crude fibre	11.20	8.10
Ether extract	3.00	4.40
Ash	9.00	8.50

Table II. Reproductive traits of the Kivircik ewes under three lambing systems in two years.

Mating season	Estrus rate		Lambing rate		Multiple lambing rate		Litter size	
	N	N%	%	N	%	N		%
August (Summer)	200	192	96.00	175	87.50 ^a	98	56.00	1.70 ^a
April (Spring)	196	181	92.35	167	85.20 ^a	73	43.71	1.50 ^b
December (Winter)	185	146	78.92	108	58.38 ^b	44	40.74	1.43 ^b
P		ns		**		ns		**

ns: Non significant ($P > 0.05$); ^{a,b}Means within the same columns followed by different letters significantly differ (** $P < 0.01$).

RESULTS AND DISCUSSION

Reproductive traits of Kivircik ewes under three lambing system in two years is summarized in Table II. The effect of mating season on estrus and multiple lambing rates was not significant ($P > 0.05$). The effect of mating season on lambing rate and litter size was significant ($P < 0.01$). The lowest lambing rate was in the third mating season (winter), and the highest litter size was in the first mating season (summer).

Survival rates of lambs are given in Table III. The effects of mating season and birth type on survival rate at weaning were significant ($P < 0.05$). The lowest mortality at weaning was observed in the lambs obtained from the first mating season (summer). Survival rate at weaning was significant ($P < 0.01$) with single-born lambs having less mortality. The effect of sex on mortality was not significant ($P > 0.05$).

Table III. Survival rates of lambs (%).

Factors	At birth		28 th days		56 th days (weaning)	
	N	N	%	N	%	%
Mating season						
August	295	261	88.47 ^a	255	86.44 ^a	
April	250	198	79.20 ^{ab}	182	72.80 ^{ab}	
December	154	104	67.50 ^b	103	66.88 ^b	
P		*		*		
Sex						
Male	364	291	79.94	284	78.02	
Female	335	272	81.19	256	76.42	
P		ns		ns		
Birth type						
Single	235	210	89.36	207	88.09	
Multiple	464	353	76.08	333	71.77	
P		ns		*		

ns: Non significant ($P > 0.05$); ^{a,b}Means within the same columns followed by different letters significantly differ (* $P < 0.05$).

Body weights of lambs are presented in Table IV. Effect of mating season on body weights at birth and weaning was significant ($P < 0.01$). The lowest birth weight was observed in lambs obtained from the first mating season (summer), and the lowest weaning weight was observed in lambs obtained from the second mating season (spring). The male lambs were heavier ($P < 0.01$) than female lambs at birth and weaning. Single lambs were heavier ($P < 0.01$) than multiple lambs at birth and weaning.

Table IV. Least square means and standard errors (Mean±S.E) for body weights (kg) of lambs.

Factors	Periods		
	Birth weight	28 th days	56 th days
Mating period			
August	3.11±0.04 ^b	10.29±0.06 ^a	17.85±0.10 ^a
April	3.24±0.04 ^{ab}	9.38±0.07 ^b	16.38±0.11 ^b
December	3.38±0.04 ^a	10.78±0.09 ^a	18.97±0.11 ^a
P	**	*	**
Sex of lambs			
Male	3.64±0.04	10.85±0.05	18.83±0.09
Female	2.84±0.04	9.45±0.05	16.63±0.09
P	**	**	**
Birth type			
Single	4.43±0.04	11.34±0.05	19.25±0.09
Multiple	2.45±0.04	8.96±0.05	16.21±0.09
P	**	**	**

^{a,b}Means within the same columns followed by different letters significantly differ (* $P < 0.05$; ** $P < 0.01$).

Reproductive performances of different sheep breeds are generally different. These traits are economically important for a sheep enterprise. Improving reproductive performance is an important objective for increasing the profitability of sheep production (Unal *et al.*, 2006). In modern agriculture, technologies are being used for out of season estrus induction, enhancement of reproductive

performance and genetic improvement (Amiridis and Cseh, 2012; De *et al.*, 2016).

Gonadotropins have been used in synchronization protocols that aim to improve fertility, reduce the interval to ovulation and also increase prolificacy. Equine chorionic gonadotropin (eCG) has been used at the end of several protocols for its FSH activity to contribute to synchronizing ovulation (Cabrera *et al.*, 2019). Wei *et al.* (2016) reported that fluorogestone or cloprostenol could improve estrus and fertility of ewes. However, which dose of eCG administration could achieve the best efficacy for estrus synchronization in ewes is still undetermined.

