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Research Article

The Influence of Shearing on Reproduction in Angora Rabbits*

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Abstract: The aim of this study was to determine the optimum time and the conditions of mating for Angora rabbits.

The study was initiated with 60 French Angora rabbits (53 does and 7 bucks). All animals were kept in individual cages under the same environmental conditions. The does were divided into 6 groups: does in group 1 were mated a week before the shearing, does in group 2 were mated during the shearing period, does in group 3 were mated a week after shearing, does in group 4 were mated a month after shearing and does in group 5 were mated 2 months after shearing. The sixth group was considered the control group and the does in this group were mated every other day. The does were shorn approximately once every 3 or 4 months and the bucks were shorn at 7-week intervals. The experiments were conducted throughout the 4 seasons of the year. Mating rates, frequency of matings, gestation rates in mated rabbits, gestation lengths, litter size, number of litter losses during the week after the parturition, the number of surviving female and male litters, live weights before and after shearing of the does, and the wool quantity and fibre length measures were recorded.

Mating rates and gestation rates observed in the rabbits in groups 1- 6 were as follows in spring 77.7%-44.4%, 88.8%-66.6%, 77.7%-55.5%, 88.8%-55.5%, 66.6%-44.4% and 100%-100%; in autumn 77.7%-55.5%, 88.8%-66.6%, 88.8%-55.5%, 100% -66.6%, 88.8%-44.4% and 100%-100%; in winter 66.6%-55.5%, 100%-88.8%, 88.8%-88.8%, 88.8%-66.6%, 88.8%-66.6% and 100%-88.8%; and in summer 55.5%-33.3%, 88.8%-88.8%, 77.7%-77.7%, 44.4%-33.3%, 55.5%-44.4% and 88.8%-77.7%, respectively. The parturitions of the animals in group 6 were spread over a period of 3–4 weeks, whereas those in the other groups took place over 4 days.

The findings indicated that shearing significantly affected the fertility of Angora rabbits mated in summer ($P < 0.05$), but did not affect the matings in other seasons. On the other hand, shearing did not influence the litter size or the gestation length measures in any of the groups.

Key Words: Angora rabbit, shearing, reproduction

Ankara Tavşanlarında Kırkımın Üreme Verimine Etkisi

Özet: Bu araştırma, Ankara tavşanlarında en uygun çiftleşme zamanını ve koşullarını tespit etmek amacı ile yapılmıştır.

Çalışmaya 60 adet Fransız Ankara tavşanı (53 adet dişi ve 7 adet erkek) ile başlanmıştır. Tüm hayvanlar bireysel kafeslerde aynı koşullarda barındırılmışlardır. Dişi hayvanlar altı gruba ayrılmıştır. 1. gruptaki hayvanlara kırkımdan yedi gün önce, 2. gruptaki hayvanlara kırkım zamanında, 3. gruptaki hayvanlara kırkımdan yedi gün sonra, 4. gruptaki hayvanlara kırkımdan bir ay sonra ve 5. gruptaki hayvanlara kırkımdan iki ay sonra çiftleştirme denemeleri yapılmıştır. Altıncı grup kontrol grubu olarak adlandırılmıştır ve bu gruptaki hayvanlara günaşırı çiftleştirme denemeleri uygulanmıştır. Dişi hayvanlar yaklaşık olarak 3-4 ayda bir, erkekler ise yedi hafta arayla kırkılmıştır. Denemeler yılın dört mevsiminde de tekrarlanmıştır. Çalışmada çiftleşen tavşan oranı, çiftleşme sayısı, çiftleşen tavşanlarda gebelik oranı, gebelik süresi, doğan yavru sayısı, canlı dişi ve erkek yavru sayıları, kırkım öncesi ve sonrası canlı ağırlık, yün ağırlığı ve elyaf uzunluğu kaydedilmiştir.

