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## Effects on Flock Efficiency of Sexual Experience and Behaviour Characteristics of Saanen x Hair Male Goats Based on Age<sup>#</sup>

### ABSTRACT

**Objective:** This study aimed to investigate the impact of bucks' sexual experience on the mating performance of does. Therefore, experienced bucks with high mating efficiency and sexual experience were included in the mating program to increase flock fertility.

**Materials and Methods:** Fifteen sexually inexperienced young bucks were housed individually in pens with six estrus synchronized does. Ninety female Saanen x Hair does divided into 15 groups of 6 does were used in the study. Data was collected through direct observation and by use of closed-circuit cameras same time term for two years. Sexual behaviour characteristics of bucks such as number of times mounted, time taken to mount, number of ejaculations, ejaculation time, mating efficiency, courtship behaviour and effects of mating behaviours on the fertility rate of does were evaluated. Mating efficiency scores of bucks and the pregnancy and fertility rate of does were calculated in the first and second years. Paired samples t-test was performed to determine differences between the years, and correlation coefficients were calculated to determine the relationship between the variables for each year. Arcsine transformation was applied to data obtained as a percentage.

**Results:** In the first year, litter size and fertility rate were found to be 1.26 and 21%, respectively. In the second year, these increased to 2.93 and 69%, respectively. Mating efficiency scores of bucks for the first and second year were calculated as 0.10 and 0.60, respectively. Results showed that the experienced mature bucks had statistically significant effect on the mating performance of the doe and, consequently, on herd productivity.

**Conclusion:** Sexual performance traits in bucks affect the conception rate of does. By observing changes in the rates of sexual behaviours, the achievement of mating with timely intervention can be increased. The evaluation of the sexual behaviour of bucks, testicular measurements, and semen characteristics together is recommended.

**Keywords:** Courtship behaviour; fertility; mating behaviour; inexperienced bucks; sexually active bucks

## Saanen x Kıl Erkek Keçilerin Yasa Göre Cinsel Deneyim ve Davranış Özelliklerinin Sürü Verimliliğine Etkisi

### ÖZ

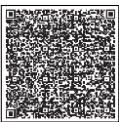
**Amaç:** Bu çalışma, tekelerin cinsel deneyiminin keçilerin çiftleşme performansı üzerindeki etkisini araştırmayı amaçladı. Bu nedenle, çiftleşme verimi ve cinsel deneyimi yüksek deneyimli tekeler, sürü verimliliğini artırmak için çiftleştirme programına dahil edilmiştir.

**Materyal ve Method:** Onbeş cinsel deneyimsiz genç teke, eş zamanlı altı kızgın dişinin bulunduğu bölmelerde ayrı ayrı barındırıldı. Doksan dişi Saanen x Kıl, 6'şarlı 15 gruba ayrılarak deneyde kullanıldı. Veriler, iki yıl boyunca aynı zaman diliminde doğrudan gözlem yoluyla ve kapalı devre kameralar kullanılarak toplandı. Tekelerin binme sayısı, binme süresi, boşalma sayısı, boşalma süresi, çiftleşme etkinliği, kur yapma davranışı gibi cinsel davranış özellikleri ve çiftleşme davranışlarının keçilerin doğurganlık oranlarına etkisi değerlendirildi. Tekelerin çiftleşme etkinlik skorları ile keçilerin gebelik ve doğurganlık oranları 1. ve 2. yılda hesaplandı. Yıllar arasındaki farkı belirlemek için eşleştirilmiş (bağımlı) örnekler t-testi yapıldı ve her yıl için değişkenler arasındaki ilişkiyi belirlemek amacıyla korelasyon katsayıları hesaplandı. Yüzde olarak elde edilen verilere arcsin dönüşümü uygulandı.