In the current study, eCG and FIS hormone protocol was used for induction and synchronization of estrus of Kivircik ewes. It was found that 96% ewes showed estrus signs in the first mating season (summer). This value is higher than those of previous studies (De *et al.*, 2015; De *et al.*, 2016). In the present study, the highest lambing rate were detected in the first mating season (summer). Similarly, De *et al.* (2016) reported higher lambing rate in breeding season as compared to out of breeding season following estrus synchronization. deNicolo *et al.* (2008) reported higher pregnancy rate in breeding season as compared to out of breeding season following estrus synchronization. Gul and Keskin (2010) reported that the onset of estrus, litter size, birth weight and weaning weight were affected by mating months. September and November were the most appropriate months for enhancing estrus ratio and litter size. Bulbul *et al.* (2014) reported that more fecundity and lamb productivity is achieved by accelerated lambing than once a year lambing. Synchronization methods were found to be effective on fecundity and lamb productivity in accelerated lambing applications. Also, Bulbul *et al.* (2014) reported that as a result of the economic analyzes performed by taking into account hormone and feed costs, synchronization was not profitable for single births in flocks synchronized with hormone.

De *et al.* (2016) reported that breeding season had significant effect on fertility of sheep following estrus synchronization and artificial insemination under field condition in semi-arid tropical region. The use of Institute-developed impregnated intra-vaginal sponge and eCG injection can be a useful technique to bring anestrus ewes into synchronized estrus in any season of the year as demonstrated in current study. Zarkawi (2011) reported that the good response of the Syrian Awassi ewes to the combined (FGA + eCG) treatment in terms of increased fecundity rate indicates the relevance of using such a treatment. The accelerated lambing system employed (three lambing in 2 years) increased the frequency of lambing and the number of lambs born/ewe/year, with no adverse effects on weaning weights of the lambs.

Use of accelerated lambing program (in this case 3 times lambing in 2 years) with estrus synchronization and PMSG administration, was effective in increasing parturition mean, prolificacy rate, fecundity rate, lamb born crop and lamb weaned crop in Zandi ewes, while it hadn't any negative significant effect on ewe's survival rate, and this method can increase the economic performance of Zandi sheep herds.

Survival rates of Kivircik lambs in the present study were lower when compared to the result of previous similar study (Akcapanar *et al.*, 2000) using different flock of Kivircik lambs. In our study, the survival rate of the Kivircik lambs obtained in the third mating season (winter) of accelerated lambing system was lower than those of the lambs obtained in the first and second mating seasons (summer and spring). The lower survival of lambs obtained in the winter breeding season may be the result of feeding system of their dams and seasonal weather. Male and lambs did not differ in terms of survival rate. This finding is consistent with the results of previous studies (Akcapanar *et al.*, 2000; Unal *et al.*, 2002; Unal *et al.*, 2006). In the present study the total mortality of twin lambs was higher than single lambs. This is consistent with Berger *et al.* (1989).

Ekiz and Altinel (2006) reported that birth weight for Kivircik lambs was 3.85 kg. The birth weights in the present study were lower than the birth weight reported for Kivircik lambs by Ekiz and Altinel (2006). Kivircik lambs born in summer had the smallest birth weight due to larger litter size. Similar effect of litter size on lamb birth weight was observed by Sormunen-Cristianand and Suvela (1999). Ekiz and Altinel (2006) reported that and body weight for Kivircik lambs at the age of 60 days was 15.47 kg. The finding contradicts the value recorded for lambs at the age of 56 days in the present study. The effects of mating seasons on birth weight and weight at different periods till weaning were significant. These results were similar to the results of some previous studies (Yilmaz and Akmaz, 2000; Yilmaz *et al.*, 2007), but were different from the results of some studies (Cetin and Akcapanar, 2005). Differences between the present results and those in literature might be due to genotype, lambing system, season, management and feeding programs.

CONCLUSIONS

The findings of the current study show that the reproductivity of Kivircik ewes (in three lambing in two years) synchronized with combination of eCG and FIS tended to improve. Lambing rate and litter size were the highest in the first mating season and the lowest in the third mating season. Lambing rate in the second mating season

was similar to that in the first mating season. Survival of lambs at weaning was the highest in the first lambing season and the lowest in the third lambing season. Weaning weight was the highest in the third lambing season and the lowest in the second lambing season. These results also indicate that three lambing system in two years could be utilized in Kivircik sheep.

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Statement of conflict of interest

The authors declare no conflict of interest.

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