Çalışmada 1, 2, 3, 4, 5. ve 6. gruplarda çiftleşen tavşan oranları ile gebelik oranları sırasıyla, ilkbahar mevsiminde: % 77,7-% 44,4, % 88,8-% 66,6, % 77,7-% 55,5, % 88,8-% 55,5, % 66,6-% 44,4, % 100–% 100, sonbahar mevsiminde: % 77,7-% 55,5, % 88,8-% 66,6, % 88,8-% 55,5, % 100-% 66,6, % 88,8-% 44,4, % 100–% 100, kış mevsiminde: % 66,6-% 55,5, % 100-% 88,8, % 88,8-% 88,8, % 88,8-% 66,6, % 88,8-% 66,6, % 100-% 88,8 ve yaz mevsiminde: % 55,5-% 33,3, % 88,8-% 88,8, % 77,7-% 77,7, % 44,4-% 33,3, % 55,5-% 44,4 ve % 88,8-% 77,7 olarak saptanmıştır. Tüm denemelerde, 6. grupta doğumlar yaklaşık olarak 3–4 haftaya yayılmıştır. Diğer gruplarda ise doğumlar yaklaşık olarak dört gün içinde tamamlanmıştır.

Sonuç olarak, Ankara tavşanlarında kırkımın, sadece yaz mevsiminde yapılan çiftleştirmelerde üreme verimi üzerine olumlu bir etkisinin olduğu ($P < 0,05$), diğer mevsimlerde ise belirgin bir yararının görülmediği saptanmıştır. Ayrıca, kırkımın doğan yavru sayısı ve gebelik süreleri üzerine belirgin bir etkisi tespit edilmemiştir.

Anahtar Sözcükler: Ankara tavşanı, kırkım, üreme

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Introduction

The considerably long hair of Angora rabbits has been suggested to have a negative impact on fertility, like increased rates of embryonic losses, decreases in duration of lactation due to insufficient food consumption in does, and decreases in libido, as well as elevated deformations of spermatozoa in bucks. Thus, decreases in fertility caused by high wool yields have been reported by several researchers (1,2).

Although no orderly cyclicity are observed, the sexual activity of Angora rabbits is maximum in late winter and throughout the spring and is minimum in summer (3,4).

The suggestion that high temperatures affect the spermatological parameters in bucks has been set forth by many researchers. The volume of semen samples collected in March has consistently been found to be higher than those collected in November. In addition, exposures to short (36 ºC for 8 h) or long (30 ºC for 14 h) periods of heat are likely to decrease the spermatozoa viability, and temperatures over 30 ºC could result in decreased libido (5,6). For these reasons, bucks should be sheared at short intervals at temperatures over 20 ºC. Since the sperm motility tends to decrease after the ninth week, shearing intervals should not be less than 6 weeks and not more than 8 weeks. It has been reported that shortening of the shearing intervals is likely to lead to significant increases in wool yield, food consumption, live weight, fertility rate, and sperm motility (7,8).

McNitt et al. (9) have reported an increase in luteinizing hormone (LH) in spring, but a decrease in summer. Specifically, greater embryonic losses, and decreases in both fertility and food intake were observed at temperatures higher than 30-33 ºC (10,11).

Magofke et al. (12) have identified a relationship between litter size and wool yield. Generally, the litter size in Angora rabbits is lower than that in all other rabbit races because of embryonic losses (10,11). They found that during the first 4 shearing intervals, rabbits with an average litter size of 5 lose approximately 5% wool yield compared to those with lower litter sizes.

Hormonal and environmental factors have a great influence on ovulation since in rabbits ovulation is stimulated by provocation, generally by the stimuli of mating. Some researchers have observed that the stimuli caused by/during the shearing could provoke oestrus and ovulation, and, in turn, increase reproduction. Therefore, the shearing intervals of rabbits used for breeding and for wool should be managed differently (2,13).

Brockhausen et al. (14), in their study investigating the relationship between pregnancy rates and shearing of Angora rabbits, reported that shearing conducted on the 2^{nd} and 15^{th} days after mating resulted in a 46.2% pregnancy rate, 7 days before shearing, 59.3% 21 days after mating and on the day of mating 70.4%. Contrary to the pregnancy rates, no influence whatsoever on litter size was reported. Consequently, it appears that matings that take place only on the shearing day increase the mating and pregnancy rates. Except for the above-mentioned study, no other research was found in the literature that investigated the relationship between the shearing period and fertility taking seasonal changes into consideration as a control variable.

In the current study, the influence of shearing time on the fertility of Angora rabbits was explored in order to identify the most optimal conditions required for increased fertility and to suggest an effective mating scheme drawing on the findings.