**Bulgular:** Birinci yılda yavru sayısı ve doğurganlık oranı sırasıyla %1.26 ve %21 olarak bulundu. İkinci yılda bunlar sırasıyla %2.93 ve %69'a yükseldi. Tekelerin birinci ve ikinci yıl çiftleşme verim puanları sırasıyla 0.10 ve 0.60 olarak hesaplandı. Sonuçlar, deneyimli olgun tekelerin, keçilerin çiftleşme performansı ve dolayısıyla sürü verimliliği üzerinde istatistiki olarak çok önemli bir etkiye sahip olduğunu gösterdi.

**Sonuç:** Tekelerde cinsel performans özellikleri, keçilerin gebe kalma oranlarını etkilemektedir. Cinsel davranış oranlarındaki değişimler gözlemlenerek zamanında müdahale ile çiftleşme başarısı artırılabilir. Tekelerin cinsel davranışları, testis ölçüleri ve semen özelliklerinin birlikte değerlendirilmesi önerilmektedir.

**Anahtar Kelimeler:** Kur yapma davranışı; doğurganlık; çiftleşme davranışı; deneyimsiz tekeler; cinsel olarak aktif tekeler



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## INTRODUCTION

Mating performance and fertility are important factors for assessing the reproductive rate of goats. While estrus synchronization is performed on goats, the libido levels and behaviours of goats are typically ignored. Nonetheless, in estrus synchronization in females, it is crucial that the libido and reproductive performance of male animals be at a level that allows mating to be completed in a short period of time (Tölü et al., 2021). The age of the goat with which a female goat mates is an additional factor that can affect her sexual response. It is recommended that mature bucks be used to promote the reproductive activity of does, as adult bucks exhibit greater sexual behaviour and release more pheromones than their younger counterparts (Rosa et al., 2002). Ungerfeld et al. (2008) showed that ewes exposed to adult rams had greater rates of estrus behaviours, number of induced spawning, and pregnancy rate than ewes exposed to yearling rams. Similar to young does, young bucks isolated from females before mating exhibit a decrease in sexual behaviour because male sexual behaviours are influenced by previous experiences with other females (Lacuesta et al., 2018). For example, sexual behaviour measurement such as the number of ejaculations during a serving capacity test would be low when a sexually-inexperienced male is first exposed to a receptive female. As the male gains sexual experience, the frequency of ejaculations increases (Imwalle and Katz, 2004). In terms of animal production, it is unclear what kind of influence sexual experience has on young and adult sexual performance. Under these circumstances, several aspects of male sexual behaviour, such as mounting activity, ejaculation frequency, libido, and variation in body weight constitute important pieces of information to design a mating program to incorporate young males. However, it is unknown to what extent these behaviours contribute to reproductive success. In uncontrolled mating systems, fertility is significant in terms of management success. Courtship is defined as the exchange of signals between bucks and does to communicate with one another that they are ready for mating.

This study will characterize the sexual behaviour of bucks during a mating period under controlled conditions over a two-year period to determine whether experience or age has an effect on the mating frequency and conception rate of Saanen x Hair bucks. A key objective will be to distinguish the impact of the buck's sexual experience on breeding efficiency as opposed to the mating performance of the does.

## MATERIAL and METHODS

### Location

The study was conducted at Isparta Applied Sciences University, Sheep and Goat Research and Application Unit, in the Western Mediterranean region of Türkiye. The study area is located between 37°50'3.41"N latitude and 30°32'18.82"E longitude. The data provided pertain to the summer (June to September) season. The climate of the area is characterized as semi-arid with cold winters (SMSI, 2018).