Materials and Methods

This study was conducted with 60 formerly shorn (first shearing) French Angora rabbits (53 does and 7 bucks), 3 months of age, weighing 1800-2500 g. All animals were kept in individual cages under the same environmental and management conditions. No treatments were applied to the animals until they reached puberty (approx. 5 months of age).

The does were randomly divided into 6 groups: does in group 1 were mated a week before the shearing, does in group 2 were mated during the shearing period, does in group 3 were mated a week after shearing, does in group 4 were mated a month after shearing and does in group 5 were mated 2 months after shearing. The sixth group was considered the control group and the does in this group were mated every other day. The experiments were held throughout the 4 seasons of the year (The first in spring, second in autumn, third in winter and fourth in summer).

All rabbits (immediately before and after the shearing) and individual wool yields at every round were weighed with a digital scale. Fiber lengths were measured with a ruler.

Pregnancy was diagnosed by abdominal palpation on the 15th day post-mating, Litter size was assigned and recorded on the third day after parturition and the sex of the litter was determined after weaning.

The data obtained from the study were analyzed using statistical methods. Statistically significant differences between the groups were assessed through chi-square test, Kruskal-Wallis analysis of variance (ANOVA) test and a repeated Friedman ANOVA test, using the SPSS for Windows statistical package.

Results

The experiments were conducted throughout the 4 seasons of the year (The first in spring, second in autumn, third in winter and fourth in summer) in order to estimate the best time for shearing.

The differences in mating rates between the groups in the first 3 trials were statistically insignificant. However, in the fourth trial, the differences in mating rates between the groups were statistically significant ($P < 0.05$) (Table 1).

The differences in mating frequencies between the groups throughout the study were non-significiant (Table 2).

In the first 3 trials, the differences in mean gestation rates between the groups were statistically insignificant, but in the fourth, carried out in summer, the differences were statistically significant ($P < 0.05$) (Table 3).

Parturitions in the sixth (control) group were spread over a 3-week period in the first 3 trials but the fourth trial covered a period of 4 weeks. There were no statistically significant differences among the groups in terms of gestation length (Table 4).

Table 1. Mated rabbit rate.

Groups	1st trial		2nd trial		3rd trial		4th trial	
	n	MRR % (n)	n	MRR % (n)	n	MRR % (n)	n	MRR % (n)
Group 1	9	77.7 (7)	9	77.7 (7)	9	66.6 (6)	9	55.5 (5)
Group 2	9	88.8 (8)	9	88.8 (8)	9	100 (9)	9	88.8 (8)
Group 3	9	77.7 (7)	9	88.8 (8)	9	88.8 (8)	9	77.7 (7)
Group 4	9	88.8 (8)	9	100 (9)	9	88.8 (8)	9	44.4 (4)
Group 5	9	66.6 (6)	9	88.8 (8)	9	88.8 (8)	9	55.5 (5)
Group 6	8	100 (8)	8	100 (8)	9	100 (9)	9	88.8 (8)

MRR: Mated rabbit rate

Table 2. Mean mating numbers.

Groups	1st trial		2nd trial		3rd trial		4th trial	
	n	MMN X ± Sx (n)	n	MMN X ± Sx (n)	n	MMN X ± Sx (n)	n	MMN X ± Sx (n)
Group 1	9	2.7 + 0.5 (7)	9	1.1 + 0.3 (7)	9	1.1 + 0.8 (6)	9	1.6 + 0.5 (5)
Group 2	9	1.8 + 0.4 (8)	9	1.1 + 0.3 (8)	9	1.3 + 0.5 (9)	9	1.2 + 0.4 (8)
Group 3	9	2.4 + 0.5 (7)	9	1.3 + 0.5 (8)	9	1.7 + 0.7 (8)	9	1.1 + 0.3 (7)
Group 4	9	1.8 + 0.8 (8)	9	1.6 + 0.8 (9)	9	1.6 + 0.7 (8)	9	1.5 + 0.5 (4)
Group 5	9	1.1 + 0.4 (6)	9	1.5 + 0.5 (8)	9	1.3 + 0.5 (8)	9	1.6 + 0.5 (5)
Group 6	8	3.2 + 0.8 (8)	8	2.3 + 0.7 (8)	9	2.0 + 0.8 (8)	9	1.6 + 0.7 (8)

MMN: Mean mating numbers

Table 3. Mean gestation rate.

Groups	1st trial		2nd trial		3rd trial		4th trial	
	n	MGR % (n)	n	MGR % (n)	n	MGR % (n)	n	MGR % (n)
Group 1	9	44.4 (4)	9	55.5 (5)	9	55.5 (5)	9	33.3 (3)
Group 2	9	66.6 (6)	9	66.6 (6)	9	88.8 (8)	9	88.8 (8)
Group 3	9	55.5 (5)	9	55.5 (5)	9	88.8 (8)	9	77.7 (7)
Group 4	9	55.5 (5)	9	66.6 (6)	9	66.6 (6)	9	33.3 (3)
Group 5	9	44.4 (4)	9	44.4 (4)	9	66.6 (6)	9	44.4 (4)
Group 6	8	100 (8)	8	100 (8)	9	88.8 (8)	9	77.7 (7)

MGR: Mean gestation rate

Table 4. Mean gestation length.

Groups	1st trial		2nd trial		3rd trial		4th trial	
	n	MGL X ± Sx	n	MGL X ± Sx	n	MGL X ± Sx	n	MGL X ± Sx
Group 1	4	31.0 + 0.8	5	29.4 + 2.0	5	31.6 + 0.8	3	31.6 + 0.5
Group 2	6	30.8 + 1.7	6	30.6 + 1.8	8	31.7 + 0.7	8	31.5 + 1.0
Group 3	5	29.2 + 2.1	5	29.8 + 2.7	8	31.6 + 0.5	7	31.4 + 0.7
Group 4	5	30.8 + 0.8	6	31.0 + 0.8	6	31.4 + 0.8	3	31.6 + 0.5
Group 5	4	31.0 + 1.0	4	30.5 + 1.2	6	31.6 + 0.9	4	32.0 + 0.0
Group 6	8	30.7 + 1.4	8	31.5 + 2.0	8	31.5 + 0.9	7	31.6 + 0.7

MGL: Mean gestation length (day)

No statistically significant differences were found in mean litter size between the groups in any of the trials (Table 5).

The differences between the groups in overall live litter size and by sex distribution were statistically non-significant.

The wool yield data were recorded from the second shearing because all rabbits had been pre-shorn once. The wool yield and fiber length obtained from does in all trials are given in Table 7.

The wool yield and fiber length of bucks throughout the study are summarized in Table 8. The differences between the wool yield and fiber length of both does and bucks between the groups were insignificant.

Discussion

Does were shorn at 3- to 4-month intervals, whereas bucks were shorn generally at 7 week intervals in order to avoid male-dependent infertility. The first trial was held in spring, when sexual activity is maximimum. In this trial, the does (group I) were 150.5 ± 3.9 days old and this corresponds to the findings reported by McNitt et al. (9) and Theau- Clement et al. (11), which indicated that the first mating age in Angora does ranged from 5 to 7 months.

The highest mating rates were obtained in the control group. The differences seemed to be due to the matings achieved every other day throughout the year, except for the gestation periods. However, matings in the study groups were completed over 3 consecutive days.

Table 5. Mean litter size (n: number of parturated does).

Groups	1st trial		2nd trial		3rd trial		4th trial	
	n	MLS X ± Sx	n	MLS X ± Sx	n	MLS X ± Sx	n	MLS X ± Sx
Group 1	4	8.5 + 1.0	5	5.4 + 1.3	5	7.4 + 2.3	3	7.6 + 0.5
Group 2	6	6.8 + 1.9	6	6.5 + 0.8	8	7.6 + 1.6	8	7.8 + 2.1
Group 3	5	7.4 + 2.9	5	6.6 + 0.5	8	7.6 + 1.4	7	7.2 + 2.4
Group 4	5	7.8 + 1.6	6	8.6 + 1.3	6	7.6 + 1.1	3	7.3 + 0.5
Group 5	4	7.3 + 1.5	4	7.5 + 1.2	6	6.8 + 1.4	4	6.5 + 1.2
Group 6	8	8.8 + 2.9	8	7.8 + 1.8	8	6.8 + 1.2	7	7.1 + 1.3

MLS: Mean litter size

Table 6. Overall litter size and sexual distribution.