### Animals and description of experimental groups

Ninety female Saanen x Hair does in their second and later parturitions, divided into 15 groups of 6 and 15 Saanen x Hair male goats under one year of age (9 months) were used in the experiment. The males were kept isolated from the does until the mating period. For mating behaviour assessment, a single buck was placed in a pen over a typical two-month mating program with 6 does which were estrus synchronized and had given birth at least once. In the second year, the same bucks (21 months of age) were used under the same conditions. The average live weight of the bucks used in the study for the first and second years were 37.36 and 50.61 kg, respectively. The goat flock was kept in a semi-open shed. Animals were reared on pasture where the groups were allowed to graze on natural pasture twice a day, morning and afternoon (05:30 - 11:30 and 16:30 - 21:30) and kept in their closed pens overnight. The bucks were kept indoors during the study. Drinkable water and mineral-salt blocks were provided ad-libitum. The management protocol for the study animals did not change throughout the entire two-year experiment period. All animals were raised under similar environmental, nutritional and managerial conditions. By using pen mating as opposed to flock or pasture mating, we prevented disturbance to the does by the males during grazing and ensured that the bucks were well-fed whilst the does were grazing.



### Estrus synchronization treatments

The estrus cycle of the goats was synchronized using intra-vaginal progestogen sponges impregnated with 45 mg cronolone (FGA, Chronogest, Intervet, Netherlands) (Omontese et al., 2014). Ten days after the progestogen application, 5 mg of intramuscular (i.m.) PGF2 $\alpha$  (İliren<sup>®</sup>, Intervet, Türkiye) was injected. Sponges were removed after 12 days, and the females received an i.m. injection containing 500 IU PMSG (Folligon, Intervet, Netherlands) (Zonturlu et al., 2011) and 90 does were mated with bucks (Ince, 2010). Does started kidding from the second week of February until the first week of March. Fertility was regarded as a reproductive feature. Sexual behaviours were observed by the researcher for 30 minutes during the early morning (05:00) and late evening (21:30) using real-time camera systems with 5 angles (Bench et al., 2001; Darwish and Mahboub, 2011).

### Behavioural measurements

In this study, sexual behaviour characteristics of goats such as number of times mounted, time taken to mount, number of ejaculations, ejaculation time, mating efficiency, courtship behaviour and effects of mating behaviours on fertility rate of does were evaluated. The sexual behaviour test was applied to determine the sexual behaviour of the male goats. Tests were administered in September during the mating season. Initially, male goats were put in each of the 5 $\times$ 5 m enclosures. In each pen, there were six synchronized does. All does give birth at least once and were experienced. Definitions of observed behavioural traits of bucks (Véliz et al., 2002; Prado et al., 2003; Öziş and Kaymakçı, 2003; Imwalle and Katz, 2004; Konyalı et al., 2011) and courtship behaviour index value of bucks (CBIVB) are given in Table 1. However, the time taken to mount by bucks (TTM), ejaculation number (EN), and ejaculation time (ET) were also *determined*. *Mating efficiency scores for each buck in each condition were calculated as follows:*

$$\text{Mating Efficiency} = \text{Ejaculation number} / (\text{mount number} + \text{mount attempt number})$$

(Bench et al., 2001; Véliz et al., 2002; Prado et al., 2003; Imwalle and Katz, 2004; Kaymakçı, 2010; Darwish and Mahboub, 2011; Konyalı et al., 2011). In the first and second years, the pregnancy rate (%) and fertility rate (%) of the six does with one buck in each pen were calculated.

**Table 1.** Definitions of observed behavioural traits of bucks

**Tablo 1.** Tekelerde gözlenen davranış özelliklerinin tanımları

Buck Behaviours	Descriptions
Mounting (M)	Buck mounts on a female without ejaculation
Flehmen (F)	Buck curling upper lip and sniff air
Leg kicking (LK)	Frequency of buck's leg- kicking to female
Anogenital sniffing (AS)	Buck sniffs the urogenital region of females
Touching to vulva (TV)	Buck touches to vulva of female with his head
Courtship behaviour index value of bucks (CBIVB)	The sum of frequencies of observed buck's willingness behaviour (M+F+LK+AS+TV)

### Statistical analysis

Statistical 7.0 package software (StatSoft, 2018) was used for conducting statistical analyses. CBIVB and the mounting behaviour of the bucks were not distributed normally. These parameters were subjected to the square root transformation. This transformation was applied to data obtained via counting. Following transformation, paired samples t-test was performed to determine differences between the years, and correlation coefficients were calculated to determine the relationship between the variables for each year. Arcsine transformation was applied to data obtained as a percentage for pregnancy rate and fertility rate. P-value of 0.05 or lower was considered statistically significant.



## RESULTS

Except for TTM and ET, all buck-related parameters increased in the second year (Table 2). Results show that all of the bucks gained weight during the study and their average body weight increased from 37.36±4.38 kg in the first year to 50.61±5.40 kg in the second year ( $P<0.05$ ). Although the courtship behaviour index value of the bucks increased between the first and second year, no significant differences were observed. There were significant differences between the first and second years for TTM. As bucks got older, TTM decreased (from 359.40 to 69.06 seconds). The ejaculation number of the bucks was higher in the second year than in the first year ( $P<0.05$ ). Ejaculation time between the two years was insignificant even though the difference between these two years is important for the experience of the goats.

**Table 2.** The paired samples t-test statistics for body weight, courtship behaviour traits between years

**Tablo 2.** Tekelerin yıllar arasında canlı ağırlık, kur yapma davranışı özelliklerinin t-testi istatistikleri

Variable	Year	Mean	SD	T	P-value
BW, kg	1	37.36	4.38	-13.211	0.0001*
	2	50.61	5.40		
CBIVB	1	1.74	0.52	-1.053	0.147
	2	2.02	0.52		
TTM, seconds	1	359.40	54.89	1.929	0.007*
	2	69.06	8.78		
EN	1	1.72	0.37	-3.540	0.003*
	2	2.27	0.37		
ET, seconds	1	239.33	36.38	0.502	0.623
	2	184.46	19.33		

**BW:** Body weight, **CBIVB:** Courtship behaviour index value of bucks, **TTM:** Time taken to mount, **EN:** Ejaculation number, **ET:** Ejaculation time, **SD:** Standard deviation, \* $P < 0.05$ .

Mating efficiency scores of bucks for the first and second year were calculated as 0.10 and 0.60, respectively, indicating significant increase in mating efficiency in the second year ( $P<0.05$ ). The reproductive performances of the does are given in Table 3. In this study, 19 and 44 does of total 90 does were pregnant during the first and second year, respectively. In other words, the pregnancy rate was found to be 21.1% in the first year and 48.8% in the second year. The number of pregnancies per pen for each year was calculated as the rate of pregnancy per pen (for 6 does) using the total number of pregnant does in that year. In the first and second years, numbers of pregnancy/pen were 1.26 and 2.93, respectively. All the reproductive parameters increased significantly ( $P<0.05$ ) in the second year compared to the first year. In the first and second years, fertility rates were 21% and 69%, respectively.

**Table 3.** The paired samples t-test statistics for reproductive parameters between years

**Tablo 3.** Yıllar arasında üreme parametreleri için eşleştirilmiş örnekler t-testi istatistikleri

Reproductive Parameters	Year	Mean	SD	T	P-value
Number of pregnancy/Pen*	1	1.26	0.96	-3.851	0.001
	2	2.93	1.75		
Fertility rate	1	0.21	0.16	-3.851	0.001
	2	0.69	0.29		

\* Does pregnant by each buck in each pen, ( $P < 0.05$ ), SD: Standard deviation.



The correlation coefficients among observed behavioural parameters in the first year are presented in Table 4. None of the observed behavioural parameters, except for ME, exhibited any effect on the CBIVB. There was a strong correlation of 0.77 between CBIVB and ME ( $P < 0.05$ ). Significant ( $P < 0.05$ ) positive correlations between the number of pregnancies and CBIVB as well as ME and EN were found to be 0.75, 0.73, and 0.73, respectively. The number of pregnancy was not influenced by BW, TTM, and ET. BW had a significant ( $P < 0.05$ ) negative effect on ET value. Additionally, there were positive and significant ( $P < 0.05$ ) correlations among fertility rate, CBIVB, EN and ME values. Strong and positive correlations existed among CBIVB, EN, EN and reproductive features of does (Table 4).