Groups	1st trial			2nd trial			3th trial			4th trial		
	♀	♂	T	♀	♂	T	♀	♂	T	♀	♂	T
Group 1	14	14	28	7	12	19	3	5	8	8	6	14
Group 2	15	19	34	13	15	28	6	4	10	22	16	38
Group 3	16	18	34	12	10	22	5	7	12	15	20	35
Group 4	19	17	36	19	18	37	3	1	4	8	4	12
Group 5	10	14	24	5	9	14	2	6	8	7	11	18
Group 6	28	33	61	23	30	53	5	6	11	15	18	33

T: Total

Table 7. Wool yield and fiber length of does.

Shearing (n)	Wool yield (g)			Fiber length (cm)		
	Min.	Max.	X ± Sx	Min.	Max.	X ± Sx
2nd Sheare (53)	100	210	157.9 + 24.9	9,5	14	11.0 + 1.0
3th Sheare (53)	50	260	153.0 + 58.4	6	18	13.7 + 2.6
4th Sheare (54)	140	260	191.6 + 27.2	7	12	10.0 + 1.2
5th Sheare (54)	50	270	186.8 + 46.0	7	12	10.7 + 1.1
6th Sheare (54)	90	200	134.6 + 27.9	9	14	10.7 + 1.1

n: Number of animals shorn

Table 8. Wool yield and fiber length of bucks.

Shearing (n)	Wool yield (g)			Fiber length (cm)		
	Min.	Max.	X ± Sx	Min.	Max.	X ± Sx
2nd Sheare(53)	80	100	96.0 + 8.9	7	8	7.3 + 0.4
3th Sheare (53)	75	130	106.0 + 19.8	10	13	11.0 + 1.0
4th Sheare (54)	100	140	112.1 + 15.2	10	13	10.8 + 1.2
5th Sheare (54)	130	170	148.5 + 15.7	7	9	7.8 + 0.8
6th Sheare (54)	70	120	95.7 + 17.1	8	12	9.5 + 1.5
7th Sheare (7)	80	120	98.5 + 13.4	7	11	9.1 + 1.5
8th Sheare (7)	90	120	104.2 + 9.7	8	11	9.5 + 0.9

n: Number of animals shorn

The differences in mating rates between the groups in the first 3 trials were statistically insignificant. On the other hand, in the fourth trial, the differences in mating rates between the groups were statistically significant ($P < 0.05$).

Hence, it was obvious that mating rates increased when does were shorn on the mating day or a week afterwards (especially in summer), whereas no influence of shearing on mating rates in other seasons was observed. This finding confirms the results reported by Brockhausen et al. (14), which suggested that mating rates were elevated from 59.3% to 70.4% when does were shorn on the mating day only.

On the other hand, our findings conflict with other results by Brockhausen et al. (14) which indicated that gestation rates were 46.2% when mating took place 2 days following the shearing.

In the summer trials of this study, considering the mating day and the shearing stress as a moderator variable in repeated tests, it was observed that the mating rates improved significantly a week after the shearing day.

The differences in mating frequencies between the groups throughout the study were non-significant.

In the first 3 trials, the differences in mean gestation rates between the groups were statistically insignificant, but in the fourth trial, held in summer, the differences were statistically significant ($P < 0.05$).

On the basis of the findings, gestation rates in summer were higher when matings were on the shearing day or a week afterwards, probably due to a decrease in embryonic losses, hence it is obvious that shearing could decrease the losses. These findings agree with those reported by Cheng et al. (1) and Theau-Clément et al. (11).

There were no statistical differences among the groups in terms of gestation length. These findings agree with those published by Lebas et al. (10) and Schlolaut et al. (13).

No statistical differences were found in mean litter size between the groups in all trials. Our results corroborate those given by Brockhausen et al. (14), indicating that shearing has no influence on litter size. In addition, the sex of the litter appeared to be equally distributed throughout the study.

Although the differences between the groups in the sex distribution of the litter were statistically insignificant, significant differences were observed between the winter trial (third trial) and the others ($P < 0.05$). These finding agree with those published by McNitt et al. (9) and Schlolaut et al. (13).

The differences in wool yield and fiber length between does and bucks in the study groups were insignificant, which corresponds with the findings obtained by McNitt et al. (9) and Schlolaut et al. (13).

The findings indicated that shearing significantly affected the reproduction of Angora rabbits mated in summer ($P < 0.05$), but did not affect the matings in other seasons. On the other hand, shearing did not influence the litter size or the gestation length measures in any of the groups.

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