**Table 4.** The correlation coefficients ( $r$ ) among the behavioural and reproductive traits for the first year.

**Tablo 4.** Birinci yıl için davranış ve üreme özellikleri arasındaki korelasyon katsayıları ( $r$ )

Variable	BW	CBIVB	TTM	EN	ET	ME
Number of pregnancies	0.24	0.75*	0.36	0.73*	-0.20	0.73*
Fertility rate?	0.24	0.74*	0.36	0.73*	-0.20	0.74*
BW		0.36	-0.21	0.47	-0.37*	0.07
CBIVB			0.13	0.39	-0.09	0.77*
TTM				0.50	-0.18	0.36
EN					-0.33	0.55*
ET						-0.24

**BW: Body weight, CBIVB: Courtship behaviour index value of bucks, TTM: Time taken to mount, EN: Ejaculation number, ET: Ejaculation time, ME: Mating efficiency. \*P < 0.05**

Table 5 showed the correlation coefficients for the second year. The level of relationship between CBIVB and EN was increased and statistically significant ( $P < 0.05$ ) in the second year. Similarly, the number of pregnancies, fertility rate and EN in the second year revealed statistically significant ( $P < 0.05$ ) correlations with ME value.

**Table 5.** The correlation coefficients ( $r$ ) among the behavioural and reproductive traits for the second year.

**Tablo 5.** The correlation coefficients ( $r$ ) among the behavioural and reproductive traits for the second year.

Variable	BW	CBIVB	TTM	EN	ET	ME
Number of pregnancies	0.12	0.59*	-0.08	0.77*	-0.15	0.90*
Fertility rate?	0.12	0.59*	-0.08	0.74*	-0.15	0.90*
BW		-0.03	0.30	-0.08	-0.14	-0.01
CBIVB			0.08	0.65*	0.12	0.71*
TTM				0.05	0.04	0.11
EN					-0.29	0.80*
ET						-0.16

**BW: Body weight, CBIVB: Courtship behaviour index value of bucks, TTM: Time taken to mount, EN: Ejaculation number, ET: Ejaculation time, ME: Mating efficiency. \* P < 0.05**



## DISCUSSION

Early sexual experience in bucks is an important factor regarding their sexual behaviours. Especially, inexperienced candidate male goats at a young age may lead to fewer female goats getting pregnant and the herd fertility dropping. The age of the bucks was a significant factor in the mounting behaviour. Observed behaviour parameters were improved with increasing age and sexual experience. Older bucks have more courtship behaviour than younger ones. The present data showed that the mating and courtship behaviours of bucks are influenced by sexual experience (Gelez et al., 2004; Nikolov et al., 2005). Some researchers indicated that the mating behaviour of small ruminants are influenced both by age and sexual experience (Gelez et al., 2004; Simitzis et al., 2006). Bucks seemed to gain experience as CBIVB increased, and TTM and ET decreased (Véliz et al., 2002; Imwalle and Katz, 2004).

Mating efficiency scores of bucks increased due to their experience. Darwish and Mahboub (2011) reported similar results. However, Karaca et al. (2016) reported that the effect of experience was statistically insignificant. Inexperienced male goats are more likely to experience jumps that do not result in ejaculation. However, the frequency of copulation is important for male reproductive activity because the number of sperms in the ejaculate tends to decrease as the incidence of copulation increases (Mellado et al. 2000). Bucks showed higher mounting efficiency with increasing age (Perkins and Roselli, 2007). This is consistent with previous reports (Mellado et al., 2000; Ungerfeld, 2003; Gelez et al., 2004; Nikolov et al., 2005; Simitzis et al., 2006; Perkins and Roselli, 2007; Karaca et al., 2016), except for the results of Mellado et al. (2000), Konyalı et al. (2011) and Karaca et al. (2016). The inconsistent results could be explained by the low number of bucks/does or difference in climatic conditions as season influences libido, testicular size and hormonal secretion in male animals through photoperiod and/or changes in temperature, humidity index and rainfall. Consequently, degenerative changes are observed in the form of reduction in testicular weight, size and consistency, which ultimately affect the testicular endocrine profiles, libido and semen production profiles (Perumal et al., 2017). Imwalle and Katz (2004) suggested that does have an important role in improving sexual experience. However, numerous factors have been illustrated to affect sexual performance tests such as experience, testing period length, doe impact, motivation, anxiety, etc. (Imwalle and Katz, 2004; Price et al., 1994). Reproductive parameters of the bucks and mating does were also influenced by experience (Price et al., 1998). When the reproductive parameters in each year were examined, it was seen that the mating of each buck increased in every pen in the second year. Specifically, 21% of the does that mated inexperienced bucks gave birth, while after the same bucks gained experience, the percentage rate of birth increased to 69%. There is an evident and significant difference between these two percentage rates. This suggests that evaluating and gaining experience in terms of sexual performance before bucks are used in mating programs is of great importance in terms of herd fertility. As a matter of fact, throughout previous studies, it was observed that bucks exhibited more courtship behaviours instead of mating behaviour during the period in which they were inexperienced. This suggests that it is inevitable to provide male animals with sufficient experience for overuse (Price et al., 1998; Panagiotis et al., 2006). Bucks with sexual experience have high mating efficiency which is primarily affected by their low mount time and mount attempt number. These results are consistent with the findings of Maina and Katz (1999) and Konyalı et al. (2011). Bucks with sexual experience determine the estrous does in a shorter time and warn does by making more mounts (Price et al., 1998). Similar to the results of this study, Veliz et al. (2002) compared mating efficiency between sexually experienced and inexperienced Creole bucks and observed high sexual behaviour in the experienced bucks. Young and sexually inexperienced bucks hesitantly approached does and the number of mounting and ejaculation was less than experienced bucks (Kaymakçı, 2010). However, Price et al. (1998) examined the number of mounting and ejaculations of Alpine and Saanen x Alpine goat crossbred bucks and found lower values in sexually experienced bucks. This may be possibly linked to the incapacity of the male goats to reproduce. As in this study's results, Imwalle and Katz (2004) observed that the ejaculation number of French Alpine and Alpine x Boer crossbred male goats without sexual experience was lower. Less mounting with experience only increased ejaculation (Price et al., 1998). Nevertheless, the role of experience may be important, particularly when considering the emotions of bucks (Lynch et al., 1992).



## CONCLUSIONS

In conclusion, the study demonstrated unequivocally that bucks with experience performed better than their younger, inexperienced counterparts with regards to herd fertility. By observing changes in the rates of sexual behaviours, the achievement of mating with timely intervention can be increased. Age and experience increased bucks' activity, which in turn, promoted mobilization in non-estrus does. The study also proved that sexual experience influenced courtship behaviour, thus experienced bucks with high mating efficiency and sexual experience must be incorporated to increase herd fertility. The study showed, however, that even under controlled and confined settings such as pen mating, the performance of the young male goats was markedly lower than when they were experienced a year later. Therefore, it would also be feasible to claim that it is not as many missed opportunities or chance mating factors that impact mating performance as is commonly believed. Further study is recommended to examine the relationship between sexual behaviour and testicular and semen characteristics to ascertain the effect of sperm quality on male sexual behaviour. Other factors to consider for future research are environmental aspects such as temperature, nutrition, and flock size influences. By making use of the relationship between the sexual behaviour of goats and their reproductive performance, success can be increased in selection and indirectly in some reproductive traits.

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

**Ethical statement:** The Animal Experiments Local Ethics Committee of Isparta University of Applied Sciences approved all the procedures performed in these studies. In the study, there was no need for ethical approval due to the lack of blood sampling from the animals and the absence of any surgical procedures (E-77211729-804.01-43260).

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